K – WILLIAMSBURG WORKS SITE

KINGS COUNTY

BROOKLYN, NEW YORK

INTERIM SITE MANAGEMENT PLAN

NYSDEC Site Number: 224055

Prepared for:

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Revisions to Final Approved Site Management Plan:

Revision No.	Date Submitted	Summary of Revision	NYSDEC Approval Date
1	October 28, 2022	HASP updates	

JULY 2021

PROFESSIONAL ENGINEER CERTIFICATION STATEMENT

I JEFFREY PARILLO certify that I am currently a New York State registered professional engineer and that this Interim Site Management Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

_____ P.E.

July 30, 2021 DATE



It is a violation of Article 145 of New York State Education Law for any person to alter this document in any way without the express written verification of adoption by any New York State licensed engineer in accordance with Section 7209(2), Article 145, New York State Education Law.

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List of Acronyms

BSM	Bucket Soil Mixing
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
BUG	The Brooklyn Union Gas Company
CAMP	Community Air Monitoring Plan
CCR	Construction Completion Report
CFR	Code of Federal Regulation
CP	Commissioner Policy
CSM	Conceptual Site Model
DER	Division of Environmental Remediation
EC	Engineering Control
ECL	Environmental Conservation Law
ELAP	Environmental Laboratory Approval Program
EWP	Excavation Work Plan
HASP	Health and Safety Plan
IC	Institutional Control
IDIP	IRM Design and Implementation Plan
IRM	Interim Remedial Measure
ISS	In-Situ Stabilization
ISMP	Interim Site Management Plan
MGP	Manufactured Gas Plant
NAVD	North American Vertical Datum
NYCDDC	New York City Department Design and Construction
NYCDOS	New York City Department of Sanitation
NYCDPR	New York City Department of Parks and Recreation
NYCRR	New York Codes, Rules and Regulations
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOT	New York State Department of Transportation
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PDI	Pre-Design Investigation
P.E. or PE	Professional Engineer
PFAS	Per- and Polyfluoroalkyl Substances
PRP	Potentially Responsible Party
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QEP	Qualified Environmental Professional
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RIWP	Remedial Investigation Work Plan
RP	Remedial Party and Respondent
SCG	Standards, Criteria and Guidelines

SCO	Soil Cleanup Objective
SI	Site Investigation
SMP	Site Management Plan
SPDES	State Pollutant Discharge Elimination System
TAL	Target Analyte List
TCL	Target Compound List
TOGS	Technical and Operational Guidance Series
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOC	Volatile Organic Compound

ES EXECUTIVE SUMMARY

The following provides a brief summary of the controls implemented for the K - Williamsburg Works Site, as well as the inspections, monitoring, maintenance and reporting activities required by this Interim Site Management Plan (ISMP):

Site Identification: Site Identification No. 224055

K - Williamsburg Works Site

Institutional Controls:	1. Block 2288 Lot 1 may be used for industrial use and Block 2287 Lots 1, 16, and 30 may be used for restricted residential or commercial use.
	2. Environmental Easements shall be placed on the individual tax parcels of the Site to prevent future exposure to impacts.
	3. All Engineering Controls must be inspected at a frequency and in a manner defined in the ISMP.
	4. The use of groundwater is prohibited unless approved by the appropriate state and local agencies.
Engineering Controls:	1. Soil Cover system
	2. NAPL Recovery Well System

Inspections:	Frequency
1. Soil cover system inspection	Annually and after severe weather conditions that may affect ECs
Monitoring:	
1. NAPL Recovery Wells	Monitoring, as needed, based on contemporary rates of NAPL accumulation. Recovery, as needed, based on contemporary NAPL accumulation rates.
Reporting:	
1. NAPL Recovery Data	Quarterly Data Reports provided quarterly to NYSDEC, by email

Site Identification: Site Identification No. 224055
K - Williamsburg Works Site

2. Site-wide Inspection Report	Annually, or as otherwise determined by NYSDEC
3. Severe Conditions Inspection Report	As Needed

Further descriptions of the above requirements are provided in detail in Sections 3, 4 and 6 of this ISMP.

The property owners are required to comply with this ISMP including all notifications, which are to be made to both National Grid and NYSDEC, and the provisions in the Excavation Work Plan (Appendix B). The property owner's responsibilities are more fully described in Table 7, Matrix of Responsibility by Property Owner, National Grid, and Government Agency. If property ownership changes after the submission of the ISMP, ICs must be addressed by the property owner's successors.

Boundaries that are covered by this ISMP will be revaluated after the approval of the Final Engineering Report, and the ISMP will be replaced by the final SMP.

National Grid is responsible for Manufactured Gas Plant (MGP)-related impacts, only. If a remedy is determined to be necessary to address non-MGP-related impacts at the Site, this will be evaluated separately, by NYSDEC, for further action.[1]

[1] **While National Grid has voluntarily assumed responsibility for preparation of this ISMP, National Grid reserves all of its rights under federal and state environmental laws to pursue other parties who may have responsibilities at this Site and for violations of the ISMP.**

1.0 INTRODUCTION

1.1 General

By way of Order on Consent Index No. TBD (the 2021 Order), National Grid ("Party" or "Respondent") has agreed voluntarily to manage the K - Williamsburg Works Site, while preserving its rights to seek reimbursement from any responsible parties. Pursuant to that Order, National Grid further agreed to develop this Interim Site Management Plan (ISMP), attached to the 2021 Order as Attachment B.

The K - Williamsburg Works Site, is located in the Williamsburg neighborhood of Brooklyn, New York (see Figure 1) and is coterminous with four tax parcels, identified as Parcels 1 through 4, as follows:

- Parcel 1 - Block 2288, Lot 1 located at 35 Kent Avenue;
- Parcel 2 - Block 2287, Lot 1, located at 41 North 11th Street (also known as 50 Kent Avenue);
- Parcel 3 – Block 2287, Lot 16, located at 20 N. 12th Street; and
- Parcel 4 – Block 2287, Lot 30 located at 2 N. 12th Street, Brooklyn, New York.

The K – Williamsburg Works site, Parcels 1 through 4 collectively, is hereinafter referred to as "the Site" or "Site". A figure showing the Site location and boundaries and the boundaries of Parcels 1 through 4 is provided in Figure 2. The boundaries of the Site are more fully described in the metes and bounds site description that is part of the Environmental Easement provided in Appendix A. The Site is in the New York State (NYS) Inactive Hazardous Waste Disposal Site Remedial Program, which is administered by New York State Department of Environmental Conservation (NYSDEC or Department).

The Brooklyn Union Gas Company, now doing business as National Grid NY (National Grid), previously, on February 7, 2007, entered into Order on Consent and Administrative Settlement, Index # A2-0552-0606 with the NYSDEC to develop and implement remedial programs for former manufactured gas plant (MGP) and gas holder locations in Kings, Queens, Nassau, and Suffolk counties, New York (the 2007 Order).

The Site was added to the 2007 Order via a modification dated August 2007. With its addition to the 2007 Order, a Remedial Investigation was required.[2]

The Remedial Investigation was conducted between June 2009 and December 2012 and the report was submitted to NYSDEC in January 2015. A NAPL recovery well Interim Remedial Measure (IRM) was performed for Parcel 2 in 2014 with NAPL recovery continuing to the present, and from November 2015 through June 2017, an excavation/stabilization-based IRM was performed for Parcel 2. The NAPL recovery well IRM Construction Completion Report (CCR) was submitted to, , NYSDEC in December 2014 and approved by NYSDEC on September 8, 2015.

In a letter to NYSDEC dated November 7, 2016, National Grid announced that it was exercising its unilateral right to withdraw the Williamsburg Works site from the 2007 Order. In November 2017, NYSDEC and National Grid entered into a Stipulation and Order of Settlement and Discontinuance (the Stipulation) upon which the Order was terminated with respect to the Williamsburg Works site. Per a condition of the Stipulation, the excavation/stabilization-based IRM CCR was submitted to and approved by NYSDEC. The document was submitted in January 2018 and was accepted as it pertained to the work completed at the 50 Kent Avenue Parcel, on March 28, 2018.

After completion of the IRMs Parcel 2, some impacts were left in the subsurface at the Site. Institutional and Engineering Controls (ICs and ECs) have been and will be incorporated into the Site remedy to control exposure to target compounds and target analytes detected at concentrations exceeding applicable Standards Criteria and Guidance (SCGs) in environmental samples collected at the Site (*i.e.*, remaining impacts) to ensure protection of public health and the environment. An Environmental Easement, anticipated to be granted to the NYSDEC by the property owners, hereinafter "the Property Owner" and/or "the Grantor" (see Table 1) and recorded with the Kings County Clerk, will require compliance with this ISMP and all ECs and ICs placed on the Site. Once it is granted, the Environmental Easement will be located in Appendix A.

[2] See the Construction Completion Report, 50 Kent Avenue Property Holder Area Portion of NYSDEC Site Number 224055 and Brooklyn North 1 Garage NYSDEC Site Number 224028, Brooklyn, Kings County, New York, dated March 2018 for the history of the Williamsburg Works site, which is hereby incorporated herein.

This ISMP was prepared to manage remaining impacts at the Site until it is replaced by the final SMP or the Environmental Easement is extinguished in accordance with Environmental Conservation Law (ECL) Article 71, Title 36. This plan has been approved by the NYSDEC, and compliance with this plan is required by the Grantor of the Environmental Easement and the Grantor's successors and assigns. This ISMP may only be revised with the approval of the NYSDEC.

It is important to note that:

- This ISMP details the Site-specific implementation procedures that are required by the Environmental Easement. Failure to properly implement the ISMP is a violation of the Environmental Easement.

- Failure to comply with this ISMP is a violation of ECL Article 71, Title 36 Environmental Easements and, 6 New York Codes, Rules, and Regulations (NYCRR) Part 375, and thereby subject to applicable penalties. If the failure to comply with this ISMP occurs, the NYSDEC may take action against the violating party.

- The Grantor is required to comply with this ISMP including all notifications to National Grid and to NYSDEC, and the provisions in the Excavation Work Plan (EWP) (Appendix B).

- NYSDEC can take action against an onsite and/or offsite owner if they interfere with the remedial program under the ECL. Triggers include improper disposal, release of contaminants of concern to environment, lack of odor control, etc.

All reports associated with the Site can be viewed by contacting the NYSDEC or its successor agency managing environmental issues in New York State. A list of contacts for persons involved with the Site is provided in Appendix C of this ISMP.

This ISMP was prepared by GEI Consultants, Inc., P.C. (GEI), on behalf of National Grid, in accordance with the requirements of the NYSDEC's Division of Environmental Remediation (DER)-10 ("Technical Guidance for Site Investigation and Remediation"), dated May 2010, and the guidelines provided by the NYSDEC. This ISMP addresses the means for implementing the ICs and ECs that are required by the Environmental Easement for the Site.

This ISMP includes the following two plans:

1. An Institutional and Engineering Control Plan that identifies all use restrictions and engineering controls for the Site and details the steps and media-specific

requirements necessary to ensure the following institutional and engineering controls remain in place and effective:

- Institutional Controls: an Environmental Easement; and
- Engineering Controls: a soil cover system and NAPL Recovery Well System;

The Institutional and Engineering Control Plan, which is presented in Section 3 of this ISMP, includes the following plans and provisions:

- An Excavation Work Plan which details the provisions for management of excavations in areas of remaining impacts;
- A Health and Safety Plan;
- A Community Air Monitoring Plan;
- A Quality Assurance Project Plan;
- A Field Sampling Plan;
- Management and inspection of the identified engineering controls (see Section 3.3);
- Maintenance of Site access controls and Department notification.

2. A Monitoring Plan to assess the performance and effectiveness of the remedy. The plan includes:
   - NAPL gauging and recovery;
   - Annual inspections.

   The Monitoring Plan is presented in Section 4 of this ISMP.

1.2 Revisions

Revisions to this plan will be proposed in writing to the NYSDEC's project manager. The NYSDEC can also make changes to the ISMP or request revisions from the remedial party. Revisions will be necessary upon, but not limited to, the following occurring: a change in media monitoring requirements, upgrades to or shut-down of a remedial system, post-remedial removal of impacted sediment or soil, or other significant change to the Site conditions. In accordance with the Environmental Easement for the

Site, the NYSDEC project manager will provide a notice of any approved changes to the ISMP and append these notices to the ISMP that is retained in its files.

1.3 Notifications

All intrusive activities must be approved by NYSDEC. Sufficient notification must be made to NYSDEC so it can make the decision on the type of reporting. Typically, the type of notification and reporting requirements depend on the scope of work.

Notifications shall be submitted in writing, by the property owner, to the NYSDEC, and to National Grid, as needed, in accordance with NYSDEC's DER – 10 for the following reasons:

1. 60-day advance notice of any proposed changes in Site use that are required under the Order, 6NYCRR Part 375, and/or ECL.

2. 7-day advance notice of the start of any field activity not pursuant to the EWP (e.g., work associated with or related to maintenance to the building slab or construction).

3. 15-day advance notice of any proposed ground-intrusive activity pursuant to the EWP. If the ground-intrusive activity qualifies as a change of use as defined in 6 NYCRR Part 375, the above mentioned 60-day advance notice is also required.

4. Notice within 48-hours of any damage or defect to the EC that reduces or has the potential to reduce the effectiveness of an EC, and likewise, any action to be taken to mitigate the damage or defect.

5. Verbal notice by noon of the following day of any emergency, such as a fire; flood; or earthquake that reduces or has the potential to reduce the effectiveness of ECs in place at the Site. The Grantor will provide written confirmation within 7 days that includes a summary of actions taken, or to be taken, and the potential impact to the environment and the public.

6. Follow-up status reports on actions taken to respond to any damage or defect to the EC requiring ongoing responsive action will be prepared and submitted to the NYSDEC within 45 days describing and documenting actions taken to restore the effectiveness of the ECs.

Any change in the ownership of the Site, use of the Site, or the responsibility for implementing this ISMP will include the following notifications:

7. At least 60 days prior to the change, National Grid and the NYSDEC will be notified in writing of the proposed change. This will include a certification that the prospective purchaser/Remedial Party has been provided with a copy of the Order on Consent, and all approved work plans and reports, including this ISMP.

8. Within 15 days after the transfer of all or part of the Site, the new owner's name, contact representative, and contact information will be confirmed in writing to National Grid and to the NYSDEC.

In addition to the above notifications pursuant to DER-10, notification shall be made to National Grid for the following reasons:

1. 30-day advance notice of the start of any field activity not pursuant to the EWP (*e.g.*, work associated with or related to maintenance to the building slab or construction).

2. As-soon-as-possible advance notice of any proposed ground-intrusive activity pursuant to the EWP.

3. 12-month advance notice of any property redevelopment and/or building demolition.

Table 2 includes contact information for the above notifications. The information on this table will be updated as necessary to provide accurate contact information. A full listing of Site-related contact information is provided in Appendix C.

2.0 SUMMARY OF PREVIOUS INVESTIGATIONS AND REMEDIAL ACTIONS

2.1 Site Location and Description

The Site is located in the Williamsburg neighborhood of Brooklyn, Kings County, New York and consists of four tax parcels, identified as Borough 3 Block 2288 Lot 1 (Parcel 1) and Block 2287 Lots 1 (Parcel 2), 16 (Parcel 3), and 30 (Parcel 4) on the City of New York Tax Map (see Figure 2). The Site is an approximately 5.5-acre area and is bounded by N. 12th Street to the north, N. 11th Street to the south, an industrial property to the east, and the East River to the west. Kent Avenue separates Parcels 1 and 2, bordering Parcel 1 to the east and Parcel 2 to the west (see Figure 2 – Site Layout Map). The boundaries of the Site are more fully described in Appendix A –Environmental Easement. The owners of the Site at the time of issuance of this ISMP are North 12th Associates (Parcel 1) and New York City Department of Parks and Recreation (Parcels 2 through 4). Parcel 1 is operated by Amazon.

2.2 Physical Setting

2.2.1 Land Use

The Site consists of the following: a commercial building and vacant land that is being used as a park. Parcel 1 is zoned for industrial use (M1-2 or light manufacturing). Parcels 2 through 4 are zoned for heavy manufacturing use
(M3-1); however, they are being or will be used as a parkland and are currently vacant.

The properties adjoining, and in the neighborhood surrounding, the Site primarily include commercial and park properties. The properties immediately south of the Site include commercial properties; the properties immediately north of the Site include park properties; the properties immediately east of the Site include commercial and industrial properties; and the East River is located the west of the Site. Historic property use adjoining the Site included oil refining and fuel storage operations.

2.2.2 Geology

Four major stratigraphic units, in order of increasing depth, were identified during the RI drilling program: (1) fill, (2) alluvial, harbor, and marsh deposits, (3) glacial deposits [glacial till, glacial outwash, and glacial lacustrine (lake)], and (4) bedrock [Fordham Gneiss]. Sample locations and cross section baselines are shown in Figure 3 and geologic cross sections are shown in Figure 4. Site-specific boring logs are provided in Appendix D.

2.2.2.1 Fill

Fill was encountered in each of the soil borings drilled at the area investigated. Fill is present beneath the asphalt pavement, concrete slabs, and buildings. The majority of the area investigated was created historically by filling shoreline areas of the East River and Bushwick Inlet. The fill consists primarily of loose, non-cohesive sand, and silty-sand mixed with ash, gravel, and fragments of brick, concrete, coal, and wood.

The former shoreline of the Bushwick Inlet and East River was located along the eastern edge of the 50 Kent Avenue property, as shown on an 1844 Map of New York Bay and Harbor and The Environs (Appendix E). This property was landfilled as part of the development of the waterfront in the mid-1800s. Historically, a portion of the area investigated was in a marsh (possibly intertidal) area and submerged under 3 feet to more than 15 feet of water. The depth of the water increased to the west towards the East River. In the 1800s, the area was filled and developed.

Fill depths range from a few feet, in multiple locations, to generally 10 to 20 feet along the East River. The thickness of fill deposits increases from east to west, which is consistent with the land filling of shorelines of the East River and Bushwick Inlet. Fill materials, including brick, wood, ash, and cinders, were encountered near the current shoreline of the East River.

2.2.2.2 Alluvial, Harbor, and Marsh Deposits

Alluvial, harbor, and marsh deposits, where present, were found beneath the fill layer. The alluvial deposits consist of sub-units of primarily sands with occasional silt and/or gravel. Harbor deposits consist of organic materials, including fine-grained soil such as organic soil. Marsh deposits consist of primarily silt, silt-clay, clay, and peat.

Based on historical maps, these deposits are believed to be associated with a former marsh (possibly inter-tidal) located adjacent to the Bushwick Inlet and harbor deposits in the East River.

2.2.2.3 Glacial Deposits

Glacial deposits were encountered beneath the fill and alluvial, harbor, and marsh deposits (where present), and above bedrock. Glacial deposits were the most extensive unit encountered during investigations at the Site and were present at up to a thickness of approximately 97 feet based upon deep soil borings completed at the 50 Kent Avenue property. The glacial deposits are categorized into three sub-units:

- glacial till,
- glaciolacustrine (glacial lake) clay, and
- glacial outwash.

Glacial outwash was the most predominant geologic unit observed. Sporadic layers of glacial till and a continuous glaciolacustrine layer are present within the glacial outwash. The glacial deposits encountered are consistent with glacial stratigraphy described by Merguerian (2003) and Moss and Merguerian (2005 and 2007). The sequence of deposits is likely associated with the advance of the Harbor Hill terminal moraine, damming of glacial meltwaters and forming of glacial lakes, and breaching of the Harbor Hill Terminal Moraine at The Narrows of New York Harbor and subsequent retreat of the glacier.

The glacial outwash sands are typically light brown, brown, loose, non-cohesive, well-sorted, fine to coarse sands with varied amounts of gravel, sporadic cobbles and trace silt. The glacial outwash deposits extend to the bedrock surface, which is located approximately 99 feet bgs [-87.27 feet North American Vertical Datum (NAVD), WW-SB-102].

Sporadic layers of glacial till were present within the glacial outwash. Glacial till layers generally consist of silt-sand mixtures. The glacial till thickness was generally less than 10 feet.

A consistent layer of glaciolacustrine clay (a glacial silt-clay unit) was encountered beneath the area investigated. This deposit consists of a cohesive, dense, red

to brown to gray, clay with varying amounts of fine sand, with varves of silt and fine sand. The glacial silt-clay was encountered below the fill layer and inter-bedded with the glacial outwash. The glacial silt-clay was encountered as deep as 90 feet bgs [-78.27 feet NAVD, WW-SB-102]. The glacial silt-clay unit is likely glaciolacustrine in origin as evidenced by the varves of fine sand. Similar deposits within New York Harbor, described by Merguerian (2003), were inferred to be associated with damming of Hudson River by the Harbor Hill Terminal Moraine to the southwest.

2.2.2.4 Bedrock

Bedrock was encountered at 99 feet [-87.27 feet NAVD] in boring WW-SB-102 installed as part of a Pre-Design Investigation (PDI) (URS, 2013). Published bedrock information presented by Buxton, et al. (1981) indicates that bedrock in the vicinity of the Site is located at approximately -100 feet NAVD.

2.2.3 Hydrogeology

The Site is located within approximately 500 feet of the west bank of the East River. The East River has been classified as Class I Saline Surface Water by the NYSDEC. Class I waters are suitable for secondary contact recreation and fishing. These waters shall be suitable for fish propagation and survival. No known public water-supply wells are located within a one-mile radius of the Site.

The local land-surface topography and the East River are the main controlling influences on groundwater depth and flow direction at and around the Site. The groundwater flow direction is to the west, toward the East River. The depth to groundwater gauged in off-Site monitoring wells in May 2019 ranged from 3.63 feet (4.48 feet NAVD) at WW-MW-10 to 11.72 feet (7.38 feet NAVD) at WW-MW-2. A groundwater contour map is shown in Figure 5. Groundwater elevation data is provided in Table 3. Groundwater-monitoring-well construction logs are provided in Appendix D.

2.3 Investigation and Remedial History

The following narrative provides a summary of the available project records to document key milestones for the Site and nearby properties. Full titles for each of the reports referenced below are provided in Section 8.0 - References.

Parcel 2 was previously leased and operated by the New York City Department of Sanitation (NYCDOS). There were at least three spill numbers (9401167, 9600011, and 9607376) and a petroleum bulk storage site number (2-456098) associated with the DOS operations. Multiple investigations were completed at the Site during the time NYCDOS operated it. VOCs, heavy metals, and free phase diesel fuel were observed during these investigations. During the investigations and/or subsequent removal actions, between 2000 and 2004, 6,402 gallons of contaminated fluids (including 131 gallons of free product) were removed from wells on the property. In 2004, an area around a well with free product was excavated.

Site Investigation (SI) and Cost to Cure Reports were prepared for the New York City Department of Design and Construction (NYCDDC) in 2006 and 2007, respectively, in preparation for developing Parcels 2, 3, and 4 as a park. These reports describe impacts by alleged responsible parties including: former petroleum distillery operations, known and unknown off-site historic petroleum releases, former USTs, including the one closed in place, the former MGP operations, and off-site industrial operations located along the East River. These reports also describe conceptual plans for the park and provide potential remedial cost estimates.

On behalf of National Grid, GEI conducted RI field work for the Williamsburg Works site from June 2009 through December 2012. The initial RI field work was conducted in accordance with the NYSDEC-approved RI Work Plan, (GEI, 2008) and NYSDEC-approved RI Work Plan (RIWP) Addendums dated November 19, 2008, February 12, 2009, and December 17, 2009. At their request, an interim data deliverable was submitted to NYSDEC in August 2010, and in September 2010 NYSDEC responded with a letter requesting that an excavation/stabilization-based IRM be performed at "the 50 Kent Ave. parcel (bounded by Citi Storage [Block 2278, Lot 16], N. 12th St., Kent Ave., and N. 11th St.)."

On August 2, 2011, NYSDEC approved, with modification, a GEI-prepared IRM Design Work Plan dated July 2011 and subsequently revised in August 2011. The IRM Design Work Plan was implemented by URS (URS has since become part of AECOM) between January 2012 and June 2015. URS submitted a NAPL Recovery Plan to NYSDEC in October 2014. URS designed and managed the construction of 13 NAPL recovery wells (NRW-1 through NRW-13) as part of IRM activities. AECOM recovers NAPL on a weekly basis from wells where NAPL has collected in the sumps. URS submitted an IRM 100% Design Report (Design Report) to NYSDEC in June 2015. The Design Report was approved by NYSDEC on August 17, 2015. The IRM was conducted from November 2015 through June 2017.

During design of the IRM, GEI continued to implement RI field work in accordance with a NYSDEC-approved Supplemental RIWP dated August 25, 2010. A RI Report, prepared by GEI, was submitted to NYSDEC on January 31, 2015 (the RI Report). NYSDEC neither approved nor disapproved the RI Report.

2.3.1 Investigation Findings and Remediation

2.3.1.1 Investigations and Remediation Prior to the Remedial Investigation

Multiple investigations were completed at the Site during NYCDOS operations. Volatile organic compounds (VOCs), heavy metals, and free phase diesel fuel were observed during these investigations as summarized below. During the investigations and/or subsequent removal actions, between 2000 and 2004, 6,402 gallons of contaminated fluids (including 131 gallons of free product) were removed from wells on the property. In 2004, an area around a well with free product was excavated. No NYCDOS reports are available for this property after January 2005.

SI and Cost to Cure Reports were prepared for the New York City Department of Design and Construction (NYCDDC) in 2006 and 2007, respectively, in preparation for developing the property and adjacent properties as a park. These reports describe impacts by alleged responsible parties including: the former petroleum distillery operations, known and unknown off-site historic petroleum releases, the former Underground Storage Tanks (UST)s, including the one closed in place, the former MGP operations,

and off-site industrial operations located along the East River. These reports also describe the conceptual plans for the park and provide potential remedial cost estimates.

Refer to the CCR by AECOM dated January 2018 for a more detailed history of investigations on the Site and surrounding properties.

2.3.1.2 Williamsburg Works Site Remedial Investigation (GEI 2015)

The RI defined the overall vertical extent of MGP impact migration on the Site. Visual impacts were not observed below the clay layer within deep borings surrounding the Site installed by GEI.

MGP impacts were commingled with petroleum-impacted soil and fill at depths from ground surface to greater than 40 feet. Petroleum impacts are likely associated with multiple sources including historic on-site fuel storage, oil use and storage during NYCDOS operations, long-term off-site fuel storage and operations at the adjacent former refinery, and historic urban filling. The presence of additional non-MGP related chemicals including metals, solvents, pesticides, and polychlorinated biphenyls (PCBs) in soils on the Site and adjacent to the Site further confirm the presence and comingling of multiple sources of impacts.

2.3.2.3 Interim Remedial Measures

IRMs were conducted at Parcel 2 in accordance with the NAPL Recovery Well Work Plan, prepared by AECOM and dated October 2013, as approved by NYSDEC, and the IRM 100% Design Report, prepared by AECOM and dated June 2015, as approved by NYSDEC (the Design Report). The NAPL recovery well IRM was performed for Parcel 2 in 2014 with NAPL recovery continuing to the present, and from November 2015 through June 2017, an excavation/stabilization-based IRM was performed for Parcel 2. The NAPL recovery well IRM CCR was submitted to NYSDEC in December 2014 and approved by NYSDEC on September 8, 2015. The excavation/stabilization-based IRM CCR was submitted to NYSDEC in January 2018 and approved, as it

pertained to the work completed at the 50 Kent Avenue Parcel, by NYSDEC, on March 28, 2018. The major components of the IRMs were:

1. Excavation and off-site treatment and disposal of soil and fill material and subsurface structures up to a 30 ft depth (except as noted below and approved by NYSDEC) at and adjacent to the Relief Holder and Holder No. 1, depicted on Figure 6.
2. Excavation and off-site treatment and disposal of soil and fill material exceeding the criteria established in the NYSDEC-approved Shallow Soil Reuse Acceptance Plan dated February 2016 to a minimum depth of 5 ft or to water table if warranted by the visual impacts.
3. Excavation of the shallow soils across the Site and segregation, size reduction (as necessary), and reuse as backfill in the deep excavation of shallow soils that were suitable for reuse, in accordance with the NYSDEC-approved Shallow Soil Reuse Acceptance Plan dated February 2016.
4. Removal and disposal of former NYCDOS facility USTs.
5. In-situ solidification (ISS) of soils within Holder No. 2 using segmented Bucket Soil Mixing (BSM) to minimize the ability of contaminants to migrate and to prevent future direct contact exposures.
6. Construction of a minimum 5 ft soil cover system consisting of select fill material and topsoil.
7. Abandonment of monitoring and recovery wells within the footprint of the Site.
8. Installation of thirteen NAPL recovery wells (NRW-1 through NRW-13) under the IRM NAPL Recovery Work Plan for the 50 Kent Avenue Parcel.
9. Weekly NAPL recovery from wells where NAPL has collected in the sumps.

In 2017, with NYSDEC's permission, three recovery wells (NRW-01, NRW-02, and NRW-03) located within the Site boundary along with two recovery wells (NRW-09 and NRW-11) damaged during the soil excavation/solidification IRM implementation were abandoned. The latter two wells were replaced with recovery wells NRW-09R and NRW-11R at locations selected in consultation with the NYSDEC in 2017.

Throughout and upon completion of the soil excavation/solidification IRM, NAPL collection continued from existing recovery wells at the Site. NAPL was removed by pump from the recovery wells two to three times a week to maintain the level of cumulated NAPL below the top of the well sumps. During the soil excavation/solidification IRM, sump depths were reduced at some of the recovery wells due to sedimentation and gravel falling into the well or due to damage to well casings.

Based on the depth to bottom measurements collected prior to and after completion of the soil excavation/solidification IRM, it was clear that sump capacities in recovery wells NRW-01, NRW-02, NRW-07, NRW-08, NRW-09R, NRW-11R and NRW-13 were compromised.

Sump capacities of five of the seven compromised wells were successfully restored using air lift and surge and purge methods during the May 2019 well rehabilitation efforts. Attempts of obstruction removal was not successful at two NAPL recovery wells (NRW-01 and NRW-08), which resulted in decommissioning of these wells and replacing them with NRW-01R and NRW-08R, as approved by NYSDEC.

2.4 Remedial Action Objectives

The Remedial Action Objectives (RAOs) for the Site as listed by NYSDEC are as follows:

Groundwater

RAOs for Public Health Protection

- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.
- Prevent contact with, or inhalation of, volatiles from contaminated groundwater.

Soil

RAOs for Public Health Protection

- Prevent ingestion/direct contact with contaminated soil.
- Prevent inhalation of or exposure from contaminants volatilizing from contaminants in soil.

Soil Vapor

RAOs for Public Health Protection

- Mitigate impacts to public health resulting from existing, or the potential for, soil vapor intrusion into buildings at a Site.

2.5 Remaining Impacts

2.5.1 Soil

2.5.1.1 Parcel 1

On and adjacent to Parcel 1, exceedances of the Industrial Use Soil Cleanup Objectives (SCOs) were limited to PAH compounds in the soil samples collected from soil boring WW-SB-19, at depths of 2 to 3 feet and 4 to 5 feet bgs; soil boring WW-SB-20, at a depth of 55 to 57 feet bgs; soil boring WW-SB-21, at a depth of 33 to 34 feet bgs; soil boring WW-SB-22 at a depth of 3 to 4 feet bgs; soil boring WW-MW-02, at a depth of 2 to 5 feet bgs; and soil boring WW-MW-03, at depths of 2 to 5 and 28 to 30 feet bgs, and BTEX and PAH compounds detected in the soil sample collected from soil boring WW-SB-22 at a depth of 37 to 38 bgs.

Table 4 and Figure 7 summarize the analytical detections, in all soil samples collected on and adjacent to Parcel 1, during the RI, that exceed the Unrestricted Use SCOs and the Industrial Use SCOs.

2.5.1.2 Parcel 2

The excavation/ stabilization-based IRM for Parcel 2 was designed to remove soil and fill from those areas in and adjacent to the former Relief Holder and Holder No. 1 foundations, and elsewhere on the Site above the groundwater table, and to solidify soil and fill within the Holder No. 2 tank, but impacts remain below the demarcation barriers placed below or within the imported clean fill. Remaining impacts include petroleum product contamination. Gasoline odors were observed in soil borings in the west and east shallow excavation areas at depths greater than the excavation performed in these areas. The area bounded by the support of excavation wall was excavated to a target depth of 30

feet. The remainder of Parcel 2 was excavated to a minimum of 5 feet (elevation 8 feet NAVD). The several distinct areas of excavation described in this section are shown in Figure 6. This figure also shows the depth of excavation in each section.

Within the footprint of the eastern shallow excavation area, exceedances of the Restricted-Residential SCOs were generally limited to BTEX and PAH compounds in soil the samples collected from the WW-MW-04 boring at a depth of 31 to 33 feet bgs, soil boring BPB-19 at a depth of 19 to 21 feet, and soil boring BPB-21 at a depth of 21 to 23 feet. Other detections of constituents that exceeded their respective Restricted Residential SCOs include 1,2,4-trimethylbenze in the soil sample collected from BPB-21 at a depth of 21 to 23 feet bgs, 1,2,4-trimethylbenze and PAHs in the soil sample collected from BPB-22 at a depth of 35 to 37 feet bgs, and PAHs and arsenic in the soil sample collected from BPB-20 at a depth of 17 to 19 feet bgs. Soil samples collected within the footprint of the eastern shallow excavation area at depths of 58 to 59 feet and 96 to 97 feet bgs met the Unrestricted SCOs.

Within the footprint of the deep excavation area, exceedances of the Restricted-Residential SCOs were generally limited to BTEX and PAH compounds detected in soil samples collected from soil boring WW-SB-23 at a depth of 31 to 33 feet bgs and at a depth 62 to 63 feet bgs., from soil boring WW-SB-24 at a depth of 38 to 40 feet bgs, from soil boring WW-SB-42 at a depth of 62 to 62.5 feet bgs, from soil boring WW-MW-06 at a depth of 50 to 52 feet bgs, and from soil boring WW-MW-07 at a depth of 48.5 to 49.5 feet bgs. Other detections of constituents that exceeded their respective Restricted Residential SCOs include dibenzofuran, which was detected in the soil sample collected from soil boring WW-SB-33 at a depth of 31 to 33 feet, and manganese, which was detected in the soil sample collected from soil boring WW-SB-42 at a depth of 62 to 62.5 feet bgs.

Within the footprint of the western shallow excavation area, exceedances of the Restricted-Residential SCOs were generally limited to PAH compounds in the soil samples collected from soil boring WW-SB-09, at a depth of 11 to 12 feet bgs; soil boring BPB-11, at a depth of 7 to 9 feet bgs; and soil boring BPB-12 at a depth of 7 to 9 feet bgs, and BTEX and PAH compounds detected in soil samples collected from soil boring WW-SB-09, at a depth of 53 to 54 bgs; soil boring WW-SB-10, at a depth of 49 to

50 feet bgs; soil boring BPB-10, at a depth of 9 to 11 feet bgs; soil boring BPB-12, at a depth of 49 to 57 feet bgs; soil boring BPB-14, at a depth of 19 to 21 feet bgs; and soil boring BPB-15, at a depth of 15 to 17 feet bgs. Other detections of constituents that exceeded their respective Restricted Residential SCOs include barium in the soil sample collected from WW-SB-40, at a depth of 95 to 95.5 feet bgs; 1,2,4-trimethylbenze in the soil sample collected from BPB-12, at a depth of 49 to 51 feet bgs; 1,2,4-trimethylbenze and total cyanide in the soil sample collected from BPB-14, at a depth of 19 to 21 feet bgs; and 1,2,4-trimethylbenze and 1,3,5-trimethylbenzene in the soil sample collected from BPB-15, at a depth of 15 to 17 feet bgs.

Within the former no-excavation area, exceedances of the Restricted-Residential SCOs were limited to PAH compounds, lead, and mercury detected in the soil sample collected from soil boring WW-MW-17, at a depth of 7 to 8 feet bgs, and BTEX and PAHs detected in the soil sample collected from soil boring WW-MW-08, at a depth of 7.5 to 8.5 feet bgs.

Table 4 and Figure 7 summarize the analytical detections, in all soil samples collected on and adjacent to Parcel 2 during the RI that exceed the Unrestricted Use SCOs and the Restricted Residential Use SCOs after completion of excavation/ stabilization-based IRM.

2.5.1.3 Parcels 3 and 4

Adjacent to Parcels 3 and 4, exceedances of the Restricted-Residential SCOs were generally limited to PAH compounds in the soil samples collected from soil borings along N. 11th and N. 12th Streets at depths from 1 to 15 feet bgs. Other detections of constituents that exceeded their respective Restricted Residential SCOs include BTEX in the soil samples collected from WW-SB-13, at a depth of 12 to 15 feet bgs, and WW-SB-14, at a depth of 10 to 11 feet bgs; arsenic, lead, and mercury in the soil sample collected from WW-MW-15, at a depth of 1 to 4 feet bgs; arsenic and lead in the soil sample collected from WW-MW-15, at a depth of 12 to 13 feet bgs; arsenic and mercury in the soil samples collected from WW-SB-13, WW-SB-15, and WW-SB-16, at depths of 12 to 15 feet bgs, 7 to 9 feet bgs, and 12 to 13 feet bgs, respectively, and mercury in the soil sample collected from WW-SB-15, at a depth of 3 to 5 feet bgs.

Table 4 and Figure 7 summarize the analytical detections, in all soil samples collected adjacent to Parcels 3 and 4 during the RI that exceed the Unrestricted Use SCOs and the Restricted Residential Use SCOs.

2.5.2 Groundwater

Historic groundwater sampling showed groundwater impacts associated with the soil impacts at the Site. All on-Site monitoring wells on and adjacent to Parcel 2, including wells installed by others than National Grid, were abandoned during the IRM except WW-MW-17, which could not be located. Based on the location of WW-MW-17 within the excavation, this well no longer exists. Table 5 and Figure 8 summarize the Pre-IRM results of all samples of groundwater collected on the Site outside of the deep excavation area that exceed the SCGs. DNAPL has been observed in recovery wells adjacent to the Site, on N. 11th and N. 12th Streets, screened from various depths between 8 and 60 feet bgs. Based on the presence of DNAPL in these recovery wells, groundwater is impacted. Shallow groundwater is anticipated to be cleaner than observed during the RI following the completion of the excavation/solidification-based IRM on Parcel 2.

On and adjacent to Parcel 1, exceedances of the AWQS were limited to BTEX compounds, chlorinated VOCs, PAH compounds, aldrin, iron, magnesium, manganese, sodium, total cyanide, and ammonia in the groundwater samples collected from temporary groundwater points on-site, up to 65 feet deep, and from shallow monitoring wells located on N. 11th and N.12th Streets.

Adjacent to Parcels 3 and 4, exceedances of the AWQS were limited to BTEX compounds, PAH compounds, phenol, pesticides, arsenic, chromium, iron, magnesium, manganese, nickel, sodium, and total cyanide in the groundwater samples collected from shallow monitoring wells located on N. 11th and N.12th Streets.

2.5.3 Soil Vapor

A SVI investigation, including the collection of sub-slab vapor, and indoor air samples, was completed within the occupied building at Parcel 1 of the Site. Ambient (outdoor air) samples were also collected adjacent to the building during the SVI

investigation. Table 6 summarizes the results of all samples of sub-slab vapor, indoor air, and outdoor air collected on Parcel 1 that exceed the New York State Department of Health (NYSDOH) Air Guidance Values (NYSDOH, 2006).

A number of VOCs, including naphthalene, were present in the sub-slab vapor samples. BTEX and naphthalene are common to petroleum products and MGP operations. Concentrations of tetrachloroethene (PCE) and trichloroethene (TCE), chlorinated solvents which are not associated with MGP operations, were also detected in each sub-slab vapor, indoor air, and outdoor air sample.

Based upon the NYSDOH guidance, TCE, carbon tetrachloride, and PCE were present within indoor air samples at concentrations that may require reasonable and practical actions to identify source(s) and reduce exposures by others. Potential sources of TCE, carbon tetrachloride, and PCE that were observed within the building at the time of the SVI investigation included paint, paint thinners, and paint removers.

3.0 INSTITUTIONAL AND ENGINEERING CONTROL PLAN

3.1 General

Since impacts remain at the Site, ICs and ECs are required to protect human health and the environment. This IC/EC Plan describes the procedures for the implementation and management of all IC/ECs at the Site. The IC/EC Plan is one component of the ISMP and is subject to revision by the NYSDEC project manager.

This IC/EC Plan provides:

- A description of all IC/ECs on the Site;
- The basic implementation and intended role of each IC/EC;
- A description of the key components of the Environmental Easement;
- A description of the controls to be evaluated during each required inspection;
- A description of plans and procedures to be followed for implementation of IC/ECs, such as the EWP (as provided in Appendix B) for the proper handling of remaining impacted material that may be disturbed during maintenance or redevelopment on the Site, HASP (Appendix F), CAMP (Appendix G), QAPP (Appendix H), and FSP (Appendix I);
- A description of the roles and responsibilities of each party with respect to this ISMP; and
- Other provisions necessary to identify or establish methods for implementing the IC/ECs required by the site remedy, as determined by the NYSDEC project manager.

3.2 Roles and Responsibilities

A description of the roles and responsibilities of each party (*i.e.*, the NYSDEC, the property owner, and National Grid) with respect to this ISMP is included as the Matrix of Responsibility (Table 7). A decision tree outlining the steps for on-Site intrusive work by the property owners is included as Figure 9.

3.3 Institutional Control

One IC, an Environmental Easement for each parcel, is required to: (1) implement, maintain and monitor Engineering Control systems; (2) prevent future

exposure to remaining impacts; and, (3) limit the use and development of the Site to Restricted Residential, Commercial, or Industrial uses only (Figure 10). The Environmental Easement requires compliance to this ISMP for current and future property owners. Restrictions identified in the Environmental Easement may not be discontinued without an amendment to or extinguishment of the Environmental Easement. The IC boundaries are shown in the figures associated with the Environmental Easement packages included in Appendix A. Key components of the Environmental Easements are:

- The Site may be used for:

  Parcel 1 – Industrial as described in 6 NYCRR Part 475-1.8(g)(2)(iv)

  Parcels 2 through 4 – Restricted Residential as described in 6 NYCRR Part 475-1.8(g)(2)(ii);

- All ECs must be operated and maintained as specified in this ISMP (see Section 3.4);

- All ECs must be inspected at a frequency and in a manner defined in the ISMP (see Section 4.2);

- The use of groundwater underlying the property is prohibited without necessary water quality treatment as determined by the NYSDOH or the New York City Department of Health and Mental Hygiene to render it safe for use as drinking water or for industrial purposes, and the user must first notify and obtain written approval to do so from the Department;

- Data and information pertinent to interim site management must be reported at the frequency and in a manner as defined in this ISMP (see Section 6);

- All future intrusive activities that will disturb remaining impacted material must be conducted in accordance with this ISMP and the EWP (see Appendix B);

- Monitoring, inspection, and reporting of any physical component of the remedy, including the soil cover system and NAPL Recovery Well System, shall be performed as defined in this ISMP (see Sections 4, 5, and 6). More detailed descriptions of the operation and of the maintenance of the NAPL Recovery Well System are presented in Appendix K;

- Access to the Site must be provided to agents, employees or other representatives of the State of New York with reasonable prior notice to the

property owner to assure compliance with the restrictions identified by the Environmental Easement;

- The potential for vapor intrusion must be evaluated for any buildings developed within the Environmental Easement boundary, and any potential impacts that are identified must be monitored or mitigated; and
- Vegetable gardens and farming on the Site are prohibited; and.
- To determine the need for remediation, a full RI shall be performed at Parcel 1 should large scale redevelopment occur, if any of the existing structures are demolished, or if the subsurface is otherwise made accessible. An Alternatives Analysis shall be performed at Parcel 1 following the RI. Further investigation, such as a Pre-Design Investigation, and remediation may be required.

The responsibility for the elements of the Environmental Easement is discussed in Table 7 – Matrix of Responsibilities. Table 7 defines the responsibilities for NYSDEC, National Grid and the property owners.

3.4 Engineering Controls

3.4.1 Soil Cover System

Exposure to remaining impacts at Parcel 2 is prevented by a soil cover system. Parcel 2 this soil cover system is comprised of a minimum of five feet of clean soil (minimum 4.5 feet of clean backfill and 0.5 feet of topsoil) underlain by a demarcation geotextile. The soil cover system is a permanent control that will not be terminated. Figure 11 presents the location of the soil cover system. Parcel 2 is designated for Restricted Residential or Commercial use as described in 6 NYCRR Part 475-1.8(g)(2)(ii).

The soil cover systems purpose is to maintain a barrier between the public and impacted material, and the inspection will focus on the structural/remedial integrity of the soil cover system. Monitoring for aesthetics or functionality apart from the remedial purpose is not required by the ISMP.

Although not an EC, the concrete foundations on Parcel 1also maintains a barrier between the public and impacted material. Parcel 1 is designated for industrial use as described in 6 NYCRR Part 475-1.8(g)(2)(iv).

Although not an EC, the concrete foundations on Parcels 3 and 4 also maintain a barrier between the public and impacted material, if any. Parcels 3 and 4 are designated for restricted residential or commercial use as described in 6 NYCRR Part 475-1.8(g)(2)(ii).

The EWP provided in Appendix B outlines the procedures required to be implemented in the event the soil cover system or concrete slabs are breached, penetrated or temporarily removed. This includes any work below the demarcation barrier (minimum elevation 8 feet NAVD) or the water table, whichever is shallower. Procedures for the inspection of this cover are provided in the Monitoring Plan included in Section 4.0 of this ISMP. Any work conducted pursuant to the EWP must also be conducted in accordance with the procedures defined in a HASP and associated CAMP prepared for the Site and provided in Appendix G. Any disturbance of the Site cover system must be overseen by a qualified environmental professional as defined in 6 NYCRR Part 375, a Professional Engineer (PE) who is licensed and registered in New York State, or a qualified person who directly reports to a PE who is licensed and registered in New York State.

3.4.2 NAPL Recovery Well System

A network of DNAPL recovery wells was installed at the Site during the Remedial Action. The NAPL Recovery Well System is comprised of ten recovery wells adjacent to the Site along N. 11th and N. 12th Streets. NAPL monitoring and recovery events are currently undertaken once a week at the Site and include the following activities:

- Measurement of depth of recovery wells;
- Measurement of NAPL thickness in each recovery well;
- Recovery of NAPL from wells as required;
- Evaluation of NAPL collected in each well sump; and
- Containerization and off-Site disposal of recovered NAPL.

Construction details for the wells and procedures for inspecting, maintaining, and operating the DNAPL Recovery Well System are documented in Appendix K – NAPL

Recovery Plan. Procedures for operating and maintaining the NAPL Recovery Well System are documented in the Operation and Maintenance Plan (Section 5.0 of this SMP). Figure 11 shows the location of the ECs for the Site.

3.5 Plans and Procedures to be Followed for Implementation of IC/ECs

A description of each of the plans and procedures to be followed for implementation of IC/ECs is provided below.

3.5.1 Steps to Be Taken in Advance of On-Site Intrusive Work

A decision tree describing notifications and actions to be taken in advance of on-site work by the property owner is included as Figure 9.

3.5.2 Excavation Work Plan

This ISMP includes an EWP that is to be used for excavations (Appendix B). This EWP will be implemented to address any intrusive activities at the Site.

3.5.3 HASP

This ISMP includes a Health and Safety Plan. Any work conducted pursuant to the EWP must also be conducted in accordance with the procedures defined in the HASP provided in Appendix F. This HASP establishes policies and procedures to protect personnel from the potential hazards posed by the activities at the Site. Site workers are required to review and sign the HASP, acknowledging that they understand and will adhere to the HASP. Subcontractors will also prepare their own Site-specific HASP for the protection of their employees from the hazards associated with their work tasks and may use this document as a guide.

3.5.4 CAMP

A CAMP has been developed and describes the community air monitoring means and methods that will be implemented during activities conducted below the site-wide soil cover system (Appendix G).

3.5.5 QAPP

The QAPP presents the project scope and goals, organization, objectives, sample handling procedures and specific quality assurance/quality control (QA/QC) procedures. Furthermore, the QAPP identifies project responsibilities, prescribes guidance and specifications to make certain that:

- Samples are identified and controlled through sample tracking systems and chain-of custody protocols;
- Field and laboratory analytical results are valid and usable by adherence to established protocols and procedures;
- Laboratory data are validated so they can be applied to developing a conceptual understanding of the nature and extent of contamination of soils and ground waters at the Site; and
- All aspects of the investigation, from field to laboratory are documented to provide data that are technically sound and legally defensible.

The requirements of this QAPP apply to all contractor activities as appropriate for their respective tasks. This QAPP was prepared based upon guidance provided by the United States Environmental Protection Agency (USEPA) and NYSDEC including DER-10, Technical Guidance for Site Investigation and Remediation, New York State Department of Environmental Conservation, May 2010. The QAPP is included as Appendix H.

3.5.6 Field Sampling Plan

The Field Sampling Plan (FSP) provides the applicable procedures for collecting, transporting, and logging analytical samples. The FSP is a companion document to the QAPP described in Section 3.4.5 and is included as Appendix I.

3.6 Maintenance of Site Access Controls

Access to the Site is currently controlled by existing fences. Control of access to the Site is to be maintained. Responsibility for maintenance of site access controls *(e.g.*, fences) is per the Matrix of Responsibility (Table 7).

3.7 Notification of the Department

As stated in Section 1.3, NYSDEC must be notified in advance of all intrusive work performed at the Site. Responsibility for notifications to the Department, including those described in Section 1.3 of this ISMP, is per the Matrix of Responsibility (Table 7).

4.0 MONITORING PLAN

4.1 General

This Monitoring Plan describes the measures for evaluating the overall performance and effectiveness of the remedy. This Monitoring Plan may only be revised with the approval of the NYSDEC project manager.

This Monitoring Plan describes the methods to be used for:

- Evaluating Site information periodically to confirm that the remedy continues to be effective in protecting public health and the environment.

To adequately address this issue, this Monitoring Plan provides information on:

- NAPL gauging and recovery; and
- Annual inspection.

Reporting requirements are provided in Section 6.0 of this ISMP.

4.2 Site – wide Inspection

Site-wide inspections will be performed annually by a Qualified Environmental Professional (QEP) or their designee. These periodic inspections must be conducted when the ground surface is visible *(i.e*. no snow cover). Site-wide inspections will be performed by a qualified environmental professional as defined in 6 NYCRR Part 375, a PE who is licensed and registered in New York State, or a qualified person who directly reports to a PE who is licensed and registered in New York State. Modification to the frequency or duration of the inspections will require approval from the NYSDEC project manager. Site-wide inspections will also be performed after all severe weather conditions that may affect ECs. During these inspections, an inspection form will be completed as provided in Appendix J – Site Management Forms. The form will compile sufficient information to assess the following:

- Compliance with all ICs, including site usage;
- An evaluation of the condition and continued effectiveness of ECs;
- General site conditions at the time of the inspection; and

- The interim site management activities being conducted.

A comprehensive site-wide inspection will be conducted and documented according to the ISMP schedule. The site-wide inspections will determine and document the following:

- Whether ECs continue to perform as designed;
- If these controls continue to be protective of human health and the environment; and
- Compliance with requirements of this ISMP and the Environmental Easement.

Reporting requirements are outlined in Section 6.0 of this plan.

Inspections will also be performed in the event of an emergency. If an emergency, such as a natural disaster or an unforeseen failure of any of the ECs occurs that reduces or has the potential to reduce the effectiveness of ECs in place at the Site, verbal notice to the NYSDEC project manager must be given by noon of the following day. In addition, an inspection of the Site will be conducted by a QEP within five days of the event (to the extent possible) to verify the effectiveness of the IC/ECs implemented at the Site, as defined in 6 NYCCR Part 375. Written confirmation must be provided to the NYSDEC project manager within 7 days of the event (to the extent possible) that includes a summary of actions taken, or to be taken, and the potential impact to the environment and the public.

4.3 NAPL Gauging and Recovery

Recovery wells shall be gauged for NAPL on a routine basis. The NAPL Recovery Plan is included as Appendix K. Modification to the frequency will require approval from the NYSDEC.

4.4 Monitoring Protocol

All activities performed by a QEP or their designee will be recorded in a field book or associated monitoring log as provided in Appendix J - Site Management Forms. Additional detail regarding monitoring protocols are provided in the site-specific Field Sampling Plan provided as Appendix I of this document.

5.0 OPERATION AND MAINTENANCE PLAN

5.1 General

This Operation and Maintenance Plan provides a brief description of the measures necessary to operate, monitor and maintain the NAPL Recovery Well System for the Site. This Operation and Maintenance Plan:

- Includes the procedures necessary to allow individuals unfamiliar with the Site to operate and maintain the NAPL Recovery Wells;
- Will be updated periodically to reflect changes in Site conditions or the manner in which the NAPL Recovery Well system is operated and maintained.

Further detail regarding the Operation and Maintenance of the NAPL Recovery Well System is provided in Appendix K - NAPL Recovery Plan. This NAPL Recovery Plan is not to be used as a stand-alone document, but as a component document of this ISMP.

5.2 Operation and Maintenance of NAPL Recovery Well System

Operation and maintenance of the NAPL Recovery Well System will be performed in accordance with the NAPL Recovery Plan provided in Appendix K. The operation and monitoring consist of periodic gauging of NAPL levels in the NAPL recovery wells and pumping NAPL for disposal off-site.

NAPL shall be collected at a frequency designed to prevent overflow of sumps, using accumulation rates based on data collected during recent gauging events. NAPL collection shall be performed immediately following gauging activities, unless 1) no NAPL is observed during gauging or 2) the measured NAPL level in the well plus the anticipated accumulation, based on recently collected data, will be less than the height of the sump by the next recovery event. Approximate volume of NAPL expected shall be calculated based on the gauging data prior to NAPL removal. NAPL shall be recovered via pumping using a peristaltic pump or an inertial hydrolift pump (i.e., a Waterra Pump), with the extracted NAPL directed into a drum. Extraction shall continue until relatively NAPL-free liquid is recovered.

Periodic recovery well maintenance is required to maintain sufficient well yield to promote NAPL recovery and mitigate NAPL migration. Well screens can become clogged by NAPL over time which may prevent the inflow of NAPL. It may be considered necessary to undertake well rehabilitation to restore screen functionality and sump capacity. In addition, if it is determined or suspected that recovery wells are compromised and no longer functioning as intended, it may be necessary to undertake well decommissioning and reinstallation activities in order to maintain an adequate well network for NAPL recovery. Prior to commencing well maintenance activities, a work plan will be submitted to NYSDEC for review and approval.

The NAPL Recovery Well System will not be discontinued unless prior written approval is granted by NYSDEC. In the event that monitoring data indicates that the NAPL Recovery Well System is no longer required, a proposal to discontinue the system will be submitted by the remedial party. The NAPL Recovery Well System will remain in place and OMM will continue until permission to discontinue and abandon the system is granted in writing by NYSDEC.

6.0 PERIODIC ASSESSMENTS/EVALUATIONS

6.1 Climate Change Vulnerability Assessment

Increases in both the severity and frequency of storms/weather events, an increase in sea level elevations along with accompanying flooding impacts, shifting precipitation patterns and wide temperature fluctuation, resulting from global climactic change and instability, have the potential to significantly impact the performance, effectiveness and protectiveness of a given site and associated remedial systems. Vulnerability assessments provide information so that the site and associated remedial systems are prepared for the impacts of the increasing frequency and intensity of severe storms/weather events and associated flooding.

This Site is within the 500-year floodplain and therefore vulnerable to sea level rise. Given the depth of impacts at the Site, it is not anticipated that flooding would cause any release of contaminants from the Site.

7.0 REPORTING REQUIREMENTS

7.1 Interim Site Management Monitoring/Inspection Reports

All interim site management inspection, maintenance and monitoring events will be recorded on the appropriate site management forms provided in Appendix J. These forms are subject to revision by NYSDEC for use on the Site. All site management inspection, maintenance, and monitoring events will be conducted by a QEP as defined in 6 NYCRR Part 375, a PE who is licensed and registered in New York State, or a qualified person who directly reports to a PE who is licensed and registered in New York State.

All applicable inspection forms and other records generated for the Site during the reporting period will be provided in electronic format to the NYSDEC by the QEP in accordance with the requirements of Table 8.

All interim monitoring/inspections reports will include, at a minimum:

- Date of event or reporting period;
- Name, company, and position of person(s) conducting monitoring/inspection activities;
- Description of the activities performed;
- Where appropriate, color photographs or sketches showing the approximate location of any problems or incidents noted (included either on the checklist/form or on an attached sheet);
- Copies of all field forms completed (e.g., NAPL gauging logs, site inspection forms);
- Any observations, conclusions, or recommendations; and
- A determination as to whether environmental conditions have changed since the last reporting event.

Non-routine maintenance event reporting forms will include, at a minimum:

- Date of event;
- Name, company, and position of person(s) conducting non-routine maintenance/repair activities;
- Description of non-routine activities performed;

- Where appropriate, color photographs or sketches showing the approximate location of any problems or incidents (included either on the form or on an attached sheet); and

- Other documentation such as copies of invoices for repair work, receipts for replacement equipment, etc. (attached to the checklist/form).

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TABLES

Table 1. Site Property Owner
Interim Site Management Plan
Williamsburg Works Site
Brooklyn, New York

Property Address	35 Kent Avenue Brooklyn, NY 11249	50 Kent Avenue Brooklyn, NY 11249	20 N. 12th Street Brooklyn, NY 11249	2 N. 12th Street Brooklyn, NY 11249
Owner/ Occupant	North 12th Associates	New York City Department of Parks and Recreation	New York City Department of Parks and Recreation	New York City Department of Parks and Recreation
Block and Lot Number	Block 2288 Lot 1	Block 2287 Lot 1	Block 2287 Lot 16	Block 2287 Lot 30
Parcel Number	1	2	3	4
Current Zoning	M1-2	M3-1	M3-1	M3-1

Table 2. Notifications
Interim Site Management Plan
Williamsburg Works Site
Brooklyn, New York

Name	Contact Information	Required Notification
Gerald Pratt NYSDEC Project Manager	(518) 402-8246 gerald.pratt@dec.ny.gov	All Notifications
Samsudeen (Sam) Arakhan NYSDEC Regional HW Engineer	(718) 482-4931 samsudeen.arakhan@dec.ny.gov	All Notifications
Kelly Lewandowski Chief, NYSDEC Site Control	(518) 402-9569 kelly.lewandowski@dec.ny.gov	Notifications 1 and 8
Arunesh Ghosh NYSDOH Project Manager	(518) 402-7860 beei@health.ny.gov	Notifications 4, 6, and 7
Donald Campbell National Grid Project Manager	(718) 963-5453 donald.campbell@nationalgrid.com	All Notifications

Notes:
Notifications are subject to change and will be updated as necessary.
Numbers in this column reference the numbered bullets in the notification list in this section.

Table 3. Groundwater Depths and Elevations
Interim Site Management Plan
Williamsburg Works Site
Brooklyn, New York

Monitoring Well	GS Elevation (feet)	TOC Elevation (feet)	Depth to Bottom (feet)		Screen Depth (feet)		Screen Elevation (feet)		Well Diameter (inches)	Round 1: November 2, 2009					Round 2: December 19, 2012					Round 3: March 19, 2019				
										Groundwater Depth from TOC (feet)		Groundwater Elevation (feet)		Elevation Difference of Tides (feet)	Groundwater Depth from TOC (feet)		Groundwater Elevation (feet)		Elevation Difference of Tides (feet)	Groundwater Depth from TOC (feet)		Groundwater Elevation (feet)		Elevation Difference of Tides (feet)
			From GS	From TOC	Top	Bottom	Top	Bottom		High Tide	Low Tide	High Tide	Low Tide		High Tide	Low Tide	High Tide	Low Tide		High Tide	Low Tide	High Tide	Low Tide	
East River TBM	7.36		NA	NA	NA	NA	NA	NA	NA	3.09	8.79	4.27	-1.43	5.70	5.30	8.68	2.06	-1.32	3.38	2.80	--	4.56	--	--
WW-MW-01	21.37	21.05	25	24.68	13	23	8.37	-1.63	2	14.68	14.65	6.37	6.40	-0.03	--	--	--	--	--	--	--	--	--	--
WW-MW-02	19.03	18.59	17.7	17.26	7.4	17.4	11.63	1.63	2	11.68	11.66	6.91	6.93	-0.02	12.21	12.20	6.38	6.39	-0.01	11.72	11.65	7.31	7.38	-0.07
WW-MW-03	14	13.69	16	15.69	4	14	10.00	0.00	2	7.56	7.51	6.13	6.18	-0.05	7.85	7.82	5.84	5.87	-0.03	7.26	7.40	6.74	6.60	0.14
WW-MW-04	13.36	12.71	22	21.35	10	20	3.36	-6.64	2	5.37	5.35	7.34	7.36	-0.02	--	--	--	--	--	--	--	--	--	--
WW-MW-05	12.7	12.05	16	15.35	4	14	8.70	-1.30	2	4.61	4.52	7.44	7.53	-0.09	5.31	5.18	6.74	6.87	-0.13	--	--	--	--	--
WW-MW-06	12.18	11.81	12.3	11.93	0.3	10.3	11.88	1.88	2	4.07	4.00	7.74	7.81	-0.07	3.68	3.65	8.13	8.16	-0.03	--	--	--	--	--
WW-MW-07	12.35	11.84	13	12.49	1	11	11.35	1.35	2	2.26	2.30	9.58	9.54	0.04	2.68	2.64	9.16	9.20	-0.04	--	--	--	--	--
WW-MW-08	10.17	9.89	12.3	12.02	0.3	10.3	9.87	-0.13	2	4.08	3.99	5.81	5.90	-0.09	4.11	4.08	5.78	5.81	-0.03	--	--	--	--	--
WW-MW-10	8.11	7.67	16	15.56	4	14	4.11	-5.89	2	3.82	3.96	3.85	3.71	0.14	4.36	4.31	3.31	3.36	-0.05	3.63	3.89	4.48	4.22	0.26
WW-MW-11	9.2	8.72	16	15.52	4	14	5.20	-4.80	2	5.88	5.84	2.84	2.88	-0.04	6.04	6.03	2.68	2.69	-0.01	6.12	6.12	3.08	3.08	0.00
WW-MW-12	7.89	7.42	17	16.53	5	15	2.89	-7.11	2	4.75	4.62	2.67	2.80	-0.13	4.98	4.90	2.44	2.52	-0.08	5.06	5.15	2.83	2.74	0.09
WW-MW-13	7.26	6.89	16	15.63	4	14	3.26	-6.74	2	4.19	5.74	2.70	1.15	1.55	5.15	5.97	1.74	0.92	0.82	5.27	5.75	1.99	1.51	0.48
WW-MW-14	6.75	6.38	16	15.63	4	14	2.75	-7.25	2	2.46	5.51	3.92	0.87	3.05	5.16	8.94	1.22	-2.56	3.78	4.08	5.80	2.67	0.95	1.72
WW-MW-15	6.35	5.94	16	15.59	4	14	2.35	-7.65	2	3.00	4.80	2.94	1.14	1.80	4.61	4.76	1.33	1.18	0.15	4.92	5.58	1.43	0.77	0.66
WW-MW-16	10.06	9.73	16	15.67	4	14	6.06	-3.94	2	3.02	3.00	6.71	6.73	-0.02	4.29	4.31	5.44	5.42	0.02	3.94	3.90	6.12	6.16	-0.04
WW-MW-17	11.79	11.25	16	15.46	4	14	7.79	-2.21	2	4.50	4.50	6.75	6.75	0.00	4.45	4.42	6.80	6.83	-0.03	--	--	--	--	--
WW-MW-18	8.72	8.50	14	13.78	4	14	4.72	-5.28	2	--	--	--	--	--	2.51	2.61	5.99	5.89	0.10	--	--	--	--	--
WW-MW-19	7.13	6.83	14	13.7	4	14	3.13	-6.87	2	--	--	--	--	--	2.68	3.98	4.15	2.85	1.30	--	--	--	--	--
WW-MW-20	16.13	15.49	16	15.36	6	16	10.13	0.13	2	--	--	--	--	--	9.42	9.44	6.07	6.05	0.02	--	--	--	--	--
WW-MW-21	10.98	10.72	20	19.74	8	18	2.98	-7.02	2	--	--	--	--	--	4.40	4.70	6.32	6.02	0.30	4.90	4.86	6.08	6.12	-0.04
WW-MW-22	7.38	7.10	16	15.72	4	14	3.38	-6.62	2	--	--	--	--	--	5.59	6.37	1.51	0.73	0.78	5.77	5.42	1.61	1.96	-0.35
WW-MW-100I	11.04	10.51	58.5	57.97	46.5	56.5	-35.46	-45.46	2	--	--	--	--	--	8.31	8.30	2.20	2.21	-0.01	--	--	--	--	--
WW-MW-102I	11.64	11.07	61	60.43	49	59	-37.36	-47.36	2	--	--	--	--	--	7.12	7.11	3.95	3.96	-0.01	--	--	--	--	--
WW-MW-102D	11.73	10.98	102	101.25	92	102	-80.27	-90.27	2	--	--	--	--	--	8.18	8.20	2.80	2.78	0.02	--	--	--	--	--

Notes:
-- Measurement not collected. 2009 round, all wells had not been installed. 2012 round, wells could not be located.
NA - Not Applicable
GS - Ground Surface
TOC - Top of Casing
Elevations in North American Vertical Datum (NAVD)

Table 4. Remaining Soil Analytical Results
Interim Site Management Plan
Williamsburg Works Site
Brooklyn, New York

Location:	Unrestricted SCO	Industrial SCO	Parcel 1 [Block 2288 Lot 1]															N. 11th St. ROW				N. 12th St. ROW				N. 11th St. ROW		N. 12th St. ROW	
Sample Name:			WW-SB-19	WW-SB-19	WW-SB-19	WW-SB-19	WW-SB-19	WW-SB-20	WW-SB-20	Duplicate of WW-SB-20	WW-SB-20	WW-SB-21	WW-SB-21	WW-SB-21	WW-SB-22	WW-SB-22	WW-SB-22	WW-SB-22	WW-MW-02	Duplicate of WW-MW-02	WW-MW-02	WW-MW-02	WW-MW-03	WW-MW-03	WW-MW-03	Duplicate of WW-MW-03	WW-SB-01	WW-SB-01	WW-SB-02	WW-SB-02
Sample Depth(ft bgs):			(2-3)	(4-5)	(14-15)	(25-35)	(47-50)	(3-5)	(55-57)	(55-57)	(62-63)	(1-2)	(33-34)	(68-69)	(3-4)	(13-15)	(37-38)	(65-65.5)	(2-5)	(2-5)	(15-17)	(50-53)	(2-5)	(28-30)	(60-63)	(60-63)	(1-5)	(14-15)	(2-5)	(10.5-11.5)
a			7/27/2009	7/6/2009	7/28/2009	7/29/2009	7/29/2009	6/29/2009	7/21/2009	7/21/2009	7/21/2009	7/1/2009	7/22/2009	7/22/2009	6/29/2009	7/1/2009	7/24/2009	7/27/2009	7/10/2009	7/10/2009	7/10/2009	7/13/2009	6/23/2009	6/24/2009	6/26/2009	6/26/2009	7/10/2009	7/10/2009	7/8/2009	7/8/2009
BTEX (mg/kg)																														
Benzene	0.06	89	0.006 U	0.006 U	0.03 U	0.032 U	0.0061 U	0.0057 U	**13**	**9**	**0.02**	0.0057 U	**23**	0.0061 UJ	0.0055 U	0.0059 U	**90**	**0.027**	0.0058 U	0.0059 U	0.0059 U	0.0061 U	**0.0069**	**17**	**0.0097**	**0.0092**	0.0058 U	0.0055 U	**0.0014 J**	**0.012 J**
Toluene	0.7	1000	**0.037**	0.006 U	0.03 U	0.032 U	0.0061 U	**0.00016 J**	**16**	**20**	0.0064 U	0.0057 U	**17**	0.0061 U	**0.00058 J**	0.0059 U	**200**	**0.062**	0.0058 U	0.0059 U	**0.00033 J**	0.0061 U	0.0057 U	**160**	**0.026 J**	0.0053 U	0.0058 U	0.0055 U	**0.0012 J**	0.03 U
Ethylbenzene	1	780	**0.0091**	0.006 U	**0.0095 J**	**0.058**	**0.0071**	0.0057 U	**35**	**58**	**0.026**	0.0057 U	**160**	0.0061 UJ	0.0055 U	0.0059 U	**150**	**0.022**	0.0058 U	0.0059 U	0.0059 U	0.0061 U	0.0057 U	**290**	**0.033 J**	**0.011 J**	0.0058 U	0.0055 U	0.006 U	**0.11 J**
Total Xylene	0.26	1000	**0.055**	0.006 U	**0.058**	**0.049**	**0.042**	0.0057 U	**42 J**	**71 J**	**0.03**	0.0057 U	**170**	0.0061 UJ	**0.00086 J**	0.0059 U	**260**	**0.054**	0.0058 U	0.0059 U	0.0059 U	0.0061 U	0.0057 U	**420**	**0.046 J**	0.0053 U	0.0058 U	**0.001 J**	0.006 U	**0.02 J**
Total BTEX	NE	NE	**0.1011**	ND	**0.0675**	**0.107**	**0.0491**	**0.00016**	**106**	**158**	**0.076**	ND	**370**	ND	**0.00144**	ND	**700**	**0.165**	ND	ND	**0.00033**	ND	**0.0069**	**887**	**0.1147**	**0.0202**	ND	**0.001**	**0.0026**	**0.142**
Other VOCs (mg/kg)																														
Acetone	0.05	1000	0.024 U	0.024 UJ	0.12 U	**0.042 J**	**0.0064 J**	0.023 UJ	3.3 UJ	6.2 UJ	0.026 UJ	0.023 UJ	16 U	0.024 UJ	0.022 UJ	0.023 UJ	30 U	0.026 U	**0.005 J**	0.024 UJ	0.024 UJ	0.024 UJ	0.023 U	31 U	0.025 U	0.021 U	0.023 UJ	**0.064 J**	0.024 UJ	0.12 UJ
Carbon disulfide	NE	NE	0.006 U	0.006 U	0.03 U	0.032 U	0.0061 U	0.0057 U	1.3 U	2.5 U	0.0064 U	0.0057 UJ	6.3 U	0.0061 UJ	0.0055 U	**0.0011 J**	12 U	**0.0014 J**	0.0058 U	0.0059 U	**0.0014 J**	0.0061 UJ	0.0057 U	13 U	**0.0018 J**	0.0053 U	0.0058 U	**0.0016 J**	0.006 U	0.03 U
Chloroform	0.37	700	0.006 U	0.006 U	0.03 U	0.032 U	**0.00047 J**	0.0057 U	1.3 U	2.5 U	0.0064 U	0.0057 U	6.3 U	0.0061 U	0.0055 U	0.0059 U	12 U	0.0065 U	0.0058 U	0.0059 U	0.0059 U	0.0061 U	0.0057 U	13 U	0.0062 U	0.0053 U	0.0058 U	0.0055 U	0.006 U	0.03 U
cis-1,2-Dichloroethene	0.25	1000	0.006 U	0.006 U	0.03 U	**0.0045 J**	0.0061 U	0.0057 U	1.3 U	2.5 U	**0.0015 J**	0.0057 U	6.3 U	0.0061 UJ	0.0055 U	0.0059 U	12 U	0.0065 U	0.0058 U	0.0059 U	0.0059 U	0.0061 U	0.0057 U	13 U	0.0062 U	0.0053 U	0.0058 U	0.0055 U	0.006 U	0.03 U
trans-1,2-Dichloroethene	0.19	1000	0.006 U	0.006 U	0.03 U	**0.01 J**	0.0061 U	0.0057 U	1.3 U	2.5 U	0.0064 U	0.0057 U	6.3 U	0.0061 U	**0.00071 J**	0.0059 U	12 U	0.0065 U	0.0058 U	0.0059 U	0.0059 U	0.0061 U	0.0057 U	13 U	0.0062 U	0.0053 U	0.0058 U	0.0055 U	0.006 U	0.03 U
2-Butanone (Methyl ethyl ketone)	0.12	1000	0.012 U	0.012 U	0.059 U	0.065 U	0.012 UJ	0.011 U	1.3 UJ	2.5 UJ	0.013 U	0.011 U	6.3 U	0.012 UJ	0.011 U	0.012 U	12 U	0.013 U	0.012 U	0.012 U	0.012 U	0.012 UJ	0.011 U	13 U	0.012 U	0.011 U	0.012 U	0.011 U	0.012 U	0.059 U
Methylene chloride	0.05	1000	0.024 U	0.024 U	0.12 U	0.13 U	0.024 U	0.023 U	1.3 U	2.5 U	0.026 U	0.023 U	6.3 U	0.024 UJ	0.022 U	0.023 U	12 U	0.026 U	0.023 UJ	0.024 U	0.024 U	0.024 U	0.023 U	13 U	0.025 U	0.021 U	0.023 UJ	0.022 UJ	0.024 U	0.12 U
Styrene	NE	NE	0.006 U	0.006 U	0.03 U	0.032 U	0.0061 U	0.0057 U	1.3 U	2.5 U	0.0064 U	0.0057 U	6.3 U	0.0061 UJ	0.0055 U	0.0059 U	**26**	0.0065 U	0.0058 U	0.0059 U	0.0059 U	0.0061 U	0.0057 U	13 U	0.0062 U	0.0053 U	0.0058 U	0.0055 U	0.006 U	0.03 U
1,1,2,2-Tetrachloroethane	NE	NE	0.006 U	0.006 U	0.03 U	0.032 U	0.0061 UJ	0.0057 U	1.3 U	2.5 U	0.0064 U	0.0057 U	6.3 U	0.0061 U	0.0055 U	0.0059 U	12 U	0.0065 U	0.0058 U	0.0059 U	0.0059 U	0.0061 U	0.0057 U	13 U	0.0062 U	0.0053 U	0.0058 U	**0.03 J**	0.006 U	**0.2 J**
Tetrachloroethene (PCE)	1.3	300	0.006 U	0.006 U	0.03 U	0.032 U	0.0061 U	0.0057 U	1.3 U	2.5 U	0.0064 U	0.0057 U	6.3 U	0.0061 UJ	0.0055 U	0.0059 U	12 U	0.0065 U	0.0058 U	0.0059 U	0.0059 U	0.0061 U	0.0057 U	13 U	0.0062 U	0.0053 U	0.0058 U	0.0055 U	0.006 U	0.03 U
1,1,2-Trichloroethane	NE	NE	0.006 U	0.006 U	0.03 U	0.032 U	0.0061 U	0.0057 U	1.3 U	2.5 U	0.0064 U	0.0057 U	6.3 U	0.0061 U	0.0055 U	0.0059 U	12 U	0.0065 U	0.0058 U	0.0059 U	0.0059 U	0.0061 U	0.0057 U	13 U	0.0062 U	0.0053 U	0.0058 U	0.0055 U	0.006 U	0.03 U
Trichloroethene (TCE)	0.47	400	0.006 U	0.006 U	0.03 U	**0.0053 J**	0.0061 U	0.0057 U	1.3 U	2.5 U	0.0064 U	0.0057 U	6.3 U	0.0061 UJ	0.0055 U	0.0059 U	12 U	0.0065 U	0.0058 U	0.0059 U	0.0059 U	0.0061 U	0.0057 U	13 U	0.0062 U	0.0053 U	0.0058 U	0.0055 U	0.006 U	0.03 U
Total VOC	NE	NE	**0.1011**	ND	**0.0675**	**0.1688**	**0.05597**	**0.00016**	**106**	**158**	**0.0775**	ND	**370**	ND	**0.00215**	**0.0011**	**726**	**0.1664**	**0.005**	ND	**0.00173**	ND	**0.0069**	**887**	**0.1165**	**0.0202**	ND	**0.0966**	**0.0026**	**0.342**
PAHs (mg/kg)																														
Acenaphthene	20	1000	**0.27 J**	**0.96**	0.32 U	**0.57**	0.33 U	0.61 U	**27 J**	**130 J**	**0.054 J**	**0.062 J**	**33**	0.32 U	**0.3 J**	0.31 U	**9.5 J**	0.35 U	**0.25 J**	**0.29 J**	**0.89 J**	0.33 U	**0.18 J**	**72**	0.33 U	**0.046 J**	0.31 U	**0.69 J**	0.32 U	**1.1 J**
Acenaphthylene	100	1000	**3.6**	**1.7**	0.32 U	0.35 U	0.33 U	0.61 U	**5.9 J**	**29 J**	**0.028 J**	**0.7**	**4.8 J**	0.32 U	**0.78**	0.31 U	**100**	0.35 U	**5.9**	**7.2**	**0.18 J**	0.33 U	**0.42**	**17 J**	0.33 U	**0.018 J**	0.31 U	0.3 UJ	**0.027 J**	0.32 UJ
Anthracene	100	1000	**2.4**	**3.1**	**0.55**	**0.42**	0.33 U	0.61 U	**14 J**	**63 J**	**0.039 J**	**0.33**	**15**	0.32 U	**1.9**	0.31 U	**40 J**	0.35 U	**2.7**	**2.9**	**0.27 J**	0.33 U	**0.59**	**38 J**	0.33 U	**0.027 J**	0.31 U	**1.1 J**	**0.051 J**	**0.87 J**
Benz[a]anthracene	1	11	**2.4**	**4.7**	**0.21 J**	**0.13 J**	0.33 U	0.61 U	**6.8 J**	**32 J**	**0.028 J**	**0.67**	**7.7**	0.32 U	**5.7**	0.31 U	**20 J**	0.35 U	**4.4**	**3.7**	**2 J**	0.33 U	**1.7**	**19 J**	0.33 U	**0.015 J**	0.31 U	**0.34 J**	**0.26 J**	**0.51 J**
Benzo[a]pyrene	1	1.1	**4.5**	**5.4**	**0.11 J**	**0.061 J**	0.33 U	0.61 U	**4.9 J**	**22 J**	**0.02 J**	**0.93**	**5.2 J**	0.32 U	**7.3**	0.31 U	**15 J**	0.35 U	**6.5**	**8.8**	**0.76 J**	0.33 U	**1.9**	**14 J**	0.33 U	**0.0081 J**	0.31 U	**0.14 J**	**0.43**	**0.37 J**
Benzo[b]fluoranthene	1	11	**3.2**	**4.6**	**0.061 J**	**0.033 J**	0.33 U	0.61 U	**2.8 J**	**14 J**	0.34 U	**0.92**	**3.1 J**	0.32 U	**6**	0.31 U	**13 J**	0.35 U	**6.2**	**7.3**	**0.84 J**	0.33 U	**1.7**	**8.7 J**	0.33 U	0.28 U	0.31 U	**0.069 J**	**0.34**	**0.27 J**
Benzo[k]fluoranthene	0.8	110	**1.2**	**1.4**	0.32 U	0.35 U	0.33 U	0.61 U	**1.2 J**	67 U	0.34 U	**0.3 J**	**1.6 J**	0.32 U	**2.3**	0.31 U	65 U	0.35 U	**2.3**	**2.6**	**0.29 J**	0.33 U	**0.64**	66 U	0.33 U	0.28 U	0.31 U	0.3 UJ	**0.13 J**	**0.09 J**
Benzo[g,h,i]perylene	100	1000	**1.1**	**3.6**	**0.048 J**	0.35 U	0.33 U	0.61 U	**1.9 J**	**8.1 J**	**0.42**	**0.93**	**1.4 J**	0.32 U	**5.2**	0.31 U	65 U	0.35 U	**3.2**	**3.2**	**0.18 J**	0.33 U	**1**	**4.5 J**	0.33 U	0.28 U	0.31 U	**0.31 J**	**0.61**	**0.18 J**
Chrysene	1	110	**3.3**	**5.1**	**0.26 J**	**0.18 J**	0.33 U	0.61 U	**6.6 J**	**29 J**	0.34 U	**0.81**	**7.5**	0.32 U	**5.9**	0.31 U	**19 J**	0.35 U	**5.7**	**4.7**	**1.7 J**	0.33 U	**1.6**	**18 J**	0.33 U	0.28 U	0.31 U	**0.45 J**	**0.27 J**	**0.5 J**
Dibenz[a,h]anthracene	0.33	1.1	**0.63**	**1.2**	0.32 U	0.35 U	0.33 U	0.61 U	7 U	67 U	0.34 U	**0.31**	6.8 U	0.32 U	**1.7**	0.31 U	65 U	0.35 U	**1.4**	**1.4**	**0.21 J**	0.33 U	**0.52**	66 U	0.33 U	0.28 U	0.31 U	**0.21 J**	**0.46**	**0.12 J**
Fluoranthene	100	1000	**2.8**	**9.1**	**0.21 J**	**0.12 J**	0.33 U	**0.049 J**	**11 J**	**50 J**	**0.035 J**	**0.86**	**13**	0.32 U	**9.4**	0.31 U	**38 J**	0.35 U	**5.8 J**	**4 J**	**9.9 J**	0.33 U	**2.5**	**32 J**	0.33 U	**0.021 J**	0.31 U	**0.29 J**	**0.28 J**	**0.86 J**
Fluorene	30	1000	**0.8**	**1.5**	**0.64**	**0.27 J**	0.33 U	0.61 U	**15 J**	**73 J**	**0.035 J**	**0.073 J**	**17**	0.32 U	**0.57 J**	0.31 U	**52 J**	0.35 U	**0.82**	**0.88**	**0.74 J**	0.33 U	**0.22 J**	**43 J**	0.33 U	**0.035 J**	0.31 U	**0.8 J**	0.32 U	**0.93 J**
Indeno[1,2,3-cd]pyrene	0.5	11	**1.3**	**3.8**	**0.037 J**	0.35 U	0.33 U	0.61 U	**1.5 J**	**6.6 J**	**0.39**	**0.95**	**1.2 J**	0.32 U	**6**	0.31 U	65 U	0.35 U	**3.2**	**3.4**	**0.22 J**	0.33 U	**1.2**	**46 J**	0.33 U	0.28 U	0.31 U	**0.25 J**	**0.63**	**0.2 J**
2-Methylnaphthalene	NE	NE	**0.15 J**	**0.58 J**	0.32 U	**0.85**	0.33 U	0.61 U	**74 J**	**390 J**	**0.12 J**	**0.043 J**	**76**	0.32 U	**0.46 J**	0.31 U	**280**	0.35 U	**0.36 J**	**0.27 J**	0.64 UJ	0.33 U	**0.14 J**	**270**	**0.044 J**	**0.24 J**	0.31 U	0.3 UJ	**0.049 J**	**2.1 J**
Naphthalene	12	1000	0.32 U	**0.89**	0.32 U	**2.4**	0.33 U	0.61 U	**120 J**	**760 J**	0.34 U	**0.068 J**	**120**	0.32 U	**1.1**	0.31 U	**840**	0.35 U	**0.51 J**	**0.4 J**	0.64 UJ	0.33 U	**0.38**	**1000**	**0.19 J**	**1.2 J**	0.31 U	0.3 UJ	**0.082 J**	**1.1 J**
Phenanthrene	100	1000	**2.5**	**9**	**2.1**	**0.89**	0.33 U	0.61 U	**47 J**	**220 J**	**0.12 J**	**0.51**	**50**	0.32 U	**7.5**	0.31 U	**130**	0.35 U	**4.4 J**	**2.1 J**	**0.05 J**	0.33 U	**2.6**	**130**	**0.023 J**	**0.11 J**	0.31 U	**2.8 J**	**0.18 J**	**2.4 J**
Pyrene	100	1000	**5**	**8.9**	**0.64**	**0.36**	0.33 U	**0.054 J**	**18 J**	**84 J**	**0.051 J**	**1.2**	**20**	0.32 U	**9.2**	0.31 U	**36 J**	0.35 U	**7.8**	**5.9**	**6.6 J**	0.33 U	**3.8**	**55 J**	0.33 U	**0.034 J**	0.31 U	**1 J**	**0.34**	**1.5 J**
Total PAHs	NE	500	**35.15**	**65.53**	**4.866**	**6.284**	ND	**0.103**	**357.6**	**1910.7**	**1.34**	**9.666**	**376.5**	ND	**71.31**	ND	**1592.5**	ND	**61.44**	**59.04**	**24.83**	ND	**21.09**	**1767.2**	**0.257**	**1.7541**	ND	**8.449**	**4.139**	**13.1**
Other SVOCs (mg/kg)																														
Bis(2-ethylhexyl)phthalate	NE	NE	0.32 U	**0.12 J**	0.32 U	0.35 U	0.33 U	**8.9**	7 U	67 U	0.34 U	**3.7 J**	6.8 U	**0.048 J**	**4.7**	**0.11 J**	65 U	0.35 U	0.61 U	0.63 U	**0.11 J**	**0.11 J**	**0.95**	66 U	0.33 U	0.28 U	**0.48 J**	**0.63 J**	**0.5**	**0.18 J**
Butyl benzyl phthalate	NE	NE	0.32 U	0.63 U	0.32 U	0.35 U	0.33 U	**0.051 J**	7 U	67 U	0.34 U	0.31 U	6.8 U	0.32 U	0.6 U	0.31 U	65 U	0.35 U	0.61 U	0.63 U	0.64 UJ	0.33 U	0.31 U	66 U	0.33 U	0.28 U	**0.12 J**	0.3 UJ	**0.13 J**	0.32 UJ
Carbazole	NE	NE	**0.31 J**	**0.95**	0.32 U	0.35 U	0.33 U	0.61 U	**0.56 J**	67 U	0.34 U	**0.079 J**	**0.45 J**	0.32 U	**0.77**	0.31 U	65 U	0.35 U	**0.37 J**	**0.43 J**	0.64 UJ	0.33 U	**0.2 J**	66 U	0.33 U	0.28 U	0.31 U	0.3 UJ	0.32 U	0.32 UJ
Dibenzofuran	7	1000	**0.2 J**	**0.93**	0.32 U	**0.073 J**	0.33 U	0.61 U	**1.7 J**	9.4 J	0.34 U	**0.031 J**	**2 J**	0.32 U	**0.56 J**	0.31 U	8.3 J	0.35 U	**0.17 J**	**0.12 J**	0.64 UJ	0.33 U	**0.11 J**	**6 J**	0.33 U	0.28 U	0.31 U	0.3 UJ	0.32 U	**0.47 J**
2,4-Dimethylphenol	NE	NE	0.32 U	0.63 U	0.32 U	0.35 U	0.33 U	0.61 U	7 U	67 U	0.34 U	0.31 U	6.8 U	0.32 U	0.6 U	0.31 U	65 U	0.35 U	0.61 U	0.63 U	0.64 UJ	0.33 U	0.31 U	66 U	0.33 U	0.28 U	0.31 U	0.3 UJ	0.32 U	0.32 UJ
Di-n-butyl phthalate	NE	NE	0.32 U	0.63 U	0.32 U	0.35 U	0.33 U	0.61 U	7 U	67 U	0.34 U	0.31 U	6.8 U	0.32 U	0.6 U	0.31 U	65 U	0.35 U	0.61 U	0.63 U	0.64 UJ	0.33 U	0.31 U	66 U	0.33 U	0.28 U	0.31 U	0.3 UJ	0.32 U	0.32 UJ
2-Methylphenol (o-Cresol)	0.33	1000	0.32 U	0.63 U	0.32 U	0.35 U	0.33 U	0.61 U	7 U	67 U	0.34 U	0.31 U	6.8 U	0.32 U	0.6 U	0.31 U	65 U	0.35 U	0.61 U	0.63 U	0.64 UJ	0.33 U	0.31 U	66 U	0.33 U	0.28 U	0.31 U	0.3 UJ	0.32 U	0.32 UJ
4-Methylphenol (p-Cresol)	0.33	1000	0.32 U	0.63 U	0.32 U	0.35 U	0.33 U	0.61 U	7 U	67 U	0.34 U	0.31 U	6.8 U	0.32 U	0.6 U	0.31 U	65 U	0.35 U	0.61 U	0.63 U	0.64 UJ	0.33 U	0.31 U	66 U	0.33 U	0.28 U	0.31 U	0.3 UJ	0.32 U	0.32 UJ
4-Nitroaniline	NE	NE	**0.38**	0.63 U	0.32 U	0.35 U	0.33 U	0.61 U	7 U	67 U	0.34 U	0.31 U	6.8 U	0.32 U	0.6 U	0.31 U	65 U	0.35 U	0.61 U	0.63 U	0.64 UJ	0.33 U	0.31 U	66 U	0.33 U	0.28 U	0.31 U	0.3 UJ	0.32 U	0.32 UJ
Phenol	0.33	1000	0.32 U	0.63 U	0.32 U	0.35 U	0.33 U	0.61 U	7 U	67 U	0.34 U	0.31 U	6.8 U	0.32 U	**0.043 J**	0.31 U	65 U	0.35 U	0.61 U	0.63 U	0.64 UJ	0.33 U	0.31 U	66 U	0.33 U	0.28 U	0.31 U	0.3 UJ	0.32 U	0.32 UJ
Total SVOC	NE	NE	**36.04**	**67.53**	**4.866**	**6.357**	ND	**9.054**	**359.86**	**1920.1**	**1.34**	**13.476**	**378.95**	**0.048**	**77.383**	**0.11**	**1600.8**	ND	**61.98**	**59.59**	**24.94**	**0.11**	**22.35**	**1773.2**	**0.257**	**1.7541**	**0.6**	**9.079**	**4.769**	**13.75**
PCBs (mg/kg)																														
Aroclor 1248	NE	NE	0.02 UJ	0.02 U	NA	NA	NA	0.019 U	NA	NA	NA	0.019 U	NA	NA	0.019 U	NA	NA	NA	0.02 U	0.02 U	NA	NA	0.019 U	NA	NA	NA	0.02 U	NA	0.02 U	NA
Aroclor 1254	NE	NE	0.02 UJ	0.02 U	NA	NA	NA	0.019 U	NA	NA	NA	0.019 U	NA	NA	0.019 U	NA	NA	NA	0.02 U	0.02 U	NA	NA	0.019 U	NA	NA	NA	0.02 U	NA	0.02 U	NA
Aroclor 1260	NE	NE	0.02 UJ	**0.017 J**	NA	NA	NA	0.019 U	NA	NA	NA	**0.012 J**	NA	NA	0.019 U	NA	NA	NA	0.02 U	0.02 U	NA	NA	**0.023 JN**	NA	NA	NA	0.02 U	NA	**0.0067 J**	NA
Aroclor 1268	NE	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total PCBs	NE	NE	ND	**0.017**	NA	NA	NA	ND	NA	NA	NA	**0.012**	NA	NA	ND	NA	NA	NA	ND	ND	NA	NA	**0.023**	NA	NA	NA	ND	NA	**0.0067**	NA
Pesticides (mg/kg)																														
Aldrin	0.005	1.4	0.002 U	0.002 UJ	NA	NA	NA	0.0019 UJ	NA	NA	NA	0.0019 UJ	NA	NA	0.0019 UJ	NA	NA	NA	0.002 U	0.002 U	NA	NA	0.0019 U	NA	NA	NA	0.002 U	NA	0.002 UJ	NA
beta-BHC	0.036	14	0.002 U	0.002 UJ	NA	NA	NA	0.0019 UJ	NA	NA	NA	0.0019 UJ	NA	NA	0.0019 UJ	NA	NA	NA	0.002 U	0.002 U	NA	NA	0.0019 UJ	NA	NA	NA	0.002 U	NA	0.002 UJ	NA
gamma-BHC	0.1	23	0.002 U	0.002 UJ	NA	NA	NA	0.0019 UJ	NA	NA	NA	0.0019 UJ	NA	NA	0.0019 UJ	NA	NA	NA	0.002 U	0.002 U	NA	NA	0.0019 U	NA	NA	NA	0.002 U	NA	0.002 UJ	NA
delta-BHC	0.04	1000	0.002 UJ	0.002 UJ	NA	NA	NA	0.0019 U	NA	NA	NA	0.0019 UJ	NA	NA	0.0019 U	NA	NA	NA	0.002 U	0.002 U	NA	NA	0.0019 U	NA	NA	NA	0.002 U	NA	0.002 UJ	NA
alpha-chlordane	0.094	47	0.002 U	0.002 UJ	NA	NA	NA	0.0019 UJ	NA	NA	NA	0.0019 UJ	NA	NA	0.0019 UJ	NA	NA	NA	0.002 U	0.002 U	NA	NA	0.0019 U	NA	NA	NA	0.002 U	NA	0.002 UJ	NA
gamma-Chlordane	NE	NE	0.002 U	**0.00084 J**	NA	NA	NA	0.0019 U	NA	NA	NA	**0.0021 J**	NA	NA	0.0019 U	NA	NA	NA	0.002 U	0.002 U	NA	NA	**0.0031 J**	NA	NA	NA	0.002 U	NA	**0.00088 J**	NA
4,4-DDD	0.0033	180	0.004 UJ	0.004 U	NA	NA	NA	0.0038 U	NA	NA	NA	0.0037 U	NA	NA	0.0036 U	NA	NA	NA	**0.037 J**	**0.034 J**	NA	NA	0.0038 UJ	NA	NA	NA	0.0038 U	NA	0.0039 U	NA
4,4'-DDE	0.0033	120	0.004 UJ	0.004 UJ	NA	NA	NA	0.0038 U	NA	NA	NA	0.0037 UJ	NA	NA	0.0036 U	NA	NA	NA	0.0038 U	0.0039 U	NA	NA	0.0038 U	NA	NA	NA	0.0038 U	NA	0.0039 UJ	NA
4,4'-DDT	0.0033	94	**0.064 J**	0.004 UJ	NA	NA	NA	0.0038 UJ	NA	NA	NA	0.0037 UJ	NA	NA	**0.0047 J**	NA	NA	NA	**0.015 J**	**0.034 J**	NA	NA	**0.0099 JN**	NA	NA	NA	0.0038 U	NA	**0.002 J**	NA
Dieldrin	0.005	2.8	**0.0054 J**	0.004 U	NA	NA	NA	0.0038 U	NA	NA	NA	**0.002 J**	NA	NA	0.0036 U	NA	NA	NA	0.0038 U	0.0039 U	NA	NA	**0.0057 J**	NA	NA	NA	0.0038 U	NA	0.0039 U	NA
Endosulfan I	2.4	920	0.002 U	0.002 U	NA	NA	NA	0.0019 UJ	NA	NA	NA	0.0019 UJ	NA	NA	0.0019 UJ	NA	NA	NA	0.002 U	0.002 U	NA	NA	**0.0084 J**	NA	NA	NA	0.002 U	NA	0.002 UJ	NA
Endosulfan II	2.4	920	**0.011 JN**	0.004 UJ	NA	NA	NA	0.0038 UJ	NA	NA	NA	**0.0064 JN**	NA	NA	**0.0035 J**	NA	NA	NA	**0.01 J**	0.0039 U	NA	NA	**0.01 J**	NA	NA	NA	0.0038 U	NA	0.0039 U	NA
Endosulfan sulfate	2.4	920	0.004 UJ	0.004 UJ	NA	NA	NA	0.0038 U	NA	NA	NA	0.0037 UJ	NA	NA	0.0036 U	NA	NA	NA	**0.012 JN**	**0.011 J**	NA	NA	**0.0093 JN**	NA	NA	NA	0.0038 U	NA	0.0039 UJ	NA
Endrin	0.014	410	**0.011 JN**	0.004 UJ	NA	NA	NA	0.0038 U	NA	NA	NA	0.0037 UJ	NA	NA	0.0036 U	NA	NA	NA	0.0038 U	0.0039 U	NA	NA	**0.0046 JN**	NA	NA	NA	0.0038 U	NA	0.0039 UJ	NA
Endrin aldehyde	NE	NE	**0.017 JN**	**0.0023 J**	NA	NA	NA	0.0038 UJ	NA	NA	NA	**0.0082 J**	NA	NA	**0.0093 J**	NA	NA	NA	**0.01 JN**	**0.013 J**	NA	NA	**0.011 J**	NA	NA	NA	0.0038 U	NA	0.0039 U	NA
Endrin ketone	NE	NE	**0.015 JN**	0.004 UJ	NA	NA	NA	0.0038 U	NA	NA	NA	0.0037 UJ	NA	NA	0.0036 U	NA	NA	NA	**0.024 J**	**0.036 J**	NA	NA	**0.015 J**	NA	NA	NA	0.0038 U	NA	0.0039 UJ	NA
Heptachlor	0.042	29	0.002 UJ	**0.00045 J**	NA	NA	NA	0.0019 U	NA	NA	NA	**0.0015 J**	NA	NA	0.0019 U	NA	NA	NA	0.002 U	0.002 U	NA	NA	0.0019 U	NA	NA	NA	0.002 U	NA	0.002 UJ	NA
Heptachlor epoxide	NE	NE	0.002 U	0.002 UJ	NA	NA	NA	0.0019 U	NA	NA	NA	0.0019 UJ	NA	NA	0.0019 U	NA	NA	NA	**0.0036 JN**	**0.0033 J**	NA	NA	0.0019 U	NA	NA	NA	0.002 U	NA	**0.00076 J**	NA
Methoxychlor	NE	NE	**0.045 JN**	0.02 UJ	NA	NA	NA	0.019 U	NA	NA	NA	0.019 UJ	NA	NA	0.019 U	NA	NA	NA	0.02 U	0.02 U	NA	NA	**0.017 J**	NA	NA	NA	0.02 U	NA	0.02 UJ	NA

Table 4. Remaining Soil Analytical Results
Interim Site Management Plan
Williamsburg Works Site
Brooklyn, New York

Location:	Unrestricted SCO	Industrial SCO	Parcel 1 [Block 2288 Lot 1]																N. 11th St. ROW				N. 12th St. ROW				N. 11th St. ROW		N. 12th St. ROW	
Sample Name:			WW-SB-19	WW-SB-19	WW-SB-19	WW-SB-19	WW-SB-19	WW-SB-20	WW-SB-20	Duplicate of WW-SB-20	WW-SB-20	WW-SB-21	WW-SB-21	WW-SB-21	WW-SB-22	WW-SB-22	WW-SB-22	WW-SB-22	WW-MW-02	Duplicate of WW-MW-02	WW-MW-02	WW-MW-02	WW-MW-03	WW-MW-03	WW-MW-03	Duplicate of WW-MW-03	WW-SB-01	WW-SB-01	WW-SB-02	WW-SB-02
Sample Depth(ft bgs):			(2-3)	(4-5)	(14-15)	(25-35)	(47-50)	(3-5)	(55-57)	(55-57)	(62-63)	(1-2)	(33-34)	(68-69)	(3-4)	(13-15)	(37-38)	(65-65.5)	(2-5)	(2-5)	(15-17)	(50-53)	(2-5)	(28-30)	(60-63)	(60-63)	(1-5)	(14-15)	(2-5)	(10.5-11.5)
a			7/27/2009	7/6/2009	7/28/2009	7/29/2009	7/29/2009	6/29/2009	7/21/2009	7/21/2009	7/21/2009	7/1/2009	7/22/2009	7/22/2009	6/29/2009	7/1/2009	7/24/2009	7/27/2009	7/10/2009	7/10/2009	7/10/2009	7/13/2009	6/23/2009	6/24/2009	6/26/2009	6/26/2009	7/10/2009	7/10/2009	7/8/2009	7/8/2009
Metals (mg/kg)																														
Aluminum	NE	NE	**10100**	**8780**	**9390**	**3680**	**2980**	**9750**	**2350**	**1970**	**3570**	**6980**	**2820**	**1330**	**7350**	**10900**	**3570**	**3530**	**8230**	**9380**	**2990**	**5080**	**7820**	**3090**	**2600**	**2910**	**10000**	**7320**	**7350**	**3950**
Arsenic	13	16	6.1 UJ	**7.1 J**	**2.2 J**	6.7 U	6.1 U	**6.2 J**	6.8 U	6.2 U	6.7 U	**12.4 J**	6.6 U	6.1 U	**8.5 J**	6 U	6.4 U	6.8 U	**8.9 J**	**7.2 J**	5.9 UJ	**4.3 J**	**7.8 J**	**2 J**	**3.4 J**	**2.7 J**	**2.7 J**	5.6 UJ	**5.9 J**	6.2 UJ
Barium	350	10000	**102**	**139**	**54.1**	**24.1**	**28.6**	**366 J**	**12.2**	**9**	**29.7**	**160 J**	**19.2**	**14.1**	**158 J**	**94.2 J**	**30.7**	**26.9**	**193**	**189**	**15.4**	**40.4**	**159 J**	**20.8 J**	**17.1 J**	**16.2 J**	**32.6**	**152**	**83.7**	**32**
Beryllium	7.2	2700	**0.75 J**	**0.76 J**	**0.52 J**	**0.34 J**	**0.5 J**	**0.39 J**	**0.22 J**	**0.18 J**	**0.45 J**	**0.41 J**	**0.38 J**	**0.41 J**	**0.49 J**	**0.9 J**	**0.43 J**	**0.64 J**	**0.68 J**	**0.7 J**	**0.46 J**	**0.43 J**	**0.4 J**	**0.25 J**	**0.58 J**	**0.58 J**	**0.6 J**	**0.85 J**	**0.6 J**	**0.34 J**
Cadmium	2.5	60	**0.49 J**	1.5 UJ	1.4 UJ	1.6 UJ	1.4 UJ	1.4 U	**1.1 J**	**0.94 J**	**0.6 J**	**0.64 J**	**0.55 J**	1.5 UJ	**0.56 J**	1.4 UJ	**0.53 J**	1.6 UJ	1.4 UJ	1.5 UJ	1.4 UJ	1.5 UJ	**0.6 J**	1.5 U	1.6 UJ	1.3 UJ	1.4 UJ	1.3 UJ	1.5 UJ	1.5 U
Calcium	NE	NE	**3010 J**	**4550 J**	**4300 J**	**1000 J**	**951 J**	**40600**	80.9 U	74.1 U	79.7 U	**46200**	78.2 U	73.1 U	**4130**	**2220**	75.7 U	**843 J**	**16900 J**	**2860 J**	**647 J**	75.9 U	**15100 J**	**1320 J**	**554 J**	**499 J**	**694 J**	**2420 J**	**22200 J**	**10900 J**
Chromium	NE	NE	**16.1 J**	**17.1 J**	**29.3 J**	**10.4 J**	**11.8 J**	**13.7 J**	**6.6 J**	**7.4 J**	**11.7 J**	**16 J**	**11.7 J**	**8.6 J**	**16.2 J**	**30.6 J**	**15.8 J**	**20.5 J**	**18.9 J**	**33 J**	**14.2 J**	**16.1**	**14.8 J**	**9.4 J**	**14.1 J**	**16.5 J**	**16.5 J**	**14.9 J**	**19.9 J**	**11.6 J**
Cobalt	NE	NE	**7.1**	**9.5**	**10.6**	**5.3**	**4.5 J**	**3 J**	**3.8**	**2.9**	**5.5**	**24.6 J**	**3.7**	**4.5 J**	**18.7 J**	**10.6 J**	**7.2**	**4.4 J**	**7.4**	**9.1**	**6.4**	**3.4 J**	**5.2**	**4.7**	**4.8 J**	**4.6 J**	**8.8**	**7.8**	**8.4**	**3.2**
Copper	50	10000	**49.6**	**51.1 J**	**42.2**	**9.9**	**11.9**	**7.7**	**8.6**	**6**	**11.5**	**27.5 J**	**8.4**	**9.9**	**54.7 J**	**24.4 J**	**14.9**	**14.6**	**59.7 J**	**62.7 J**	**11 J**	**11.3 J**	**50 J**	**7.6 J**	**10 J**	**9.6 J**	**12.9 J**	**6.8 J**	**31.7 J**	**12.3 J**
Iron	NE	NE	**20900**	**22700**	**25400**	**12800**	**38800**	**7780**	**12300**	**8930**	**19500**	**18600**	**12000**	**36200**	**20600**	**29500**	**13700**	**44700**	**20100**	**21000**	**28600**	**38300 J**	**14000**	**8850**	**40300**	**38800**	**21200**	**24900**	**27500**	**13000**
Lead	63	3900	**191**	**311**	**9.1**	**5**	**6.7**	**762 J**	**6.6 J**	**5.4 J**	**8.4 J**	**839 J**	**6.8 J**	**6.9 J**	**190 J**	**6.2 J**	**6.6 J**	**8.2 J**	**320**	**232**	**7.8 J**	**16 J**	**459 J**	**6.5 J**	**6.5 J**	**6.2 J**	**8.2**	4 UJ	**75.9**	**19.1**
Magnesium	NE	NE	**2760 J**	**2290**	**2790 J**	**1200 J**	**630 J**	**14800**	**962 J**	**787 J**	**1150 J**	**5780**	**921 J**	73.1 UJ	**3030**	**5830**	**1220 J**	**564 J**	**6580 J**	**2410 J**	**977**	**1510**	**3820**	**1140**	**540**	**475**	**2690**	**4720**	**5680**	**1640**
Manganese	1600	10000	**231**	**600**	**765**	**193**	**445**	**387**	**245 J**	**120 J**	**481**	**375**	**82.6**	**935**	**458**	**715**	**331**	**483**	**233**	**295**	**378**	**162**	**261**	**196**	**550**	**409**	**512**	**528**	**604**	**268**
Mercury	0.18	5.7	**0.34**	**1.4**	0.056 U	0.062 U	0.057 U	**0.098 J**	0.063 U	0.058 U	0.061 U	**0.53 J**	0.062 U	0.06 U	**0.24 J**	0.057 UJ	0.056 U	**0.011 J**	**0.55**	**0.62**	**0.0059 J**	**0.012 J**	**0.65 J**	**0.0055 J**	**0.008 J**	0.053 UJ	**0.024**	0.053 U	**0.1**	**0.033**
Nickel	30	10000	**15.5**	**17.5**	**17.7**	**6.7**	**6.3**	**11.4**	**5.7**	**5**	**7.5**	**15.7**	**6.7**	**3.9 J**	**19.3**	**18.9**	**8.9**	**7.1 J**	**18.6**	**16.3**	**13**	**5.6**	**13.2 J**	**8.6 J**	**5.8 J**	**5.5 J**	**14.9**	**9.6**	**15.4**	**7.2**
Potassium	NE	NE	**822 J**	**852 J**	**1520 J**	**561 J**	**411 J**	**1040**	80.9 U	74.1 U	**620**	**1220**	**476**	73.1 U	**1340**	**2910**	**603**	**523 J**	**919 J**	**852 J**	**454 J**	**1190 J**	**1150 J**	**576 J**	**271 J**	**227 J**	**898 J**	**3710 J**	**1170 J**	**518 J**
Selenium	3.9	6800	11 UJ	11.1 UJ	10.7 UJ	12 UJ	10.9 UJ	R	12.1 UJ	11.1 UJ	12 UJ	R	11.7 UJ	**10.5 J**	R	R	11.4 UJ	**8.1 J**	10.4 UJ	10.9 UJ	**7.7 J**	11.4 UJ	10.4 U	11.2 U	11.6 UJ	**4.6 J**	10.5 UJ	**6.4 J**	11 UJ	11 UJ
Silver	2	6800	1.5 UJ	1.5 UJ	**0.54 J**	1.6 U	1.4 UJ	**0.075 J**	1.6 U	1.5 U	1.6 U	1.4 UJ	**0.12 J**	**0.15 J**	**0.28 J**	1.4 UJ	**0.29 J**	**0.25 J**	1.4 UJ	1.5 UJ	**0.14 J**	1.5 UJ	**0.27 J**	1.5 U	**0.53 J**	**0.38 J**	1.4 UJ	**0.11 J**	1.5 UJ	1.5 UJ
Sodium	NE	NE	73.2 UJ	**73.7 J**	**1050 J**	**85.3 J**	**45.6 J**	**1110 J**	80.9 UJ	74.1 UJ	79.7 UJ	**833 J**	78.2 UJ	73.1 UJ	**213 J**	**92.3 J**	75.7 UJ	81.2 UJ	**210**	**152**	70.4 UJ	75.9 U	**595 J**	**71 J**	77.6 U	65.8 U	**89.1**	66.7 UJ	**324**	73.6 U
Thallium	NE	NE	4.4 UJ	4.4 U	4.3 UJ	4.8 UJ	**3.7 J**	4.1 UJ	4.9 U	4.4 U	4.8 U	**2.8 J**	4.7 U	4.4 UJ	4 UJ	4.3 UJ	4.5 U	4.9 UJ	4.2 U	4.4 U	4.2 U	4.6 U	4.2 U	4.5 U	4.7 UJ	3.9 UJ	4.2 U	4 U	4.4 U	4.4 U
Vanadium	NE	NE	**37.2**	**24.4**	**54.1**	**20.3**	**21.7**	**18.8**	**11 J**	**10 J**	**19.2 J**	**22.1**	**28.1 J**	**20.2 J**	**23.2**	**52.3**	**26.2 J**	**23.6 J**	**22.6**	**21.1**	**19.9**	**24.3**	**21 J**	**16.5 J**	**27.4**	**25.5 J**	**23.7**	**41.5**	**32.5**	**15.1**
Zinc	109	10000	**182**	**232**	**38.2**	**24**	**25 J**	**142 J**	**14.5 J**	**11 J**	**28.8 J**	**262 J**	**18.7 J**	**24.2 J**	**270 J**	**63.4 J**	**21.1 J**	**30.8**	**190**	**166**	**24.8**	**27.6**	**258 J**	**19.5 J**	**33**	**31.1 J**	**37.8**	**44.9**	**119**	**30.4**
Cyanides (mg/kg)																														
Free Cyanide	NE	NE	0.241 U	0.238 U	0.231 U	0.257 U	0.241 U	0.227 U	0.26 U	0.246 U	0.254 U	**0.0456 J**	0.25 U	0.241 U	0.22 U	0.234 U	0.241 U	0.258 U	0.229 U	0.234 U	0.236 UJ	0.241 U	0.229 U	0.25 U	0.248 U	0.21 U	0.232 U	0.222 UJ	0.237 U	0.235 UJ
Other (mg/kg)																														
Ammonia	NE	NE	**4.6 J**	2.4 U	**20.2**	**5.4 J**	2.4 U	**1.5 J**	NA	NA	NA	**1.4 J**	**14.9**	2.4 U	**1.7 J**	**7.5**	**16.3**	**3.5 J**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 4. Remaining Soil Analytical Results
Interim Site Management Plan
Williamsburg Works Site
Brooklyn, New York

Location:	Unrestricted SCO	Restricted-Residential SCO	Parcel 2 [Block 2287 at 1]								Parcel 2 [Block 2287 at 1]																
Sample Name:			WW-MW-04	WW-MW-04	WW-MW-04	WW-MW-05	WW-MW-05	WW-MW-17	WW-MW-17	WW-SB-09	WW-SB-09	WW-SB-10	WW-SB-10	WW-SB-11	WW-SB-11	WW-SB-23	WW-SB-23	WW-SB-24	WW-SB-24	WW-SB-37	WW-SB-38	WW-SB-39	WW-SB-40	Duplicate of WW-SB-40	WW-SB-41	WW-SB-42	WW-SB-42
Sample Depth(ft bgs):			(5-10)	(31-33)	(58-59)	(12-13)	(63-64)	(7-8)	(54-55)	(11-12)	(53-54)	(49-50)	(51-52)	(50-51)	(63-64)	(31-33)	(62-63)	(38-40)	(53-55)	(96-97)	(96.5-97)	(96-97)	(95-95.5)	(95-95.5)	(96-97)	(62-62.5)	(96.5-97)
a			6/15/2009	6/15/2009	6/15/2009	6/10/2009	6/11/2009	6/8/2009	6/9/2009	7/13/2009	7/14/2009	7/15/2009	7/15/2009	7/14/2009	7/14/2009	7/17/2009	7/17/2009	7/16/2009	7/16/2009	12/28/2009	12/29/2009	12/30/2009	12/23/2009	12/23/2009	12/22/2009	12/22/2009	12/22/2009
BTEX (mg/kg)																											
Benzene	0.06	4.8	**0.021 J**	**62 J**	**0.0042 J**	**84**	0.0057 U	**0.37 J**	**0.13**	**0.73 J**	**14**	**87**	**2.8**	**0.25**	**0.0029 J**	**1100**	**13**	**840**	**0.063**	0.0058 U	0.0058 U	0.0059 U	0.0059 U	0.006 U	0.0058 U	**0.33 J**	0.0062 U
Toluene	0.7	100	**0.0014 J**	**220 J**	**0.003 J**	**220**	**0.00068 J**	**0.74 J**	**0.0027 J**	**7.6**	**15**	**180**	**1.2**	0.032 U	0.0061 U	**1800**	**32**	**1300**	**0.0033 J**	0.0058 U	**0.00019 J**	0.0059 U	0.0059 U	0.006 U	0.0058 U	**5**	0.0062 U
Ethylbenzene	1	41	0.0056 UJ	**220 J**	**0.018**	**320**	**0.002 J**	**15 J**	**0.12**	**38**	**16**	**43**	**1.5**	**0.028 J**	0.0061 U	**200**	**35**	**120**	**0.014**	0.0058 U	0.0058 U	0.0059 U	0.0059 U	0.006 U	0.0058 U	**2.5**	0.0062 U
Total Xylene	0.26	100	**0.0011 J**	**320 J**	**0.02**	**340**	**0.002 J**	**22 J**	**0.12**	**87**	**19**	**220**	**1.6**	**0.027 J**	0.0061 U	**1700**	**69**	**1200**	**0.014**	0.0058 U	0.0058 U	0.0059 U	**0.0019 J**	**0.00069 J**	0.0058 U	**18**	0.0062 U
Total BTEX	NE	NE	**0.0235**	**822**	**0.0452**	**964**	**0.00468**	**38.11**	**0.3727**	**133.33**	**64**	**530**	**7.1**	**0.305**	**0.0029**	**4800**	**149**	**3460**	**0.0943**	ND	**0.00019**	ND	**0.0019**	**0.00069**	ND	**25.83**	ND
Other VOCs (mg/kg)																											
Acetone	0.05	100	**0.048 J**	14 UJ	**0.039 J**	31 U	0.023 U	1.5 U	0.023 U	7.2 U	1.7 U	15 U	1.5 U	0.13 UJ	0.024 UJ	270 U	3 U	81 U	0.024 UJ	0.023 UJ	0.023 UJ	0.024 UJ	**0.0062 J**	**0.005 J**	0.023 U	2.8 UJ	0.025 U
Carbon disulfide	NE	NE	**0.0012 J**	**1.5 J**	0.0058 U	13 U	0.0057 U	0.59 U	0.0057 U	2.9 U	0.68 U	6 U	0.62 U	0.032 U	0.0061 U	110 U	1.2 U	33 U	0.0061 U	0.0058 U	0.0058 U	0.0059 U	0.0059 U	0.006 U	0.0058 UJ	1.1 U	0.0062 UJ
Chloroform	0.37	49	0.0056 UJ	5.8 UJ	0.0058 U	13 U	0.0057 U	0.59 U	0.0057 U	2.9 U	0.68 U	6 U	0.62 U	0.032 U	0.0061 U	110 U	1.2 U	33 U	0.0061 U	0.0058 U	0.0058 U	0.0059 U	**0.0016 J**	**0.0017 J**	0.0058 U	1.1 U	0.0062 U
cis-1,2-Dichloroethene	0.25	100	**0.0015 J**	5.8 UJ	0.0058 U	13 U	0.0057 U	0.59 U	0.0057 U	2.9 U	0.68 U	6 U	0.62 U	0.032 U	0.0061 U	110 U	1.2 U	33 U	0.0061 U	0.0058 U	0.0058 U	0.0059 U	0.0059 U	0.006 U	0.0058 U	1.1 U	0.0062 U
trans-1,2-Dichloroethene	0.19	100	0.0056 UJ	5.8 UJ	0.0058 U	13 U	0.0057 U	0.59 U	0.0057 U	2.9 U	0.68 U	6 U	0.62 U	0.032 U	0.0061 U	110 U	1.2 U	33 U	0.0061 U	0.0058 U	0.0058 U	0.0059 U	0.0059 U	0.006 U	0.0058 U	1.1 U	0.0062 U
2-Butanone (Methyl ethyl ketone)	0.12	100	0.011 UJ	5.8 UJ	0.012 U	13 U	0.011 U	0.59 U	0.011 U	2.9 U	0.68 U	6 U	0.62 U	0.063 U	0.012 U	110 U	1.2 U	33 U	0.012 U	0.012 U	0.012 U	0.012 U	0.012 U	0.012 U	0.012 U	1.1 UJ	0.012 U
Methylene chloride	0.05	100	0.022 UJ	5.8 UJ	0.023 U	13 U	0.023 U	0.59 U	0.023 U	2.9 U	0.68 U	6 U	0.62 U	0.13 U	0.024 U	110 U	1.2 U	33 U	0.024 U	0.023 U	0.023 U	0.024 U	0.024 U	0.024 U	**0.0022 J**	1.1 U	**0.0031 J**
Styrene	NE	NE	0.0056 UJ	**60 J**	0.0058 U	13 U	**0.00026 J**	**0.61 J**	0.0057 U	2.9 U	**0.24 J**	**150**	0.62 U	0.032 U	0.0061 U	**1100**	**21**	**1000**	**0.00019 J**	0.0058 U	0.0058 U	0.0059 U	**0.0009 J**	0.006 U	0.0058 U	**7.3**	0.0062 U
1,1,2,2-Tetrachloroethane	NE	NE	0.0056 UJ	5.8 UJ	0.0058 U	13 U	0.0057 U	0.59 U	0.0057 U	2.9 U	0.68 U	6 U	0.62 U	0.032 U	0.0061 U	110 U	1.2 U	33 U	0.0061 U	0.0058 U	0.0058 U	0.0059 U	0.0059 U	0.006 U	0.0058 U	1.1 U	0.0062 U
Tetrachloroethene (PCE)	1.3	19	0.0056 UJ	5.8 UJ	0.0058 U	13 U	0.0057 U	0.59 U	0.0057 U	2.9 U	0.68 U	6 U	0.62 U	0.032 U	0.0061 U	110 U	1.2 U	33 U	0.0061 U	0.0058 U	0.0058 U	0.0059 U	0.0059 U	0.006 U	0.0058 U	1.1 U	0.0062 U
1,1,2-Trichloroethane	NE	NE	0.0056 UJ	5.8 UJ	0.0058 U	13 U	0.0057 U	0.59 U	0.0057 U	2.9 U	0.68 U	6 U	0.62 U	0.032 U	0.0061 U	110 U	1.2 U	33 U	0.0061 U	0.0058 U	0.0058 U	0.0059 U	0.0059 U	0.006 U	0.0058 U	1.1 U	0.0062 U
Trichloroethene (TCE)	0.47	21	**0.0053 J**	5.8 UJ	0.0058 U	13 U	0.0057 U	0.59 U	0.0057 U	2.9 U	0.68 U	6 U	0.62 U	0.032 U	0.0061 U	110 U	1.2 U	33 U	0.0061 U	0.0058 U	0.0058 U	0.0059 U	0.0059 U	0.006 U	0.0058 U	1.1 U	0.0062 U
Total VOC	NE	NE	**0.0795**	**883.5**	**0.0842**	**964**	**0.00494**	**38.72**	**0.3727**	**133.33**	**64.24**	**680**	**7.1**	**0.305**	**0.0029**	**5900**	**170**	**4460**	**0.09449**	ND	**0.00019**	ND	**0.0106**	**0.00739**	**0.0022**	**33.13**	**0.0031**
PAHs (mg/kg)																											
Acenaphthene	20	100	0.3 U	**31 J**	0.31 UJ	**73**	0.3 U	**95**	**0.36 J**	**24 J**	**0.55 J**	**20 J**	**0.21 J**	**0.055 J**	0.32 U	**400 J**	**5.1 J**	**44 J**	0.33 U	0.3 U	0.3 U	0.32 U	0.32 U	0.32 U	0.31 U	**1.5 J**	0.33 U
Acenaphthylene	100	100	**0.069 J**	**280**	0.31 UJ	**14 J**	**0.077 J**	**16 J**	**0.033 J**	**16 J**	**3.7**	**220**	1.7 U	0.34 U	0.32 U	**3200**	**32**	**470**	0.33 U	0.3 U	0.3 U	0.32 U	0.32 U	0.32 U	0.31 U	**14**	0.33 U
Anthracene	100	100	**0.054 J**	**110 J**	0.31 UJ	**26 J**	**0.058 J**	**26 J**	0.61 U	**26 J**	**1.6**	**77**	1.7 U	0.34 U	0.32 U	**1300**	**14**	**140 J**	0.33 U	0.3 U	0.3 U	0.32 U	0.32 U	0.32 U	0.31 U	**6.1**	0.33 U
Benz[a]anthracene	1	1	**0.088 J**	**56 J**	0.31 UJ	**14 J**	**0.045 J**	**17 J**	0.61 U	**16 J**	**0.92 J**	**39 J**	1.7 U	0.34 U	0.32 U	**710 J**	**7.5**	**82 J**	0.33 U	0.3 U	0.3 U	0.32 U	0.32 U	0.32 U	0.31 U	**3.6 J**	0.33 U
Benzo[a]pyrene	1	1	**0.088 J**	**42 J**	0.31 UJ	**11 J**	0.3 U	**19 J**	0.61 U	**11 J**	**0.68 J**	**29 J**	1.7 U	0.34 U	0.32 U	**530 J**	**5.5 J**	**64 J**	0.33 U	0.3 U	0.3 U	0.32 U	0.32 U	0.32 U	0.31 U	**2.5 J**	0.33 U
Benzo[b]fluoranthene	1	1	**0.14 J**	**26 J**	0.31 UJ	**7.9 J**	0.3 U	**13 J**	0.61 U	**7.3 J**	**0.42 J**	**19 J**	1.7 U	0.34 U	0.32 U	**430 J**	**3.5 J**	**40 J**	0.33 U	0.3 U	0.3 U	0.32 U	0.32 U	0.32 U	0.31 U	**1.9 J**	0.33 U
Benzo[k]fluoranthene	0.8	100	**0.3 J**	**86 J**	0.31 UJ	33 U	0.3 U	**28 J**	0.61 U	**47 J**	**0.85 J**	**11 J**	1.7 U	0.34 U	0.32 U	**620 J**	**4.3 J**	**23 J**	0.33 U	0.3 U	0.3 U	0.32 U	0.32 U	0.32 U	0.31 U	**0.45 J**	0.33 U
Benzo[g,h,i]perylene	100	3.9	**0.046 J**	150 U	0.31 UJ	33 U	0.3 U	**5.2 J**	0.61 U	62 U	**0.15 J**	**6.4 J**	1.7 U	0.34 U	0.32 U	**140 J**	**1.1 J**	**21 J**	0.33 U	0.3 U	0.3 U	0.32 U	0.32 U	0.32 U	0.31 U	**0.81 J**	0.33 U
Chrysene	1	3.9	**0.1 J**	**56 J**	0.31 UJ	**12 J**	**0.038 J**	**16 J**	0.61 U	**15 J**	**0.88 J**	**36 J**	1.7 U	0.34 U	0.32 U	**700 J**	**6.9**	**78 J**	0.33 U	0.3 U	0.3 U	0.32 U	0.32 U	0.32 U	0.31 U	**3.6 J**	0.33 U
Dibenz[a,h]anthracene	0.33	0.33	**0.19 J**	150 U	0.31 UJ	33 U	0.3 U	**29 J**	0.61 U	62 U	1.5 U	64 U	1.7 U	0.34 U	0.32 U	1200 U	**2.9 J**	180 U	0.33 U	0.3 U	0.3 U	0.32 U	0.32 U	0.32 U	0.31 U	5.9 U	0.33 U
Fluoranthene	100	100	**0.13 J**	**88 J**	0.31 UJ	**25 J**	**0.065 J**	**26 J**	**0.032 J**	**25 J**	**1.5**	**69**	1.7 U	0.34 U	0.32 U	**1600**	**14**	**140 J**	0.33 U	0.3 U	0.3 U	0.32 U	0.32 U	0.32 U	0.31 U	**6.4**	0.33 U
Fluorene	30	100	**0.042 J**	**150**	0.31 UJ	**40**	**0.075 J**	**35**	0.61 U	**28 J**	**2**	**110**	1.7 U	0.34 U	0.32 U	**2000**	**19**	**220**	0.33 U	0.3 U	0.3 U	0.32 U	0.32 U	0.32 U	0.31 U	**9.5**	0.33 U
Indeno[1,2,3-cd]pyrene	0.5	0.5	**0.38**	150 U	0.31 UJ	**7.7 J**	0.3 U	**38**	0.61 U	**46 J**	**0.83 J**	**10 J**	1.7 U	0.34 U	0.32 U	1200 U	**4.2 J**	**24 J**	0.33 U	0.3 U	0.3 U	0.32 U	0.32 U	0.32 U	0.31 U	**0.54 J**	0.33 U
2-Methylnaphthalene	NE	NE	**0.1 J**	**790**	**0.072 J**	**200**	**0.18 J**	**320**	**1.4**	**250**	**7.5**	**550**	**2.3**	**0.14 J**	0.32 U	**7800**	**64**	**1200**	0.33 U	0.3 U	0.3 U	0.32 U	0.32 U	0.32 U	0.31 U	**45**	0.33 U
Naphthalene	12	100	**0.054 J**	**2100**	**0.13 J**	**500**	**0.27 J**	**540**	**7.3**	**610**	**15**	**1200**	**21**	**0.74**	0.32 U	**17000**	**120**	**3100**	0.33 U	0.3 U	0.3 U	0.32 U	0.32 U	0.32 U	0.31 U	**90**	0.33 U
Phenanthrene	100	100	**0.22 J**	**390**	**0.033 J**	**93**	**0.23 J**	**88**	**0.046 J**	**84**	**5.6**	**290**	1.7 U	0.34 U	0.32 U	**4800**	**50**	**540**	0.33 U	0.3 U	0.3 U	0.32 U	**0.019 J**	**0.035 J**	0.31 U	**22**	0.33 U
Pyrene	100	100	**0.23 J**	**150 J**	0.31 UJ	**36**	**0.11 J**	**29 J**	**0.03 J**	**37 J**	**2.3**	**110**	1.7 U	0.34 U	0.32 U	**1700**	**19**	**220**	0.33 U	0.3 U	0.3 U	0.32 U	0.32 U	0.32 U	0.31 U	**8.9**	0.33 U
Total PAHs	NE	NE	**2.231**	**4355**	**0.235**	**1059.6**	**1.148**	**1340.2**	**9.201**	**1242.3**	**44.48**	**2796.4**	**23.51**	**0.935**	ND	**42930**	**373**	**6406**	ND	ND	ND	ND	**0.019**	**0.035**	ND	**216.8**	ND
Other SVOCs (mg/kg)																											
Bis(2-ethylhexyl)phthalate	NE	NE	**0.15 J**	150 U	0.31 UJ	33 U	**0.031 J**	32 U	**0.73**	62 U	1.5 U	64 U	**0.36 J**	0.34 U	**0.042 J**	1200 U	6.5 U	180 U	**0.038 J**	**0.044 J**	0.3 U	0.32 U	0.32 U	0.32 U	0.31 U	5.9 U	0.33 U
Butyl benzyl phthalate	NE	NE	0.3 U	150 U	0.31 UJ	33 U	0.3 U	32 U	0.61 U	62 U	1.5 U	64 U	1.7 U	0.34 U	0.32 U	1200 U	6.5 U	180 U	0.33 U	0.3 U	0.3 U	0.32 U	0.32 U	0.32 U	0.31 U	5.9 U	0.33 U
Carbazole	NE	NE	0.3 U	150 U	0.31 UJ	33 U	0.3 U	32 U	0.61 U	62 U	1.5 U	64 U	1.7 U	0.34 U	0.32 U	1200 U	**0.77 J**	180 U	0.33 U	0.3 U	0.3 U	0.32 U	0.32 U	0.32 U	0.31 U	5.9 U	0.33 U
Dibenzofuran	7	59	0.3 U	**16 J**	0.31 UJ	**4.2 J**	0.3 U	32 U	0.61 U	**4.8 J**	1.5 U	**15 J**	1.7 U	0.34 U	0.32 U	**400 J**	**2.8 J**	**31 J**	0.33 U	0.3 U	0.3 U	0.32 U	0.32 U	0.32 U	0.31 U	**1.1 J**	0.33 U
2,4-Dimethylphenol	NE	NE	0.3 U	150 U	0.31 UJ	33 U	0.3 U	32 U	0.61 U	62 U	1.5 U	64 U	**0.75 J**	0.34 U	0.32 U	1200 U	6.5 U	180 U	0.33 U	0.3 U	0.3 U	0.32 U	0.32 U	0.32 U	0.31 U	5.9 U	0.33 U
Di-n-butyl phthalate	NE	NE	0.3 U	150 U	0.31 UJ	33 U	0.3 U	32 U	0.61 U	62 U	1.5 U	64 U	1.7 U	0.34 U	0.32 U	1200 U	6.5 U	180 U	0.33 U	0.3 U	0.3 U	0.32 U	0.32 U	0.32 U	0.31 U	5.9 U	0.33 U
2-Methylphenol (o-Cresol)	0.33	100	0.3 U	150 U	0.31 UJ	33 U	0.3 U	32 U	0.61 U	62 U	1.5 U	64 U	**0.55 J**	0.34 U	0.32 U	1200 U	6.5 U	180 U	0.33 U	0.3 U	0.3 U	0.32 U	0.32 U	0.32 U	0.31 U	5.9 U	0.33 U
4-Methylphenol (p-Cresol)	0.33	100	0.3 U	150 U	0.31 UJ	33 U	0.3 U	32 U	0.61 U	62 U	1.5 U	64 U	**0.52 J**	0.34 U	0.32 U	1200 U	6.5 U	180 U	0.33 U	0.3 U	0.3 U	0.32 U	0.32 U	0.32 U	0.31 U	5.9 U	0.33 U
4-Nitroaniline	NE	NE	0.3 U	150 U	0.31 UJ	33 U	0.3 U	32 U	0.61 U	62 U	1.5 U	64 U	1.7 U	0.34 U	0.32 U	1200 U	6.5 U	180 U	0.33 U	0.3 U	0.3 U	0.32 U	0.32 U	0.32 U	0.31 U	5.9 U	0.33 U
Phenol	0.33	100	0.3 U	150 U	0.31 UJ	33 U	0.3 U	32 U	0.61 U	62 U	1.5 U	64 U	1.7 U	**0.1 J**	0.32 U	1200 U	6.5 U	180 U	**0.23 J**	0.3 U	0.3 U	0.32 U	0.32 U	0.32 U	0.31 U	5.9 U	0.33 U
Total SVOC	NE	NE	**2.381**	**4371**	**0.235**	**1063.8**	**1.179**	**1340.2**	**9.931**	**1247.1**	**44.48**	**2811.4**	**25.69**	**1.035**	**0.042**	**43330**	**376.57**	**6437**	**0.268**	**0.044**	ND	ND	**0.019**	**0.035**	ND	**217.9**	ND
PCBs (mg/kg)																											
Aroclor 1248	NE	NE	0.019 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1254	NE	NE	0.019 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1260	NE	NE	**0.012 J**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1268	NE	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total PCBs	NE	NE	**0.012**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides (mg/kg)																											
Aldrin	0.005	0.097	0.0019 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
beta-BHC	0.036	0.36	0.0019 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
gamma-BHC	0.1	1.3	0.0019 UJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
delta-BHC	0.04	100	**0.00082 J**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
alpha-chlordane	0.094	4.2	0.0019 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
gamma-Chlordane	NE	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4-DDD	0.0033	13	0.0037 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE	0.0033	8.9	0.0037 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	0.0033	7.9	**0.0071 J**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	0.005	0.2	**0.0021 J**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan I	2.4	24	0.0019 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan II	2.4	24	0.0037 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan sulfate	2.4	24	0.0037 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endrin	0.014	11	0.0037 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endrin aldehyde	NE	NE	0.0037 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endrin ketone	NE	NE	0.0037 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor	0.042	2.1	0.0019 UJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor epoxide	NE	NE	0.0019 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methoxychlor	NE	NE	0.019 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 4. Remaining Soil Analytical Results
Interim Site Management Plan
Williamsburg Works Site
Brooklyn, New York

Location:	Unrestricted SCO	Restricted-Residential SCO	Parcel 2 [Block 2287 at 1]								Parcel 2 [Block 2287 at 1]																
Sample Name:			WW-MW-04	WW-MW-04	WW-MW-04	WW-MW-05	WW-MW-05	WW-MW-17	WW-MW-17	WW-SB-09	WW-SB-09	WW-SB-10	WW-SB-10	WW-SB-11	WW-SB-11	WW-SB-23	WW-SB-23	WW-SB-24	WW-SB-24	WW-SB-37	WW-SB-38	WW-SB-39	WW-SB-40	Duplicate of WW-SB-40	WW-SB-41	WW-SB-42	WW-SB-42
Sample Depth(ft bgs):			(5-10)	(31-33)	(58-59)	(12-13)	(63-64)	(7-8)	(54-55)	(11-12)	(53-54)	(49-50)	(51-52)	(50-51)	(63-64)	(31-33)	(62-63)	(38-40)	(53-55)	(96-97)	(96.5-97)	(96-97)	(95-95.5)	(95-95.5)	(96-97)	(62-62.5)	(96.5-97)
a			6/15/2009	6/15/2009	6/15/2009	6/10/2009	6/11/2009	6/8/2009	6/9/2009	7/13/2009	7/14/2009	7/15/2009	7/15/2009	7/14/2009	7/14/2009	7/17/2009	7/17/2009	7/16/2009	7/16/2009	12/28/2009	12/29/2009	12/30/2009	12/23/2009	12/23/2009	12/22/2009	12/22/2009	12/22/2009
Metals (mg/kg)																											
Aluminum	NE	NE	**5960 J**	**2580 J**	**2250 J**	7180	2650	7070	2430	7190	6740	4050	6850	3340	4090	2310	2770	3910	3710	915	845	13500	29700	26300	22000	3830	3400
Arsenic	13	16	**2.4 J**	5.8 UJ	5.8 UJ	**2.7 J**	5.8 UJ	**3.2 J**	6 UJ	5.9 UJ	7.1 UJ	6.3 UJ	**3.7 J**	**6.4 J**	6.2 UJ	**2.4 J**	6.1 UJ	6.8 UJ	6.2 UJ	28.9 U	**2.1 J**	6.2 UJ	6 U	6.2 U	6.1 UJ	28.8 U	**3.4**
Barium	350	400	**180 J**	**19.1 J**	**15.7 J**	**39.7**	**18.3**	**54.7**	**15.1**	**36.3**	**55.5**	**25.1**	**42.8**	**24.8**	**20.2**	**15.6**	**19.7**	**22.3**	**37.6**	**14.9**	**11.3**	**22.5**	**531**	**474**	**320**	**35.3 J**	**34.4**
Beryllium	7.2	72	**0.58 J**	**0.23 J**	**0.41 J**	**0.47 J**	**0.68 J**	**0.53 J**	**0.51 J**	**0.51 J**	**0.57 J**	**0.72 J**	**0.66 J**	**0.27 J**	**0.65 J**	**0.17 J**	**0.51 J**	**0.43 J**	**0.66 J**	**0.97 J**	**0.56 J**	**0.8 J**	**1.5**	**1.2 J**	**1.5**	**0.73 J**	**0.56 J**
Cadmium	2.5	4.3	1.4 UJ	1.4 U	1.4 UJ	1.5 U	1.4 UJ	1.5 U	1.4 UJ	1.4 U	1.7 U	1.5 UJ	1.5 U	1.5 U	1.5 UJ	1.3 U	1.4 UJ	1.6 U	1.5 UJ	6.9 U	1.4 U	1.5 UJ	1.4 UJ	1.5 UJ	1.4 UJ	6.9 UJ	**0.49 J**
Calcium	NE	NE	**63700 J**	**349 J**	**545 J**	**1040**	**413**	**14800**	**507**	70.2 U	84.3 U	74.7 U	76.4 U	76.7 U	73.8 U	65.1 U	72.5 U	81.3 U	73.8 U	**332 J**	**268 J**	**540 J**	**5010 J**	**5800 J**	**579 J**	**3060 J**	**469 J**
Chromium	NE	NE	**19.1 J**	**6.6 J**	**9.1 J**	**19.9**	**11.5**	**12.8**	**12.3**	**16.7**	**16.9**	**15.2**	**21.3**	**8.8**	**16.1**	**5.3**	**14.7**	**15.9**	**16.7**	**6.7 J**	**4.8**	**17.6**	**27.7**	**20.2**	**74**	**10.3 J**	**4.9**
Cobalt	NE	NE	**7.1 J**	**4.4 J**	**4.3 J**	**5.7 J**	**6.5 J**	**5.5 J**	**4.4 J**	**15.1**	**8.9**	**8**	**178**	**4.2**	**7.5 J**	**2.9**	**6 J**	**7.5**	**4.4 J**	**1.2 J**	**9.6 J**	**16.3 J**	**17.4 J**	**15.5 J**	**26.7 J**	**1.2 J**	**185 J**
Copper	50	270	**88**	**10.4**	**17.4 J**	**17.2**	**20.4**	**21**	**15.4**	**15.9**	**13.7**	**19.8**	**17.2**	**7.2**	**15.9 J**	**6.8**	**13.7**	**14.8**	**17.4 J**	**7.1**	**5.8**	**28.4**	**50.3**	**58.9**	**68.9**	**5.8 J**	**264**
Iron	NE	NE	**9400 J**	**10900 J**	**21700 J**	**15300**	**43800**	**15000**	**30500**	**17100 J**	**13700 J**	**28200 J**	**21200 J**	**8490 J**	**51400 J**	**6430 J**	**31400 J**	**19900 J**	**49200 J**	**439**	**3260**	**27800**	**41900**	**33400**	**42900**	**247000**	**19100**
Lead	63	400	**99.9**	**2.3 J**	**5.9**	**108 J**	**9.8 J**	**548 J**	**6.7 J**	4.2 U	5.1 U	4.5 UJ	**12.8**	4.6 U	4.4 UJ	3.9 U	4.3 UJ	4.9 U	4.4 UJ	20.6 U	**3.8 J**	**7 J**	**4.9**	**1.5 J**	**7.3**	**7.1 J**	**11.4**
Magnesium	NE	NE	**6070 J**	**911 J**	**640 J**	**2020**	**571**	**3810**	**513**	**2300**	**3770**	**1210**	**2310**	**1660**	73.8 U	**1520**	72.5 U	**1480**	73.8 U	**62.9 J**	**83.5**	**5600**	**10600**	**9350**	**10300**	**3850**	**265**
Manganese	1600	2000	**157 J**	**147 J**	**575 J**	**314**	**409**	**287**	**389**	**155**	**195**	**228**	**581**	**130**	**359**	**108**	**352**	**217**	**421**	**4.1 J**	**6.2**	**288**	**593**	**441**	**338**	**4820**	**11.3**
Mercury	0.18	0.81	**0.11**	0.056 U	0.057 U	**0.016 J**	0.055 U	**1.2**	0.053 U	**0.012 J**	**0.0068 J**	**0.01 J**	**0.022**	0.063 U	**0.0078 J**	0.051 U	0.061 U	**0.0074 J**	**0.022**	0.056 U	0.055 U	0.058 U	0.055 U	0.059 U	0.055 U	0.053 U	0.058 U
Nickel	30	310	**10 J**	**5.6 J**	**4.3 J**	**11.6**	**6.8**	**11.4**	**5.2**	**13**	**15.4**	**15.2**	**170**	**7.2**	**8.4**	**6.2**	**8.2**	**12.1**	**7.6**	6.9 U	**6.3 J**	**18.8 J**	**17.7 J**	**13.7 J**	**57.3 J**	**4.3 J**	**231 J**
Potassium	NE	NE	**543 J**	**424 J**	**332 J**	**710**	**347**	**927**	**282**	**1120 J**	**1770 J**	**643 J**	**1030 J**	**825 J**	73.8 UJ	**409 J**	72.5 UJ	**627 J**	**607 J**	688 UJ	**32.4 J**	**2980**	**13400**	**10500**	**9740**	**492**	**43.7 J**
Selenium	3.9	180	R	R	R	11.2 UJ	10.4 UJ	11.1 UJ	10.7 UJ	10.5 U	12.6 U	11.2 UJ	11.5 U	11.5 U	11.1 UJ	9.8 U	10.9 UJ	12.2 U	11.1 UJ	51.6 U	10.7 U	11 UJ	10.7 UJ	11.1 UJ	10.8 UJ	51.5 UJ	11.2 U
Silver	2	180	1.4 UJ	1.4 U	1.4 UJ	1.5 U	1.4 UJ	1.5 U	1.4 UJ	1.4 U	1.7 U	1.5 UJ	**0.14 J**	1.5 U	**0.15 J**	1.3 U	**0.3 J**	**0.12 J**	**0.22 J**	6.9 U	1.4 U	1.5 UJ	1.4 UJ	1.5 UJ	1.4 UJ	6.9 UJ	1.5 U
Sodium	NE	NE	**604**	68.7 U	69.5 U	**1210**	**57.6 J**	**362**	**48.9 J**	70.2 U	84.3 U	74.7 U	76.4 U	76.7 U	73.8 U	65.1 U	72.5 U	81.3 U	73.8 U	688 U	142 U	**1110**	**549 J**	**1030 J**	**232 J**	687 U	**46.3 J**
Thallium	NE	NE	4.1 U	4.1 U	4.2 U	4.5 U	4.2 U	**1.7 J**	4.3 U	4.2 U	5.1 U	4.5 UJ	4.6 U	4.6 U	4.4 U	3.9 U	4.3 U	4.9 U	4.4 U	20.6 U	4.3 U	4.4 UJ	4.3 UJ	4.4 UJ	4.3 UJ	20.6 UJ	**1.8 J**
Vanadium	NE	NE	**10.2 J**	**9.6 J**	**18.8 J**	**18.1**	**21**	**20.4**	**23.7**	**24.2**	**22.5**	**42.7**	**29.3**	**12.2**	**31.6**	**8.9**	**25.8**	**25.5**	**20.6**	**3.5 J**	**4.6**	**65.7**	**94.8**	**84.1**	**90**	**19.4 J**	**25.2**
Zinc	109	10000	**1020 J**	**13.5 J**	**21.6 J**	**29.6**	**35.3**	**55.4**	**27.8**	**33.1**	**33.4**	**36.1**	**127**	**21.1**	**40.8**	**13.4**	**34.6**	**31**	**35.1**	34.4 U	**6.8**	**96.4**	**89.5**	**58.5**	**102**	**22.8 J**	**161**
Cyanides (mg/kg)																											
Free Cyanide	NE	NE	0.221 U	0.229 U	0.232 U	0.25 U	0.23 U	0.234 U	0.228 U	0.229 U	0.271 U	0.238 U	0.246 U	0.253 U	0.243 U	0.213 U	0.243 U	0.257 U	0.243 U	0.231 U	0.229 U	0.234 U	0.236 U	0.239 U	0.231 U	0.222 U	0.247 U
Other (mg/kg)																											
Ammonia	NE	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 4. Remaining Soil Analytical Results
Interim Site Management Plan
Williamsburg Works Site
Brooklyn, New York

Location:	Unrestricted SCO	Restricted-Residential SCO	Adjacent to Parcel 2							Adjacent to Parcels 3 and 4							Adjacent to Parcels 3 and 4								
			N. 11th St. ROW		N. 12th St. ROW		N. 11th St. ROW			N. 11th St. ROW		N .12th St. ROW	N. 11th St. ROW	N .12th St. ROW	N. 11th St. ROW	N .12th St. ROW	N. 12th St. ROW		N. 11th St. ROW			N. 12th St. ROW			N. 11th St. ROW	
Sample Name:			WW-MW-06	WW-MW-06	WW-MW-07	WW-MW-07	WW-MW-08	WW-MW-08	Duplicate of WW-MW-08	WWSS-04	Duplicate of: WWSS-04	WWSS-05	WWSS-06	WWSS-07	WWSS-08	WWSS-09	WW-MW-10	WW-MW-10	WW-MW-11	WW-MW-11	WW-MW-11	WW-MW-13	WW-MW-13	Duplicate of WW-MW-13	WW-MW-14	Duplicate of WW-MW-14
Sample Depth(ft bgs): a			(50-52)	(58-60)	(48.5-49.5)	(59-60)	(7.5-8.5)	(40-45)	(40-45)	(0-0.2)	(0-0.2)	(0-0.2)	(0-0.2)	(0-0.2)	(0-0.2)	(0-0.2)	(4-5)	(10-11.5)	(3-5)	(11-14)	(39-40)	(2-5)	(5-10)	(5-10)	(3-5)	(3-5)
			6/18/2009	6/18/2009	6/23/2009	6/23/2009	6/19/2009	6/19/2009	6/19/2009	10/6/2009	10/6/2009	10/6/2009	10/6/2009	10/6/2010	10/6/2009	10/6/2009	9/8/2009	9/8/2009	8/21/2009	8/25/2009	8/25/2009	9/15/2009	9/15/2009	9/15/2009	9/1/2009	9/1/2009
BTEX (mg/kg)																										
Benzene	0.06	4.8	**160**	**0.15**	**230**	**2.8**	**7.1 J**	**0.013**	**0.0081**	0.0058 U	0.0058 UJ	0.0055 U	0.0056 U	0.0053 U	0.0054 U	0.0062 U	0.029 UJ	2.4 U	0.0059 U	**0.34 J**	0.0056 U	**0.0016 J**	**1.1 J**	**2.8 J**	**0.00074 J**	0.006 U
Toluene	0.7	100	**460**	**0.05**	**400**	0.6 U	**4.6 J**	0.0061 U	0.0064 U	0.0058 U	0.0058 UJ	0.0055 U	0.0056 U	0.0053 U	0.0054 U	0.0062 U	0.029 U	2.4 U	0.0059 U	2.3 U	0.0056 U	0.0062 U	7.1 U	8.1 U	0.0057 U	**0.0018 J**
Ethylbenzene	1	41	**440**	**0.058**	**64**	**0.89**	**470**	0.0061 UJ	0.0064 U	0.0058 U	0.0058 UJ	0.0055 U	0.0056 U	0.0053 U	0.0054 U	0.0062 U	**0.32 J**	2.4 U	0.0059 U	**25**	0.0056 U	0.0062 U	**70 J**	**120 J**	0.0057 U	0.006 U
Total Xylene	0.26	100	**570**	**0.073**	**550**	0.6 U	**550**	0.0061 UJ	0.0064 U	0.0058 U	0.0058 UJ	0.0055 U	0.0056 U	0.0053 U	0.0054 U	0.0062 U	0.029 U	2.4 U	0.0059 U	2.3 U	0.0056 U	0.0062 U	7.1 UJ	**72 J**	0.0057 U	0.006 U
Total BTEX	NE	NE	**1630**	**0.331**	**1244**	**3.69**	**1031.7**	**0.013**	**0.0081**	ND	ND	ND	ND	ND	ND	ND	**0.32**	ND	ND	**25.34**	ND	**0.0016**	**71.1**	**194.8**	**0.00074**	**0.0018**
Other VOCs (mg/kg)																										
Acetone	0.05	100	52 U	**0.049 J**	66 U	1.5 U	37 U	0.024 UJ	**0.049 J**	0.023 UJ	0.023 UJ	0.022 UJ	0.022 UJ	0.021 UJ	0.022 UJ	0.025 UJ	0.12 UJ	6 U	0.024 UJ	R	0.022 U	0.025 U	18 U	20 U	0.023 UJ	0.024 UJ
Carbon disulfide	NE	NE	21 U	0.0054 U	26 U	0.6 U	15 U	0.0061 U	0.0064 U	0.0058 U	0.0058 UJ	0.0055 U	0.0056 U	0.0053 U	0.0054 U	0.0062 U	0.029 UJ	2.4 U	0.0059 UJ	2.3 U	0.0056 U	0.0062 U	7.1 U	8.1 U	0.0057 U	0.006 U
Chloroform	0.37	49	21 U	0.0054 U	26 U	0.6 U	15 U	0.0061 U	0.0064 U	0.0058 U	0.0058 UJ	0.0055 U	0.0056 U	0.0053 U	0.0054 U	0.0062 U	0.029 U	2.4 U	0.0059 U	2.3 U	0.0056 U	0.0062 U	7.1 U	8.1 U	0.0057 U	0.006 U
cis-1,2-Dichloroethene	0.25	100	21 U	0.0054 U	26 U	0.6 U	15 U	0.0061 U	0.0064 U	0.0058 U	0.0058 UJ	0.0055 U	0.0056 U	0.0053 U	0.0054 U	0.0062 U	0.029 U	2.4 U	0.0059 U	2.3 U	0.0056 U	0.0062 U	7.1 U	8.1 U	0.0057 U	0.006 U
trans-1,2-Dichloroethene	0.19	100	21 U	0.0054 U	26 U	0.6 U	15 U	0.0061 U	0.0064 U	0.0058 U	0.0058 UJ	0.0055 U	0.0056 U	0.0053 U	0.0054 U	0.0062 U	0.029 U	2.4 U	0.0059 U	2.3 U	0.0056 U	0.0062 U	7.1 U	8.1 U	0.0057 U	0.006 U
2-Butanone (Methyl ethyl ketone)	0.12	100	21 U	0.011 U	26 U	0.6 U	15 U	0.012 UJ	0.013 U	0.012 U	0.012 UJ	0.011 U	0.011 U	0.011 U	0.011 U	0.012 U	0.058 UJ	2.4 U	0.012 U	2.3 U	0.011 U	0.012 U	7.1 UJ	**230 J**	0.011 U	0.012 U
Methylene chloride	0.05	100	21 U	0.021 U	26 U	0.6 U	15 U	0.024 U	0.026 U	0.023 U	0.023 UJ	0.022 U	0.022 U	0.021 U	0.022 U	0.025 U	0.12 U	2.4 U	0.024 U	2.3 U	0.022 U	0.025 U	7.1 U	8.1 U	0.023 U	0.024 U
Styrene	NE	NE	**20 J**	**0.0045 J**	**420**	0.6 U	15 U	0.0061 UJ	0.0064 U	0.0058 U	0.0058 UJ	0.0055 U	0.0056 U	0.0053 U	0.0054 U	0.0062 U	0.029 U	2.4 U	**0.001 J**	2.3 U	0.0056 U	0.0062 U	7.1 U	8.1 U	0.0057 U	0.006 U
1,1,2,2-Tetrachloroethane	NE	NE	21 U	0.0054 U	26 U	0.6 U	15 U	0.0061 UJ	0.0064 U	0.0058 U	0.0058 UJ	0.0055 U	0.0056 U	0.0053 U	0.0054 U	0.0062 U	0.029 UJ	2.4 U	0.0059 U	2.3 U	0.0056 U	0.0062 U	7.1 U	8.1 U	0.0057 U	0.006 U
Tetrachloroethene (PCE)	1.3	19	21 U	0.0054 U	26 U	0.6 U	15 U	0.0061 UJ	0.0064 U	0.0058 U	0.0058 UJ	0.0055 U	0.0056 U	0.0053 U	0.0054 U	0.0062 U	0.029 UJ	2.4 U	0.0059 U	2.3 U	0.0056 U	0.0062 U	7.1 U	8.1 U	0.0057 U	0.006 U
1,1,2-Trichloroethane	NE	NE	21 U	0.0054 U	26 U	0.6 U	15 U	0.0061 U	0.0064 U	0.0058 U	0.0058 UJ	0.0055 U	0.0056 U	0.0053 U	0.0054 U	0.0062 U	0.029 U	2.4 U	0.0059 U	2.3 U	0.0056 U	0.0062 U	7.1 U	8.1 U	0.0057 U	0.006 U
Trichloroethene (TCE)	0.47	21	21 U	0.0054 U	26 U	0.6 U	15 U	0.0061 U	0.0064 U	0.0058 U	0.0058 UJ	0.0055 U	0.0056 U	0.0053 U	0.0054 U	0.0062 U	0.029 U	2.4 U	0.0059 U	2.3 U	0.0056 U	0.0062 U	7.1 U	8.1 U	0.0057 U	0.006 U
Total VOC	NE	NE	**1650**	**0.3845**	**1664**	**3.69**	**1031.7**	**0.013**	**0.0571**	ND	ND	ND	ND	ND	ND	ND	**0.32**	ND	**0.001**	**25.34**	ND	**0.0016**	**71.1**	**424.8**	**0.00074**	**0.0018**
PAHs (mg/kg)																										
Acenaphthene	20	100	**44 J**	**0.03 J**	**46 J**	**0.028 J**	**290**	0.32 U	0.34 U	**0.18 J**	1.3 UJ	1.2 U	**0.23 J**	**0.1 J**	**0.12 J**	1.3 U	**21**	**56 J**	**1.4 J**	**110**	**0.35**	**19**	**510**	**520**	**0.3 J**	**0.45 J**
Acenaphthylene	100	100	**460**	**0.13 J**	**460**	**0.13 J**	**37 J**	0.32 U	0.34 U	**0.79 J**	**0.13 J**	1.2 U	1.2 U	1.1 U	**0.11 J**	**0.11 J**	**2.5 J**	**9.9 J**	**0.87 J**	**12 J**	**0.042 J**	**7.4**	**29 J**	**38 J**	**1.5 J**	**1.3 J**
Anthracene	100	100	**170**	**0.071 J**	**130 J**	**0.051 J**	**91 J**	0.32 U	0.34 U	**0.58 J**	**0.071 J**	**0.12 J**	**0.35 J**	**0.19 J**	**0.32 J**	**0.15 J**	**8.6**	**16 J**	**2.6 J**	**47 J**	**0.2 J**	**12**	**160**	**190**	**0.97 J**	**1.4 J**
Benz[a]anthracene	1	1	**89 J**	**0.056 J**	**83 J**	**0.04 J**	**44 J**	0.32 U	0.34 U	**2.1 J**	**0.28 J**	**0.5 J**	**0.96 J**	**0.54 J**	**1.2**	**0.53 J**	**5.9**	**15 J**	**19**	**35 J**	**0.14 J**	**24**	**83**	**110**	**4.3**	**4.5**
Benzo[a]pyrene	1	1	**64 J**	**0.033 J**	**58 J**	**0.03 J**	**35 J**	**0.044 J**	**0.049 J**	**2.9 J**	**0.37 J**	**0.6 J**	**1.1 J**	**0.64 J**	**1.5**	**0.7 J**	**4.4**	**13 J**	**41 J**	**36 J**	**0.12 J**	**30**	**70**	**99**	**5**	**5.9**
Benzo[b]fluoranthene	1	1	**39 J**	**0.016 J**	**34 J**	0.32 U	**24 J**	**0.07 J**	0.34 U	**2.9 J**	**0.47 J**	**0.81 J**	**1.4**	**0.8 J**	**1.6**	**0.77 J**	**3.3**	**9.5 J**	**47 J**	**30 J**	**0.13 J**	**23**	**76**	**74**	**6.8**	**5.8**
Benzo[k]fluoranthene	0.8	100	**88 J**	0.29 U	350 U	0.32 U	**12 J**	**0.42**	**0.44**	**1.2 J**	**0.14 J**	**0.36 J**	**0.59 J**	**0.26 J**	**0.68 J**	**0.32 J**	**1.6 J**	**3.4 J**	**20 J**	**12 J**	**0.043 J**	**9.9**	**25 J**	**34 J**	**3 J**	**2.3**
Benzo[g,h,i]perylene	100	3.9	**15 J**	0.29 U	350 U	0.32 U	160 U	0.32 U	0.34 U	**2.6 J**	**0.61 J**	**0.49 J**	**1.4**	**0.78 J**	**1.7**	**0.97 J**	**1 J**	**3 J**	**28 J**	**15 J**	**0.13 J**	**29**	38 U	**29 J**	**2.5 J**	**6.3 J**
Chrysene	1	3.9	**86 J**	**0.043 J**	**75 J**	**0.028 J**	**43 J**	0.32 U	0.34 U	**2.6 J**	**0.33 J**	**0.63 J**	**1.1 J**	**0.64 J**	**1.3**	**0.63 J**	**5.9**	**15 J**	**20**	**36 J**	**0.13 J**	**24**	**82**	**100**	**4.8**	**4.7**
Dibenz[a,h]anthracene	0.33	0.33	140 U	0.29 U	350 U	0.32 U	160 U	0.32 U	0.34 U	**0.73 J**	1.3 UJ	1.2 U	1.2 U	1.1 UJ	1.2 U	1.3 UJ	3.1 U	16 UJ	**8.2 J**	60 U	0.29 U	**6.9**	**3.7 J**	44 U	**0.48 J**	**1.2 J**
Fluoranthene	100	100	**140 J**	**0.079 J**	**130 J**	**0.057 J**	**76 J**	0.32 U	0.34 U	**2.3 J**	**0.28 J**	**1.1 J**	**2.1**	**1.1 J**	**2.2**	**0.92 J**	**9.5**	**27 J**	**17**	**71**	**0.23 J**	**26**	**150**	**180**	**6.6**	**7.1**
Fluorene	30	100	**230**	**0.084 J**	**220 J**	**0.066 J**	**120 J**	0.32 U	0.34 U	**0.2 J**	1.3 UJ	1.2 U	**0.19 J**	1.1 U	1.2 U	1.3 U	**13**	**39 J**	**1.2 J**	**59 J**	**0.2 J**	**9.7**	**210**	**230**	**0.38 J**	**0.55 J**
Indeno[1,2,3-cd]pyrene	0.5	0.5	**72 J**	0.29 U	350 U	0.32 U	**110 J**	**0.28 J**	0.34 U	**2.9 J**	**0.52 J**	**0.43 J**	**1.2 J**	**0.66 J**	**1.7**	**1 J**	**1.2 J**	**3.4 J**	**33 J**	**14 J**	**0.11 J**	**31**	38 U	**29 J**	**2.8 J**	**6.3 J**
2-Methylnaphthalene	NE	NE	**1200**	**0.32**	**1200**	**0.37**	**840**	**0.023 J**	**0.014 J**	0.31 U	1.3 UJ	1.2 U	1.2 U	1.1 U	1.2 U	1.3 U	**11**	**29 J**	6.2 U	**340**	**0.7**	**5.4**	**210**	**210**	3.1 U	1.6 U
Naphthalene	12	100	**2600**	**0.84**	**3300**	**1**	**1700**	**0.062 J**	**0.038 J**	0.42 U	1.3 UJ	1.2 U	1.2 U	1.1 U	1.2 U	1.3 U	**29 J**	**56 J**	6.2 U	**740**	0.29 U	**10**	**610**	**550**	3.1 U	1.6 U
Phenanthrene	100	100	**610**	**0.27 J**	**490**	**0.2 J**	**310**	0.32 U	0.34 U	**2.7 J**	**0.2 J**	**0.7 J**	**1.9**	**0.91 J**	**1.4**	**0.75 J**	**32**	**90 J**	**10**	**160**	**0.67**	**25**	**520**	**540**	**3.5**	**4.7**
Pyrene	100	100	**240**	**0.12 J**	**190 J**	**0.086 J**	**120 J**	0.32 U	0.34 U	**4.8 J**	**0.55 J**	**1.1 J**	**2.6**	**1.5**	**3.2**	**1.5**	**14**	**40 J**	**22**	**80**	**0.47**	**57**	**220**	**290**	**7.8**	**8.7**
Total PAHs	NE	NE	**6147**	**2.092**	**6416**	**2.086**	**3852**	**0.899**	**0.541**	**29.48**	**3.951**	**6.84**	**15.12**	**8.12**	**17.03**	**8.35**	**163.9**	**425.2**	**271.27**	**1797**	**3.665**	**349.3**	**2958.7**	**3223**	**50.73**	**61.2**
Other SVOCs (mg/kg)																										
Bis(2-ethylhexyl)phthalate	NE	NE	140 U	**0.089 J**	350 U	0.32 U	160 U	0.32 U	0.34 U	**3 J**	5.7 UJ	1.2 UJ	5.7 U	5.3 U	2.3 U	4.6 U	3.1 U	16 UJ	6.2 U	60 U	0.29 U	**0.84 J**	38 U	44 U	3.1 U	1.6 U
Butyl benzyl phthalate	NE	NE	140 U	0.29 U	350 U	0.32 U	160 U	0.32 U	0.34 U	**0.34 J**	**0.48 J**	**0.24 J**	**0.31 J**	**0.68 J**	**1.1 J**	**0.3 J**	3.1 U	16 UJ	6.2 U	60 U	0.29 U	3.3 U	38 U	44 U	**0.25 J**	**0.23 J**
Carbazole	NE	NE	140 U	0.29 U	350 U	0.32 U	160 U	0.32 U	0.34 U	**0.16 J**	1.3 UJ	**0.08 J**	**0.2 J**	**0.095 J**	**0.13 J**	1.3 U	**0.26 J**	16 UJ	**1.1 J**	**5.2 J**	0.29 U	**0.48 J**	**2.2 J**	44 U	**0.28 J**	**0.51 J**
Dibenzofuran	7	59	**26 J**	0.29 U	**27 J**	0.32 U	**14 J**	0.32 U	0.34 U	**0.12 J**	1.3 UJ	1.2 U	**0.17 J**	1.1 U	1.2 U	1.3 U	**1.8 J**	**4.5 J**	**1 J**	**11 J**	**0.032 J**	**1.1 J**	**27 J**	**34 J**	3.1 U	**0.26 J**
2,4-Dimethylphenol	NE	NE	140 U	0.29 U	350 U	0.32 U	160 U	0.32 U	0.34 U	0.31 U	1.3 UJ	1.2 U	1.2 U	1.1 U	1.2 U	1.3 U	3.1 U	16 UJ	6.2 U	60 U	0.29 U	3.3 U	38 UJ	44 UJ	3.1 U	1.6 U
Di-n-butyl phthalate	NE	NE	140 U	0.29 U	350 U	0.32 U	160 U	0.32 U	0.34 U	**0.11 J**	1.3 UJ	1.2 U	1.2 U	**0.2 J**	1.2 U	**0.23 J**	3.1 U	16 UJ	6.2 U	60 U	0.29 U	3.3 U	38 U	44 U	3.1 U	1.6 U
2-Methylphenol (o-Cresol)	0.33	100	140 U	0.29 U	350 U	0.32 U	160 U	0.32 U	0.34 U	0.31 U	1.3 UJ	1.2 U	1.2 U	1.1 U	1.2 U	1.3 U	3.1 U	16 UJ	6.2 U	60 U	0.29 U	3.3 U	38 U	44 U	3.1 U	1.6 U
4-Methylphenol (p-Cresol)	0.33	100	140 U	0.29 U	350 U	0.32 U	160 U	0.32 U	0.34 U	0.31 U	1.3 UJ	1.2 U	1.2 U	1.1 U	1.2 U	1.3 U	3.1 U	16 UJ	6.2 U	60 U	0.29 U	3.3 U	38 U	44 U	3.1 U	1.6 U
4-Nitroaniline	NE	NE	140 U	0.29 U	350 U	0.32 U	160 U	0.32 U	0.34 U	0.31 U	1.3 UJ	1.2 U	1.2 U	1.1 U	1.2 U	1.3 U	3.1 U	16 UJ	6.2 U	60 U	0.29 U	3.3 U	38 U	44 U	3.1 U	1.6 U
Phenol	0.33	100	140 U	0.29 U	350 U	0.32 U	160 U	0.32 U	0.34 U	0.31 U	1.3 UJ	1.2 U	**0.15 J**	1.1 U	1.2 U	1.3 U	3.1 U	16 UJ	6.2 U	60 U	0.29 U	3.3 U	38 U	44 U	3.1 U	1.6 U
Total SVOC	NE	NE	**6173**	**2.181**	**6443**	**2.086**	**3866**	**0.899**	**0.541**	**33.21**	**4.431**	**7.16**	**15.95**	**9.095**	**18.26**	**8.88**	**165.96**	**429.7**	**273.37**	**1813.2**	**3.697**	**351.72**	**2987.9**	**3257**	**51.26**	**62.2**
PCBs (mg/kg)																										
Aroclor 1248	NE	NE	NA	NA	NA	NA	NA	NA	NA	0.019 U	0.02 UJ	0.019 UJ	**0.018 J**	0.018 UJ	0.018 U	0.021 UJ	0.39 U	NA	0.02 U	NA	NA	2 U	NA	NA	0.019 UJ	0.02 U
Aroclor 1254	NE	NE	NA	NA	NA	NA	NA	NA	NA	**0.15 J**	**0.043 J**	**0.024 J**	**0.06 J**	**0.021 J**	**0.12 J**	**0.022 J**	0.39 U	NA	0.02 U	NA	NA	2 U	NA	NA	**0.21 J**	**0.094 J**
Aroclor 1260	NE	NE	NA	NA	NA	NA	NA	NA	NA	**0.2 J**	**0.073 J**	**0.041 J**	0.042 U	**0.017 J**	**0.1**	0.021 UJ	0.39 U	NA	0.02 U	NA	NA	2 U	NA	NA	**0.081 J**	**0.039 J**
Aroclor 1268	NE	NE	NA	NA	NA	NA	NA	NA	NA	**0.12 J**	**0.079 J**	**0.022 J**	**0.011 J**	**0.0078 J**	**0.071 J**	**0.0075 J**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total PCBs	NE	NE	NA	NA	NA	NA	NA	NA	NA	**0.47**	**0.195**	**0.087**	**0.089**	**0.0458**	**0.291**	**0.0295**	ND	NA	ND	NA	NA	ND	NA	NA	**0.291**	**0.133**
Pesticides (mg/kg)																										
Aldrin	0.005	0.097	NA	NA	NA	NA	NA	NA	NA	**0.0022 J**	0.002 UJ	0.0018 UJ	0.0019 UJ	0.0018 UJ	0.0018 UJ	0.0021 UJ	0.04 U	NA	0.002 UJ	NA	NA	0.11 U	NA	NA	0.041 UJ	0.13 UJ
beta-BHC	0.036	0.36	NA	NA	NA	NA	NA	NA	NA	**0.0037 JN**	**0.0025 JN**	0.0018 UJ	0.0019 UJ	0.0018 UJ	0.0018 UJ	0.0021 UJ	0.04 U	NA	0.002 UJ	NA	NA	0.11 U	NA	NA	0.041 UJ	0.13 UJ
gamma-BHC	0.1	1.3	NA	NA	NA	NA	NA	NA	NA	**0.0034 JN**	0.002 UJ	0.0018 UJ	0.0019 UJ	0.0018 UJ	0.0018 UJ	0.0021 UJ	0.04 U	NA	**0.00077 J**	NA	NA	0.11 UJ	NA	NA	0.041 UJ	0.13 UJ
delta-BHC	0.04	100	NA	NA	NA	NA	NA	NA	NA	**0.003 J**	**0.0019 J**	0.0018 UJ	0.0019 UJ	0.0018 UJ	0.0018 UJ	0.0021 UJ	0.04 U	NA	**0.00089 J**	NA	NA	0.11 UJ	NA	NA	0.041 UJ	0.13 UJ
alpha-chlordane	0.094	4.2	NA	NA	NA	NA	NA	NA	NA	0.0019 UJ	0.002 UJ	0.0018 UJ	**0.0038 J**	0.0018 UJ	0.0018 UJ	0.0021 UJ	0.04 U	NA	0.002 U	NA	NA	0.11 U	NA	NA	0.041 UJ	0.13 UJ
gamma-Chlordane	NE	NE	NA	NA	NA	NA	NA	NA	NA	**0.0051 JN**	**0.0041 JN**	0.0018 UJ	**0.0042 JN**	**0.003 JN**	**0.0031 JN**	0.0021 UJ	0.04 U	NA	**0.0058**	NA	NA	0.11 U	NA	NA	0.041 UJ	0.13 UJ
4,4-DDD	0.0033	13	NA	NA	NA	NA	NA	NA	NA	**0.011 JN**	**0.0084 JN**	0.0036 UJ	**0.0068 J**	**0.0041 JN**	**0.011 J**	0.004 UJ	0.04 U	NA	0.0039 UJ	NA	NA	**0.081 J**	NA	NA	0.041 UJ	0.13 UJ
4,4'-DDE	0.0033	8.9	NA	NA	NA	NA	NA	NA	NA	**0.015 J**	**0.012 J**	**0.0024 J**	**0.0047 J**	**0.0035 J**	**0.0046 J**	0.004 UJ	0.04 U	NA	0.0039 U	NA	NA	0.11 U	NA	NA	0.041 UJ	**0.017 J**
4,4'-DDT	0.0033	7.9	NA	NA	NA	NA	NA	NA	NA	**0.042 J**	**0.033 J**	**0.01 J**	**0.011 J**	0.0066 UJ	**0.013 J**	**0.011 J**	0.04 U	NA	0.0039 U	NA	NA	0.11 U	NA	NA	0.041 UJ	0.13 UJ
Dieldrin	0.005	0.2	NA	NA	NA	NA	NA	NA	NA	**0.0046 J**	**0.0042 J**	**0.0013 J**	0.0036 UJ	0.0034 UJ	0.0036 UJ	0.004 UJ	0.04 U	NA	**0.004 J**	NA	NA	0.11 U	NA	NA	0.041 UJ	0.13 UJ
Endosulfan I	2.4	24	NA	NA	NA	NA	NA	NA	NA	**0.0075 J**	**0.0068 J**	0.0018 UJ	0.0019 UJ	0.0018 UJ	0.0018 UJ	0.0021 UJ	0.04 U	NA	0.002 UJ	NA	NA	0.11 UJ	NA	NA	0.041 UJ	0.13 UJ
Endosulfan II	2.4	24	NA	NA	NA	NA	NA	NA	NA	0.0037 UJ	0.0039 UJ	0.0036 UJ	0.0036 UJ	0.0034 UJ	0.0036 UJ	0.004 UJ	0.04 U	NA	**0.0089 J**	NA	NA	0.11 U	NA	NA	0.041 UJ	0.13 UJ
Endosulfan sulfate	2.4	24	NA	NA	NA	NA	NA	NA	NA	0.0037 UJ	0.0039 UJ	0.0036 UJ	0.0036 UJ	0.0034 UJ	0.0036 UJ	0.004 UJ	0.04 U	NA	0.0039 U	NA	NA	0.11 U	NA	NA	0.041 U	0.13 U
Endrin	0.014	11	NA	NA	NA	NA	NA	NA	NA	**0.0039 JN**	0.0039 UJ	R	0.0036 UJ	0.0034 UJ	0.0036 UJ	R	0.04 U	NA	0.0039 U	NA	NA	0.11 U	NA	NA	0.041 UJ	0.13 UJ
Endrin aldehyde	NE	NE	NA	NA	NA	NA	NA	NA	NA	**0.0071 JN**	**0.029 JN**	**0.0074 JN**	**0.0056 JN**	**0.0056 JN**	**0.0098 JN**	**0.011 JN**	0.04 U	NA	**0.023 J**	NA	NA	0.11 U	NA	NA	0.041 U	0.13 U
Endrin ketone	NE	NE	NA	NA	NA	NA	NA	NA	NA	0.0037 U	0.0039 U	0.0036 U	0.0036 U	0.0034 U	0.0036 U	0.004 U	0.04 U	NA	**0.0041 J**	NA	NA	**0.099 J**	NA	NA	**0.026 J**	0.13 UJ
Heptachlor	0.042	2.1	NA	NA	NA	NA	NA	NA	NA	0.0019 UJ	0.002 UJ	0.0018 UJ	0.0019 UJ	0.0018 UJ	0.0018 UJ	0.0021 UJ	0.04 U	NA	0.002 UJ	NA	NA	0.11 U	NA	NA	0.041 UJ	0.13 UJ
Heptachlor epoxide	NE	NE	NA	NA	NA	NA	NA	NA	NA	**0.0036 JN**	**0.0072 J**	0.0018 UJ	0.0019 UJ	0.0018 UJ	0.0018 UJ	0.0021 UJ	0.04 U	NA	0.002 UJ	NA	NA	0.11 UJ	NA	NA	0.041 UJ	0.13 UJ
Methoxychlor	NE	NE	NA	NA	NA	NA	NA	NA	NA	0.019 UJ	**0.027 JN**	0.018 UJ	0.019 UJ	0.018 UJ	**0.02 JN**	0.021 UJ	0.077 U	NA	0.02 UJ	NA	NA	0.2 U	NA	NA	0.079 UJ	0.26 UJ

Table 4. Remaining Soil Analytical Results
Interim Site Management Plan
Williamsburg Works Site
Brooklyn, New York

Location:	Unrestricted SCO	Restricted-Residential SCO	Adjacent to Parcel 2							Adjacent to Parcels 3 and 4							Adjacent to Parcels 3 and 4									
			N. 11th St. ROW		N. 12th St. ROW		N. 11th St. ROW			N. 11th St. ROW	N .12th St. ROW	N. 11th St. ROW	N .12th St. ROW	N. 11th St. ROW	N .12th St. ROW		N. 12th St. ROW		N. 11th St. ROW			N. 12th St. ROW			N. 11th St. ROW	
Sample Name:			WW-MW-06	WW-MW-06	WW-MW-07	WW-MW-07	WW-MW-08	WW-MW-08	Duplicate of WW-MW-08	WWSS-04	Duplicate of: WWSS-04	WWSS-05	WWSS-06	WWSS-07	WWSS-08	WWSS-09	WW-MW-10	WW-MW-10	WW-MW-11	WW-MW-11	WW-MW-11	WW-MW-13	WW-MW-13	Duplicate of WW-MW-13	WW-MW-14	Duplicate of WW-MW-14
Sample Depth(ft bgs): a			(50-52)	(58-60)	(48.5-49.5)	(59-60)	(7.5-8.5)	(40-45)	(40-45)	(0-0.2)	(0-0.2)	(0-0.2)	(0-0.2)	(0-0.2)	(0-0.2)	(0-0.2)	(4-5)	(10-11.5)	(3-5)	(11-14)	(39-40)	(2-5)	(5-10)	(5-10)	(3-5)	(3-5)
			6/18/2009	6/18/2009	6/23/2009	6/23/2009	6/19/2009	6/19/2009	6/19/2009	10/6/2009	10/6/2009	10/6/2009	10/6/2009	10/6/2010	10/6/2009	10/6/2009	9/8/2009	9/8/2009	8/21/2009	8/25/2009	8/25/2009	9/15/2009	9/15/2009	9/15/2009	9/1/2009	9/1/2009
Metals (mg/kg)																										
Aluminum	NE	NE	**2370 J**	**2690 J**	**1860**	**2790**	**4480 J**	**2710 J**	**7800 J**	**4390**	**4600**	**4270**	**4160**	**2440**	**5260**	**13700**	**7690**	**4450**	**2170**	**1760**	**4450**	**1250**	**1670 J**	**3400 J**	**7000**	**7190**
Arsenic	13	16	**1.7 J**	5.4 UJ	6.7 U	6.3 U	**2.3 J**	**3.1 J**	**14.3 J**	5.9 U	5.9 U	5.8 U	5.8 U	5.4 U	5.6 U	**6.1 J**	6 U	6 U	**2.7 J**	**3.8**	5.9 U	**4.3**	**88.2 J**	**207 J**	**19.7 J**	**17.2**
Barium	350	400	**15.2 J**	**21.9 J**	**18.4 J**	**19.9 J**	**26.5 J**	**39.7 J**	**87.2 J**	**102 J**	**102 J**	**68.8 J**	**327 J**	**76.8 J**	**199 J**	**203 J**	**33.6**	**19.3**	**30.4**	**12.8 J**	**28.5 J**	**51 J**	**13.4 J**	**32 J**	**171 J**	**170 J**
Beryllium	7.2	72	**0.26 J**	**0.47 J**	**0.42 J**	**0.53 J**	**0.44 J**	**0.8 J**	**1.8**	**0.28 J**	**0.31 J**	**0.26 J**	**0.28 J**	**0.15 J**	**0.32 J**	**1.6**	1.4 U	1.4 U	1.4 U	**0.15 J**	**0.46 J**	1.5 U	1.7 U	2 UJ	**0.2 J**	**0.26 J**
Cadmium	2.5	4.3	1.3 U	1.3 UJ	1.6 U	1.5 UJ	1.5 U	1.5 U	1.6 U	**2.1**	**2.5**	**1 J**	**0.94 J**	**0.6 J**	**0.66 J**	1.5 U	**0.57 J**	**0.33 J**	1.4 UJ	1.4 UJ	1.4 U	**0.41 J**	**0.63 J**	**1.9 J**	**1.2 J**	**1.1 J**
Calcium	NE	NE	**580 J**	**786 J**	**436 J**	**666 J**	**737 J**	**1360 J**	**2210 J**	**13900**	**12800**	**9680**	**15200**	**21700**	**17600**	**64900**	71.5 UJ	**874 J**	71.2 UJ	**113000 J**	**1490 J**	**4660**	**686 J**	**2260 J**	**33100 J**	**31100 J**
Chromium	NE	NE	**6.9 J**	**11.2 J**	**8 J**	**11.5 J**	**11.2 J**	**10.3 J**	**18.2 J**	**22.4**	**31.5**	**20.9**	**21.1**	**22.5**	**23.8**	**32.3**	**12.8 J**	**9.2 J**	**13.3 J**	**3 J**	**13.2 J**	**5.4**	**11.3 J**	**30.2 J**	**22.3 J**	**24.1 J**
Cobalt	NE	NE	**3.8 J**	**4.2 J**	**6.5**	**5.3 J**	**5.3 J**	**15.8 J**	**53.9 J**	**5.5**	**7.6**	**4**	**4.3**	**4 J**	**4.8**	**4.1**	**5.1**	**5.5**	**1.6**	**2.2 J**	**6.4 J**	1.5 U	**6.4 J**	**15.2 J**	**5.8**	**5.2**
Copper	50	270	**9.3**	**19.8 J**	**17.1 J**	**16.8 J**	**12.9**	**35.1**	**53.9**	**89.9**	**88.1**	**51.9**	**347**	**57.2**	**75.6**	**130**	**11.7**	**7.5**	**10.2**	**12 J**	**16.4 J**	**29.6**	**86.9 J**	**233 J**	**93.9**	**136**
Iron	NE	NE	**8800 J**	**21600 J**	**10300**	**25100**	**13000 J**	**4110 J**	**9520 J**	**12800**	**15100**	**10200**	**15700**	**20500**	**12200**	**14900**	**14500**	**9600**	**5570 J**	**6210 J**	**13600 J**	**19100 J**	**11700 J**	**36300 J**	**28100 J**	**20400 J**
Lead	63	400	**3.2**	**7.4**	**4.7 J**	**5.9 J**	**4.6**	**14.5 J**	**25.9 J**	**241**	**248**	**99.6**	**251**	**99.1**	**125**	**106**	**11.1 J**	**5.8 J**	**36.9 J**	**11.8 J**	**4.5 J**	**108**	**233 J**	**576 J**	**331 J**	**316 J**
Magnesium	NE	NE	**953 J**	**888 J**	**782**	**794**	**2530 J**	**568 J**	**1600 J**	**6380**	**6820**	**5840**	**7230**	**9290**	**7630**	**18400**	**2020**	**1720**	**493 J**	**67000 J**	**2490 J**	**1450**	**197 J**	**894 J**	**7530**	**6570**
Manganese	1600	2000	**291 J**	**423 J**	**92.1**	**555**	**79.6 J**	**27.4 J**	**78.3 J**	**188**	**227**	**272**	**205**	**195**	**248**	**963**	**131**	**112**	**50.9 J**	**132 J**	**382 J**	**19.6**	**150 J**	**453 J**	**294**	**353**
Mercury	0.18	0.81	0.051 U	0.05 U	0.065 UJ	**0.0078 J**	0.059 U	**0.035**	**0.018 J**	**0.2**	**0.2**	**0.11**	**0.094**	**0.094**	**0.12**	**0.091**	**0.015 J**	0.059 U	**0.069**	**0.041 J**	0.054 UJ	**0.22 J**	**0.42 J**	**0.86 J**	**0.85**	**0.83**
Nickel	30	310	**6.1 J**	**6.5 J**	**7.6 J**	**5.6 J**	**13.4 J**	**16.7 J**	**70 J**	**19.7**	**24.2**	**14.6**	**16.7**	**19.4**	**19.3**	**20.9**	**11.8**	**11.4**	**5.2**	**5.4**	**10.8**	**4.1 J**	**23.2 J**	**40.9 J**	**20.6**	**20.6**
Potassium	NE	NE	**454 J**	**417 J**	**380 J**	**448 J**	**729 J**	**559 J**	**799 J**	**491 J**	**540 J**	**423 J**	**430 J**	**277 J**	**531 J**	**1710 J**	**699 J**	**540 J**	71.2 UJ	**496 J**	**1250 J**	**128 J**	**81.7 J**	**219 J**	**1240 J**	**1130 J**
Selenium	3.9	180	R	R	11.9 U	11.2 U	R	R	R	R	10.5 UJ	R	R	R	R	R	R	R	10.7 UJ	10.4 U	10.4 U	11.4 UJ	12.7 UJ	14.9 UJ	R	R
Silver	2	180	1.3 U	1.3 UJ	1.6 U	1.5 UJ	1.5 U	1.5 U	1.6 U	1.4 U	**0.57 J**	1.4 U	**0.39 J**	1.3 UJ	1.3 U	**0.1 J**	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U	1.5 U	1.7 U	2 UJ	**0.18 J**	**0.17 J**
Sodium	NE	NE	**58.9 J**	**56.9 J**	**138 J**	74.5 UJ	**347**	**119 J**	**248 J**	**141 J**	**152 J**	**103 J**	**238 J**	**134 J**	**231 J**	**954 J**	**249**	**139**	71.2 U	**187 J**	**229 J**	76.1 UJ	**419 J**	**698**	**1640**	**2000**
Thallium	NE	NE	3.8 U	**1.1 J**	4.8 U	4.5 U	4.4 U	4.4 U	4.7 U	4.2 UJ	4.2 UJ	4.1 UJ	4.2 UJ	3.8 UJ	4 UJ	4.6 UJ	4.3 UJ	4.3 UJ	4.3 UJ	4.2 U	4.2 U	4.6 U	5.1 U	6 UJ	4.2 UJ	4.3 UJ
Vanadium	NE	NE	**9.7 J**	**21 J**	**17.9 J**	**21.5 J**	**14.2 J**	**18.4 J**	**26.9 J**	**18.6**	**21.1**	**15.4**	**19.4**	**13.3**	**19**	**24.8**	**18.3**	**12.9**	**6.5 J**	**9.6 J**	**17.7 J**	**5**	**5.9 J**	**15.9 J**	**24.5 J**	**24.3 J**
Zinc	109	10000	**13.1 J**	**25.2 J**	**17.4 J**	**23.8 J**	**20.8 J**	**81.1 J**	**287 J**	**832**	**922**	**456**	**462**	**626**	**465**	**336**	**32.1**	**21.2**	**178**	**23.3**	**31.4**	**15.9**	**311 J**	**539 J**	**471 J**	**479 J**
Cyanides (mg/kg)																										
Free Cyanide	NE	NE	0.209 U	0.213 U	0.264 U	0.233 U	0.233 U	0.241 U	0.255 U	0.231 UJ	0.233 UJ	0.218 UJ	0.223 UJ	**0.063 J**	0.216 UJ	0.242 UJ	0.229 UJ	0.234 UJ	0.231 U	0.228 UJ	0.218 UJ	0.241 UJ	0.283 UJ	0.321 UJ	0.227 U	0.237 U
Other (mg/kg)																										
Ammonia	NE	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 4. Remaining Soil Analytical Results
Interim Site Management Plan
Williamsburg Works Site
Brooklyn, New York

Location:	Unrestricted SCO	Restricted-Residential SCO	Adjacent to Parcels 3 and 4														
			N. 11th St. ROW		N. 12th St. ROW			N. 11th St. ROW			N. 12th St. ROW			N. 12th St. ROW		N. 12th St. ROW	
Sample Name:			WW-MW-14	WW-MW-14	WW-MW-15	Duplicate of WW-MW-15	WW-MW-15	WW-SB-13	WW-SB-13	WW-SB-13	WW-SB-14	Duplicate of WW-SB-14	WW-SB-14	WW-SB-15	WW-SB-15	WW-SB-16	WW-SB-16
Sample Depth(ft bgs): a			(36-37) 9/2/2009	(55-57) 9/2/2009	(1-4) 9/24/2009	(1-4) 9/24/2009	(12-13) 9/28/2009	(4-5) 8/21/2009	(12-15) 8/24/2009	(37-38) 8/24/2009	(1-5) 9/11/2009	(1-5) 9/11/2009	(10-11) 9/11/2009	(3-5) 9/17/2009	(7-9) 9/17/2009	(0.5-5) 9/22/2009	(12-13) 9/23/2009
BTEX (mg/kg)																	
Benzene	0.06	4.8	**0.87 J**	0.0059 U	0.0059 U	0.006 U	**0.014 J**	0.006 U	**54**	**0.00086 J**	0.03 U	0.03 U	12 U	**0.017 J**	**0.061 J**	**0.046 J**	**0.22 J**
Toluene	0.7	100	5.7 U	0.0059 U	0.0059 U	0.006 U	0.031 U	0.006 U	12 U	0.006 U	0.03 U	0.03 U	12 U	0.0061 U	0.037 U	0.0055 UJ	0.031 U
Ethylbenzene	1	41	**34**	0.0059 U	0.0059 U	0.006 U	**0.0087 J**	0.006 U	**430**	0.006 U	**0.1 J**	**0.3 J**	**270**	0.0061 U	0.037 U	**0.018 J**	**0.11 J**
Total Xylene	0.26	100	5.7 U	0.0059 U	0.0059 U	0.006 U	**0.0085 J**	0.006 U	12 U	0.006 U	0.03 U	0.03 U	12 U	0.0061 UJ	0.037 UJ	0.0055 UJ	0.031 UJ
Total BTEX	NE	NE	**34.87**	ND	ND	ND	**0.0312**	ND	**484**	**0.00086**	**0.1**	**0.3**	**270**	**0.017**	**0.061**	**0.064**	**0.33**
Other VOCs (mg/kg)																	
Acetone	0.05	100	14 U	0.024 UJ	0.024 UJ	0.024 UJ	0.12 U	0.024 UJ	30 U	0.024 UJ	0.12 U	0.12 U	31 U	0.024 U	0.15 U	**0.065 J**	0.13 UJ
Carbon disulfide	NE	NE	5.7 U	0.0059 U	0.0059 U	0.006 U	0.031 U	0.006 UJ	12 U	0.006 UJ	0.03 U	0.03 U	12 U	0.0061 U	0.037 U	**0.012 J**	**0.025 J**
Chloroform	0.37	49	5.7 U	0.0059 U	0.0059 U	0.006 U	0.031 U	0.006 U	12 U	0.006 U	0.03 U	0.03 U	12 U	0.0061 U	0.037 U	R	0.031 U
cis-1,2-Dichloroethene	0.25	100	5.7 U	0.0059 U	0.0059 U	0.006 U	0.031 U	0.006 U	12 U	0.006 U	0.03 U	0.03 U	12 U	0.0061 U	0.037 U	R	0.031 U
trans-1,2-Dichloroethene	0.19	100	5.7 U	0.0059 U	0.0059 U	0.006 U	0.031 U	0.006 U	12 U	0.006 U	0.03 U	0.03 U	12 U	0.0061 U	0.037 U	R	0.031 U
2-Butanone (Methyl ethyl ketone)	0.12	100	5.7 U	0.012 U	0.012 U	0.012 U	0.061 U	0.012 U	12 U	0.012 U	0.061 U	0.061 U	12 U	0.012 U	0.074 U	**0.011 J**	0.063 U
Methylene chloride	0.05	100	5.7 U	0.024 U	0.024 U	0.024 U	0.12 U	0.024 U	12 U	0.024 U	0.12 U	0.12 U	12 U	0.024 U	0.15 U	0.022 UJ	0.13 U
Styrene	NE	NE	5.7 U	0.0059 U	0.0059 U	0.006 U	0.031 U	**0.00051 J**	12 U	0.006 U	0.03 U	**0.003 J**	12 U	0.0061 U	0.037 U	R	0.031 U
1,1,2,2-Tetrachloroethane	NE	NE	5.7 U	0.0059 U	0.0059 U	0.006 U	0.031 U	0.006 U	12 U	0.006 U	0.03 U	0.03 U	12 U	0.0061 U	0.037 U	R	0.031 U
Tetrachloroethene (PCE)	1.3	19	**0.95 J**	0.0059 U	0.0059 U	0.006 U	0.031 U	0.006 U	12 U	0.006 U	0.03 U	0.03 U	12 U	0.0061 U	0.037 U	R	0.031 U
1,1,2-Trichloroethane	NE	NE	5.7 U	0.0059 U	0.0059 U	0.006 U	0.031 U	0.006 U	12 U	0.006 U	0.03 U	0.03 U	12 U	0.0061 U	0.037 U	**0.074 J**	0.031 U
Trichloroethene (TCE)	0.47	21	5.7 U	0.0059 U	0.0059 U	0.006 U	0.031 U	0.006 U	12 U	0.006 U	0.03 U	0.03 U	12 U	0.0061 U	0.037 U	R	0.031 U
Total VOC	NE	NE	**42.82**	ND	ND	ND	**0.0312**	**0.00051**	**484**	**0.00086**	**0.1**	**0.303**	**270**	**0.017**	**0.061**	**0.226**	**0.355**
PAHs (mg/kg)																	
Acenaphthene	20	100	**180**	**1.6 J**	6.1 U	6.4 U	**3**	**5.6 J**	**350**	**0.12 J**	**89**	**92**	**200**	**16**	**120**	**6.9**	**23**
Acenaphthylene	100	100	**36**	**0.23 J**	**1.6 J**	**1.6 J**	**1 J**	**4.4 J**	150 U	0.32 U	**15 J**	**23**	**19 J**	**2.4 J**	**7 J**	**1.2 J**	**3.2 J**
Anthracene	100	100	**110**	**0.97 J**	**1.6 J**	**1.1 J**	**2.9**	**14 J**	**120 J**	**0.06 J**	**55**	**83**	**54 J**	**11**	**57**	**5.5 J**	**24**
Benz[a]anthracene	1	1	**76**	**0.61**	**6.1**	**3.9 J**	**4.6**	**76**	**57 J**	**0.05 J**	**37**	**68**	**32 J**	**26**	**52**	**5.1 J**	**19**
Benzo[a]pyrene	1	1	**59**	**0.42**	**8.3**	**6.6**	**6**	**130 J**	**43 J**	**0.038 J**	**32**	**60**	**28 J**	**39**	**72 J**	**6.3**	**17**
Benzo[b]fluoranthene	1	1	**43**	**0.4**	**8.4**	**6.4**	**5.8**	**150 J**	**34 J**	0.32 U	**27**	**50**	**21 J**	**34**	**60 J**	**5.6**	**16**
Benzo[k]fluoranthene	0.8	100	**18 J**	**0.19 J**	**3.3 J**	**2.3 J**	**2.2**	**78 J**	150 U	0.32 U	**10 J**	**21**	**9.5 J**	**15**	**30 J**	**2.3 J**	**5.6 J**
Benzo[g,h,i]perylene	100	3.9	**16 J**	**0.098 J**	**9.3**	**8.2**	**7**	**57 J**	**15 J**	0.32 U	**8 J**	**14 J**	66 U	**47**	**47 J**	**4.5 J**	**11**
Chrysene	1	3.9	**70**	**0.65 J**	**6.5**	**4 J**	**4.4**	**73**	**55 J**	**0.049 J**	**37**	**67**	**31 J**	**25**	**47**	**5.1 J**	**16**
Dibenz[a,h]anthracene	0.33	0.33	**2.5 J**	0.32 U	6.1 U	6.4 U	**1.3 J**	**22 J**	150 U	0.32 U	**2.5 J**	**4.3 J**	66 U	**7.9**	**9.1 J**	5.6 U	**2.1 J**
Fluoranthene	100	100	**140**	**1.1 J**	**8.7**	**4.3 J**	**8.8**	**60**	**130 J**	**0.088 J**	**55**	**89**	**61 J**	**32**	**62**	**9.3**	**51**
Fluorene	30	100	**130**	**1.1 J**	**0.46 J**	**0.39 J**	**1.7**	**8.6 J**	**160**	**0.064 J**	**67**	**100**	**96**	**8.8**	**56**	**4.3 J**	**7.4**
Indeno[1,2,3-cd]pyrene	0.5	0.5	**17 J**	**0.1 J**	**7.8**	**6.3 J**	**6.9**	**90 J**	150 U	0.32 U	**9.4 J**	**17**	**6.5 J**	**47**	**49 J**	**3.8 J**	**11**
2-Methylnaphthalene	NE	NE	**360**	**1.9 J**	6.1 U	6.4 U	**0.49 J**	16 U	**930**	0.32 U	16 U	16 U	**410**	**22**	**31**	5.6 U	6.7 U
Naphthalene	12	100	**490**	**1.6 J**	6.1 U	6.4 U	**1.8**	16 U	**2300**	0.32 U	16 U	16 U	**930**	**39**	**72**	5.6 U	**22**
Phenanthrene	100	100	**380**	**2.7 J**	**3.2 J**	**1.9 J**	**7.7**	**46**	**390**	**0.23 J**	**190**	**280**	**200**	**32**	**150**	**15**	**33**
Pyrene	100	100	**180**	**1.5 J**	**11**	**6.3 J**	**11**	**90**	**140 J**	**0.17 J**	**87**	**140**	**87**	**52**	**130**	**12**	**61**
Total PAHs	NE	NE	**2307.5**	**15.168**	**76.26**	**53.29**	**76.59**	**904.6**	**4724**	**0.869**	**720.9**	**1108.3**	**2185**	**456.1**	**1051.1**	**86.9**	**322.3**
Other SVOCs (mg/kg)																	
Bis(2-ethylhexyl)phthalate	NE	NE	30 U	0.32 U	6.1 U	6.4 U	1.3 U	16 U	150 U	0.32 U	16 U	16 U	66 U	**0.75 J**	20 U	5.6 U	6.7 U
Butyl benzyl phthalate	NE	NE	30 U	0.32 U	**1 J**	6.4 U	1.3 U	16 U	150 U	0.32 U	16 U	16 U	66 U	3.3 U	20 U	5.6 U	6.7 U
Carbazole	NE	NE	**6.2 J**	**0.052 J**	6.1 U	6.4 U	**0.85 J**	**2.3 J**	**13 J**	0.32 U	**1.5 J**	**2.5 J**	66 U	**1.8 J**	**3.1 J**	**0.4 J**	**1.9 J**
Dibenzofuran	7	59	**34**	**0.18 J**	6.1 U	6.4 U	**1.3 J**	**2.2 J**	**43 J**	0.32 U	**7.4 J**	**9.6 J**	**9.9 J**	**2.8 J**	**7.9 J**	**1.4 J**	**6.9**
2,4-Dimethylphenol	NE	NE	30 U	0.32 U	6.1 U	6.4 U	1.3 U	16 U	150 U	0.32 U	16 U	16 U	66 UJ	3.3 UJ	20 UJ	5.6 U	6.7 U
Di-n-butyl phthalate	NE	NE	30 U	0.32 U	6.1 U	6.4 U	1.3 U	16 U	150 U	0.32 U	16 U	16 U	66 U	3.3 U	20 U	5.6 U	6.7 U
2-Methylphenol (o-Cresol)	0.33	100	30 U	0.32 U	6.1 U	6.4 U	1.3 U	16 U	150 U	0.32 U	16 U	16 U	66 U	3.3 U	20 U	5.6 U	**0.42 J**
4-Methylphenol (p-Cresol)	0.33	100	30 U	0.32 U	6.1 U	6.4 U	1.3 U	16 U	150 U	0.32 U	16 U	16 U	66 U	3.3 U	20 U	5.6 U	**1.2 J**
4-Nitroaniline	NE	NE	30 U	0.32 U	6.1 U	6.4 U	1.3 U	16 U	150 U	0.32 U	16 U	16 U	66 U	3.3 U	20 U	5.6 U	6.7 U
Phenol	0.33	100	30 U	0.32 U	6.1 U	6.4 U	1.3 U	16 U	150 U	0.32 U	16 U	16 U	66 U	3.3 U	20 U	5.6 U	6.7 U
Total SVOC	NE	NE	**2347.7**	**15.4**	**77.26**	**53.29**	**78.74**	**909.1**	**4780**	**0.869**	**729.8**	**1120.4**	**2194.9**	**461.45**	**1062.1**	**88.7**	**332.72**
PCBs (mg/kg)																	
Aroclor 1248	NE	NE	NA	NA	0.041 U	NA	NA	0.02 U	NA	NA	0.04 U	0.04 U	NA	0.44 U	NA	0.037 U	NA
Aroclor 1254	NE	NE	NA	NA	0.041 U	NA	NA	0.02 U	NA	NA	0.04 U	0.04 U	NA	0.44 U	NA	0.037 U	NA
Aroclor 1260	NE	NE	NA	NA	0.041 U	NA	NA	0.02 U	NA	NA	0.04 U	0.04 U	NA	0.44 U	NA	0.037 U	NA
Aroclor 1268	NE	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total PCBs	NE	NE	NA	NA	ND	NA	NA	ND	NA	NA	ND	ND	NA	ND	NA	ND	NA
Pesticides (mg/kg)																	
Aldrin	0.005	0.097	NA	NA	0.021 U	NA	NA	0.002 UJ	NA	NA	0.21 U	0.42 U	NA	0.045 U	NA	0.038 UJ	NA
beta-BHC	0.036	0.36	NA	NA	0.021 U	NA	NA	0.002 UJ	NA	NA	0.21 U	0.42 U	NA	0.045 U	NA	0.038 UJ	NA
gamma-BHC	0.1	1.3	NA	NA	0.021 U	NA	NA	**0.0021 J**	NA	NA	0.21 UJ	0.42 U	NA	0.045 UJ	NA	0.038 UJ	NA
delta-BHC	0.04	100	NA	NA	0.021 U	NA	NA	**0.00089 J**	NA	NA	0.21 UJ	0.42 U	NA	0.045 UJ	NA	0.038 UJ	NA
alpha-chlordane	0.094	4.2	NA	NA	0.021 U	NA	NA	**0.0025**	NA	NA	0.21 U	0.42 U	NA	0.045 U	NA	0.038 UJ	NA
gamma-Chlordane	NE	NE	NA	NA	0.021 U	NA	NA	0.002 U	NA	NA	0.21 U	0.42 U	NA	0.045 U	NA	0.038 UJ	NA
4,4-DDD	0.0033	13	NA	NA	0.021 U	NA	NA	0.0039 UJ	NA	NA	0.21 U	0.42 UJ	NA	0.045 UJ	NA	0.038 UJ	NA
4,4'-DDE	0.0033	8.9	NA	NA	0.021 U	NA	NA	0.0039 U	NA	NA	0.21 U	0.42 U	NA	0.045 U	NA	0.038 U	NA
4,4'-DDT	0.0033	7.9	NA	NA	0.021 U	NA	NA	0.0039 U	NA	NA	0.21 U	0.42 UJ	NA	0.045 UJ	NA	0.038 U	NA
Dieldrin	0.005	0.2	NA	NA	0.021 U	NA	NA	0.0039 UJ	NA	NA	0.21 U	0.42 U	NA	0.045 U	NA	0.038 UJ	NA
Endosulfan I	2.4	24	NA	NA	0.021 U	NA	NA	0.002 UJ	NA	NA	0.21 U	0.42 U	NA	0.045 UJ	NA	0.038 UJ	NA
Endosulfan II	2.4	24	NA	NA	0.021 U	NA	NA	**0.014 J**	NA	NA	0.21 U	0.42 U	NA	0.045 U	NA	0.038 U	NA
Endosulfan sulfate	2.4	24	NA	NA	0.021 U	NA	NA	0.0039 U	NA	NA	0.21 U	0.42 U	NA	0.045 U	NA	0.038 U	NA
Endrin	0.014	11	NA	NA	0.021 U	NA	NA	0.0039 UJ	NA	NA	0.21 U	0.42 U	NA	0.045 U	NA	0.038 UJ	NA
Endrin aldehyde	NE	NE	NA	NA	0.021 U	NA	NA	**0.03 J**	NA	NA	0.21 U	0.42 U	NA	0.045 U	NA	0.038 U	NA
Endrin ketone	NE	NE	NA	NA	**0.011 J**	NA	NA	**0.0016 J**	NA	NA	0.21 U	0.42 U	NA	**0.043 J**	NA	0.038 U	NA
Heptachlor	0.042	2.1	NA	NA	0.021 U	NA	NA	0.002 UJ	NA	NA	0.21 U	0.42 U	NA	0.045 U	NA	0.038 UJ	NA
Heptachlor epoxide	NE	NE	NA	NA	0.021 U	NA	NA	0.002 UJ	NA	NA	0.21 U	0.42 U	NA	0.045 UJ	NA	0.038 UJ	NA
Methoxychlor	NE	NE	NA	NA	0.041 U	NA	NA	0.02 UJ	NA	NA	0.4 U	0.81 UJ	NA	0.088 U	NA	0.073 UJ	NA

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Williamsburg Works Site
Brooklyn, New York

Location:	Unrestricted SCO	Restricted-Residential SCO	Adjacent to Parcels 3 and 4															
			N. 11th St. ROW		N. 12th St. ROW			N. 11th St. ROW			N. 12th St. ROW			N. 12th St. ROW		N. 12th St. ROW	
Sample Name:			WW-MW-14	WW-MW-14	WW-MW-15	Duplicate of WW-MW-15	WW-MW-15	WW-SB-13	WW-SB-13	WW-SB-13	WW-SB-14	Duplicate of WW-SB-14	WW-SB-14	WW-SB-15	WW-SB-15	WW-SB-16	WW-SB-16
Sample Depth(ft bgs): a			(36-37) 9/2/2009	(55-57) 9/2/2009	(1-4) 9/24/2009	(1-4) 9/24/2009	(12-13) 9/28/2009	(4-5) 8/21/2009	(12-15) 8/24/2009	(37-38) 8/24/2009	(1-5) 9/11/2009	(1-5) 9/11/2009	(10-11) 9/11/2009	(3-5) 9/17/2009	(7-9) 9/17/2009	(0.5-5) 9/22/2009	(12-13) 9/23/2009
Metals (mg/kg)																	
Aluminum	NE	NE	**3210**	**5340**	**4950**	**4710**	**3510**	**2790**	**4000**	**2700**	**6820**	**6650**	**8110**	**1370**	**3960**	**5160**	**2620**
Arsenic	13	16	**7 J**	**2.8 J**	**39.2**	**45.1**	**65.9**	**3.9 J**	**31.9**	6 U	6.3 UJ	6.2 U	6.5 U	**6.6**	**16.9**	**14.4 J**	**17.7 J**
Barium	350	400	**36.8 J**	**43.7 J**	**54**	**56.1**	**38 J**	**21.4**	**56.5 J**	**15.1 J**	**46.6**	**52.3**	**30.7**	**36.6 J**	**64.8 J**	**44.5**	**30.6**
Beryllium	7.2	72	**0.49 J**	**0.28 J**	**0.31**	**0.27**	1.5 U	1.4 U	**0.36 J**	**0.64 J**	1.5 UJ	1.5 U	1.5 U	1.5 U	**0.31 J**	**0.27 J**	**0.14 J**
Cadmium	2.5	4.3	**0.31 J**	1.4 U	1.4 U	1.5 U	1.5 U	1.4 UJ	1.5 U	1.4 UJ	**1.6 J**	**0.87 J**	**0.79 J**	1.5 U	1.8 UJ	1.3 U	1.5 U
Calcium	NE	NE	**5040 J**	**10800 J**	**2260**	**5380**	**1960**	71.3 UJ	**12100 J**	**384 J**	**3230 J**	**2910 J**	**743 J**	**1380**	**4040**	**18700 J**	**21700 J**
Chromium	NE	NE	**10.6 J**	**13 J**	**15.7**	**21.6**	**43.7 J**	**4.2 J**	**12.9 J**	**17.9 J**	**13 J**	**11.1 J**	**15.5 J**	**6.2**	**11**	**15 J**	**20.2 J**
Cobalt	NE	NE	**5.9**	**6.2**	**6.9**	**4.8**	**12.2**	**1.3 J**	**3.8 J**	**5.2 J**	**5.8**	**5.7**	**6.9**	**2.2 J**	**8.4 J**	**5.7**	**3.2**
Copper	50	270	**11.3**	**13.7**	**104**	**142**	**202**	**7.9**	**64.2 J**	**17.1 J**	**36.4**	**36.6**	**13**	**54.1**	**123**	**50.6**	**57.8**
Iron	NE	NE	**24400 J**	**17700 J**	**17900**	**12700**	**14800**	**5830 J**	**14500 J**	**44200 J**	**32300 J**	**15800 J**	**20200**	**6470 J**	**25600 J**	**11400**	**9200**
Lead	63	400	**5.7 J**	4.3 U	**345**	**502**	**450 J**	**25.3 J**	**99 J**	**6 J**	**219 J**	**243 J**	**10.3 J**	**353**	**320**	**90.7 J**	**369 J**
Magnesium	NE	NE	**3730**	**5720**	**2740**	**2880**	**2550**	**517 J**	**1700 J**	**535 J**	**1830**	**1830**	**2160**	**550**	**1310**	**3260**	**2120**
Manganese	1600	2000	**875**	**421**	**132**	**90**	**196**	**24.8 J**	**178 J**	**348 J**	**268**	**180**	**230**	**25.3**	**174**	**111**	**103**
Mercury	0.18	0.81	**0.0075 J**	**0.017 J**	**0.34**	**1.6**	**0.11**	**0.12**	**0.81 J**	**0.0065 J**	**0.18**	**0.19**	**0.014 J**	**0.84 J**	**8.6 J**	**0.41 J**	**6.9 J**
Nickel	30	310	**10.3**	**10.1**	**19.8**	**14.6**	**17.1 J**	**4.1**	**9.9**	**6.7**	**14.5**	**13.3**	**12.7**	**6.6 J**	**18.8 J**	**22.9**	**14.3**
Potassium	NE	NE	**774 J**	**1170 J**	**903**	**1000**	**652 J**	71.3 UJ	**655 J**	**255 J**	**793 J**	**796 J**	**868 J**	**359 J**	**635 J**	**914 J**	**640 J**
Selenium	3.9	180	R	R	10.5 U	11.2 U	**6 J**	10.7 U	11.1 U	10.7 U	R	R	R	11.3 UJ	13.5 UJ	9.8 U	11.4 U
Silver	2	180	1.4 UJ	1.4 U	**0.083**	**0.21**	**0.27 J**	1.4 U	**0.11 J**	1.4 U	1.5 UJ	1.5 U	1.5 U	1.5 U	**0.43 J**	**0.87 J**	**0.29 J**
Sodium	NE	NE	**800**	**1480**	**1850**	**1590**	**1560**	71.3 U	**510 J**	**67.8 J**	**177 J**	**178**	**296**	75.5 UJ	**1270 J**	**391**	**2410**
Thallium	NE	NE	4.3 UJ	4.3 UJ	**2.2**	**1.6**	**1.1 J**	4.3 UJ	4.5 U	4.3 U	4.5 UJ	4.4 UJ	4.6 UJ	4.5 U	5.4 UJ	**1 J**	4.6 U
Vanadium	NE	NE	**19.6 J**	**22.2 J**	**19.8**	**19.7**	**13.9 J**	**7.9 J**	**15.7 J**	**28.9 J**	**21.5**	**19**	**24.5**	**5.2**	**16.4**	**36.7 J**	**10.3 J**
Zinc	109	10000	**32 J**	**32.6 J**	**248**	**177**	**94.2 J**	**26.9**	**89.8**	**35.5**	**317**	**345**	**31.1**	**6.6 J**	**216**	**93.2**	**84.9**
Cyanides (mg/kg)																	
Free Cyanide	NE	NE	0.228 U	0.234 U	0.233 U	0.238 U	0.242 UJ	0.237 U	0.234 UJ	0.238 U	0.242 UJ	0.24 UJ	0.238 UJ	0.24 UJ	0.296 UJ	0.218 UJ	0.249 UJ
Other (mg/kg)																	
Ammonia	NE	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 4. Remaining Soil Analytical Results
Interim Site Management Plan
Williamsburg Works Site
Brooklyn, New York

Notes:

mg/kg - milligrams/kilogram or parts per million (ppm)
BTEX - benzene, toluene, ethylbenzene, and xylenes
VOCs - volatile organic compounds
PAHs - polycyclic aromatic hydrocarbons
SVOCs - semivolatile organic compounds
PCBs - polychlorinated biphenyls
Total BTEX, Total VOCs, Total PAHs, Total SVOCs, and Total PCBs are calculated using detects only.
Total PAHs are calculated using the EPA16 list of analytes: Acenaphthene, Acenaphthylene, Anthracene, Benz[a]anthracene, Benzo[a]pyrene, Benzo[b]fluoranthene, Benzo[g,h,i]perylene, Benzo[k]fluoranthene, Chrysene, Dibenz[a,h]anthracene, Fluoranthene, Fluorene, Indeno[1,2,3-cd]pyrene, 2-Methylnaphthalene, Naphthalene, Phenanthrene, and Pyrene

6 NYCRR - New York State Register and Official Compilation of Codes, Rules and Regulations of the State of New York
Comparison of detected results are performed against one or more of the following NYCRR, Chapter IV, Part 375-6 Soil Cleanup Objectives (SCO)s: Unrestricted Use, Residential, Restricted-Residential, Commercial, Industrial, Protection of Ecological Resources, or Protection of Groundwater
* 500 ppm total PAH SCO for non-residential sites (Commercial or Industrial), per NYSDEC CP-51 / Soil Cleanup Guidance, Section V(H).

NE - not established
NA - not analyzed
ND - not detected; total concentrations are listed as ND because no analytes are detected in the group

Bolding indicates a detected concentration
Gray shading and bolding indicates that the detected result value exceeds the Unrestricted SCO
Yellow shading and bolding indicates that the detected result value exceeds the Restricted Residential SCO
Orange shading and bolding indicates that the detected result value exceeds the Industrial SCO

Validation Qualifiers:

J - estimated value
JN - analyte is presumptively present at an approximated quantity
R - rejected
U - indicates not detected to the reporting limit
UJ - not detected at or above the reporting limit shown and the reporting limit is estimated

Table 5. Detected Groundwater Analytical Results
Interim Site Management Plan
Williamsburg Works Site
Brooklyn, New York

Location:	NYS AWQS	Parcel 1 - [Block 2288 Lot 1]											Adjacent to Parcel 1		Parcel 2 [Block 2287 ot 1]				Adjacent to Parcel 2	Adjacent to Parcels 3 and 4				
													N. 11th St. ROW	N. 12th St. ROW					N. 11th St.	N. 11th St. ROW		N. 12th St. ROW		
Sample Name:		WW-SB-19	WW-SB-19	Duplicate of WW-SB-19	WW-SB-19	WW-SB-21	Duplicate of WW-SB-21	WW-SB-21	WW-SB-21	WW-SB-22	WW-SB-22	WW-SB-22	WW-MW-02	WW-MW-03	WW-SB-03	WW-MW-04	Duplicate of WW-MW-04	WW-MW-17	WW-MW-08	WW-MW-14	WW-MW-11	WW-MW-10	WW-MW-13	WW-MW-15
Sample Depth (feet):		(5-15)	(25-35)	(25-35)	(40-50)	(4-14)	(4-14)	(15-25)	(40-50)	(6-16)	(35-45)	(55-65)	(7.4-17.4)	(4-14)	(5-10)	(10-20)	(10-20)	(4-14)	(0.3-10.3)	(4-14)	(4-14)	(4-14)	(4-14)	(4-14)
Sample Date:		7/28/2009	7/29/2009	7/29/2009	7/29/2009	7/8/2009	7/8/2009	7/22/2009	7/23/2009	7/8/2009	7/27/2009	7/27/2009	11/4/2009	11/4/2009	7/14/2009	11/4/2009	11/5/2009	11/5/2009	11/5/2009	11/6/2009	11/5/2009	11/5/2009	11/6/2009	11/6/2009
BTEX (ug/L)																								
Benzene	1	**79**	**44**	**36**	5 U	**330**	**370**	**4000**	**8300**	**43**	**1300**	**9600**	5 U	5 U	**3700**	**8.7**	**9.2**	5 U	**570**	5 U	**320**	**29**	**540**	**1.7 J**
Toluene	5	**170**	**91 J**	**59 J**	**64**	**3.7 J**	**4.5 J**	**2000**	**2700**	5 U	**360**	**1100**	5 U	5 U	**110 J**	**5.2**	**5.4**	5 U	**64 J**	5 U	**38 J**	**3.1 J**	**7 J**	5 U
Ethylbenzene	5	**35**	**45**	**40**	**11**	**46**	**50**	**850**	**1600**	**1 J**	**160**	**1400**	5 U	5 U	**3000**	**16**	**17**	5 U	**2800**	5 U	**1600**	**330**	**190**	5 U
Total Xylene	5	**190**	**95**	**75**	**55**	**58**	**65**	**3200**	**1800**	5 U	**290**	**1500**	5 U	5 U	**1800**	**21**	**23**	5 U	**3100**	5 U	**280**	**200**	**100**	5 U
Total BTEX	NE	**474**	**275**	**210**	**130**	**437.7**	**489.5**	**10050**	**14400**	**44**	**2110**	**13600**	ND	ND	**8610**	**50.9**	**54.6**	ND	**6534**	ND	**2238**	**562.1**	**837**	**1.7**
Other VOCs (ug/L)																								
Acetone	50*	10 U	10 U	10 U	10 U	40 U	40 U	500 U	1000 U	10 U	**55 J**	1000 U	10 U	10 UJ	400 U	10 UJ	10 UJ	10 U	200 U	10 U	100 U	**16 J**	50 U	10 U
Chloroform	7	**7.9**	**7.6**	**7.1**	**3.1 J**	20 U	20 U	250 U	500 U	5 U	50 U	500 U	5 U	5 U	200 U	5 U	5 U	5 U	100 U	5 U	50 U	10 U	25 U	5 U
1,1-Dichloroethene	0.07	5 U	**1.4 J**	**1.5 J**	5 U	20 U	20 U	250 U	500 U	5 U	50 U	500 U	5 U	5 U	200 U	5 U	5 U	5 U	100 U	5 U	50 U	10 U	25 U	5 U
cis-1,2-Dichloroethene	5	**1.1 J**	**21**	**19**	**4.9 J**	20 U	20 U	250 U	**130 J**	5 U	**97**	500 U	**14**	5 U	200 U	**4.4 J**	**4.9 J**	5 U	100 U	5 U	50 U	10 U	25 U	5 U
trans-1,2-Dichloroethene	5	5 U	**30 J**	**29 J**	5 U	20 U	20 U	250 U	**240 J**	5 U	50 U	500 U	5 U	5 U	200 U	**0.91 J**	**1.1 J**	5 U	100 U	5 U	50 U	10 U	25 U	5 U
Styrene	5	5 U	5 U	5 U	5 U	20 U	20 U	**400**	500 U	5 U	**16 J**	500 U	5 U	5 U	200 U	**1.9 J**	**2.1 J**	5 U	100 U	5 U	50 U	10 U	25 U	5 U
Trichloroethene	5	5 U	**42**	**38**	5 U	**2.9 J**	20 U	250 U	500 U	5 U	50 U	500 U	5 U	5 U	200 U	**2.6 J**	**3 J**	5 U	100 U	5 U	50 U	10 U	25 U	5 U
Vinyl chloride	2	5 U	**1.4 J**	**1.3 J**	5 U	20 U	20 U	250 U	500 U	5 U	**14 J**	500 U	5 U	5 U	200 U	**1.2 J**	**1.2 J**	5 U	100 U	5 U	50 U	10 U	25 U	5 U
Total VOCs	NE	**483**	**378.4**	**305.9**	**138**	**440.6**	**489.5**	**10450**	**14770**	**44**	**2292**	**13600**	**14**	ND	**8610**	**61.91**	**66.9**	ND	**6534**	ND	**2238**	**578.1**	**837**	**1.7**
PAHs (ug/L)																								
Acenaphthene	20*	**4.5**	**3 J**	**2 J**	4.2 U	**42**	**58**	**29 J**	**42 J**	**3.1 J**	**40 J**	**82 J**	4 U	**0.33 J**	**86 J**	**3 J**	**3 J**	**2 J**	**140 J**	4.2 U	**140 J**	**28 J**	**100**	**7.8**
Acenaphthylene	NE	**1.4 J**	**0.71 J**	**0.52 J**	4.2 U	40 U	**2 J**	**18 J**	**53 J**	**0.66 J**	**24 J**	200 U	4 U	4 U	400 U	**11**	**12**	4 U	800 U	4.2 U	830 U	40 U	42 U	4.3 U
Anthracene	50*	**2.5 J**	4.2 U	4 UJ	4.2 U	**3.3 J**	**4.3 J**	210 U	200 U	**0.59 J**	210 U	200 U	4 U	4 U	400 U	**3.7 J**	**3.5 J**	4 U	800 U	4.2 U	830 U	40 U	**5.4 J**	**0.52 J**
Benz[a]anthracene	0.002*	**0.8 J**	4.2 U	4 UJ	4.2 U	40 U	20 U	210 U	200 U	4 U	210 U	200 U	4 U	4 U	400 U	4 U	4.2 U	4 U	800 U	4.2 U	830 U	40 U	42 U	4.3 U
Benzo[g,h,i]perylene	NE	4 U	4.2 U	4 UJ	4.2 U	40 U	20 U	210 U	200 U	**5.5**	210 U	200 U	4 U	4 U	400 U	4 U	4.2 U	4 U	800 U	4.2 U	830 U	40 UJ	42 U	4.3 U
Chrysene	0.002*	**0.92 J**	4.2 U	4 UJ	4.2 U	40 U	20 U	210 U	200 U	4 U	210 U	200 U	4 U	4 U	400 U	4 U	4.2 U	4 U	800 U	4.2 U	830 U	40 U	42 U	4.3 U
Fluoranthene	50*	**1.1 J**	4.2 U	4 UJ	4.2 U	40 U	**2.2 J**	210 U	200 U	**0.39 J**	210 U	200 U	4 U	4 U	400 U	**1.1 J**	**1.1 J**	4 U	800 U	4.2 U	830 U	40 U	**3.5 J**	**1.2 J**
Fluorene	50*	**5.3**	**0.65 J**	**0.53 J**	4.2 U	**8.1 J**	**11 J**	210 U	**21 J**	**1.2 J**	210 U	200 U	4 U	4 U	400 U	**9.8**	**10**	**0.59 J**	800 U	4.2 U	830 U	**13 J**	**21 J**	**2.3 J**
Indeno[1,2,3-cd]pyrene	0.002*	4 UJ	4.2 UJ	4 UJ	4.2 UJ	40 U	20 U	210 U	200 U	**5.3**	210 U	200 U	4 U	4 U	400 U	4 U	4.2 U	4 U	800 U	4.2 U	830 U	40 UJ	42 U	4.3 U
2-Methylnaphthalene	NE	**17**	**3.6 J**	**2.5 J**	4.2 U	**35 J**	**28**	**180 J**	**280**	4 U	**220**	**220**	4 U	4 U	**380 J**	**35**	**45**	**1.1 J**	**540 J**	4.2 U	**620 J**	**110**	**17 J**	4.3 U
Naphthalene	10*	**6.8**	**28**	**21 J**	4.2 U	**440 J**	**180 J**	**3400**	**2200**	4 U	**2000**	**2600**	**0.87 J**	4 U	**5800**	**43**	**56**	**4.1**	**4000**	4.2 U	**6300**	**580**	**370**	**1.4 J**
Phenanthrene	50*	**12**	**1.2 J**	**0.89 J**	4.2 U	**15 J**	**21**	**24 J**	**21 J**	**1.7 J**	210 U	200 U	4 U	4 U	400 U	**15**	**17**	**0.68 J**	800 U	4.2 U	830 U	**15 J**	**35 J**	**3.5 J**
Pyrene	50*	**2.4 J**	4.2 U	4 UJ	4.2 U	40 U	**2 J**	210 U	200 U	**0.38 J**	210 U	200 U	4 U	4 U	400 U	**2.8 J**	**2.6 J**	4 U	800 U	4.2 U	830 U	**3.6 J**	**4.3 J**	**0.56 J**
Total PAHs	NE	**54.72**	**37.16**	**27.44**	ND	**543.4**	**308.5**	**3651**	**2617**	**18.82**	**2284**	**2902**	**0.87**	**0.33**	**6266**	**124.4**	**150.2**	**8.47**	**4680**	ND	**7060**	**749.6**	**556.2**	**17.28**
Other SVOCs (ug/L)																								
Bis(2-ethylhexyl)phthalate	5	4 U	4.2 U	**0.94 J**	4.2 U	40 U	20 U	210 U	200 U	**2.8 J**	210 U	200 U	4 U	4 U	400 U	**1.1 J**	**1.9 J**	4 U	800 U	4.2 U	830 U	40 U	42 U	4.3 U
Butyl benzyl phthalate	50*	4 U	4.2 U	4 UJ	4.2 U	40 U	20 U	210 U	200 U	**1.8 J**	210 U	200 U	4 U	4 U	400 U	4 U	4.2 U	4 U	800 U	4.2 U	830 U	40 U	42 U	4.3 U
Carbazole	NE	**3.1 J**	**0.49 J**	**0.36 J**	4.2 U	**6 J**	**7.8 J**	210 U	200 U	**0.74 J**	210 U	200 U	4 U	4 U	400 U	4 U	4.2 U	4 U	800 U	4.2 U	830 U	40 U	**5.8 J**	4.3 U
Dibenzofuran	NE	**2.3 J**	4.2 U	4 UJ	4.2 U	40 U	**5.8 J**	210 U	200 U	4 U	210 U	200 U	4 U	4 U	400 U	**1.1 J**	**1 J**	4 U	800 U	4.2 U	830 U	40 U	**5.2 J**	**2 J**
Diethyl phthalate	50*	4 U	4.2 U	4 UJ	4.2 U	40 U	20 U	210 U	200 U	**1.1 J**	210 U	200 U	4 U	4 U	400 U	4 U	4.2 U	4 U	800 U	4.2 U	830 U	40 U	42 U	4.3 U
Di-n-butyl phthalate	50	**0.4 J**	4.2 U	4 UJ	4.2 U	40 U	20 U	210 U	200 U	**0.82 J**	210 U	200 U	4 U	4 U	400 U	4 U	4.2 U	4 U	800 U	4.2 U	830 U	40 U	42 U	4.3 U
2-Methylphenol (o-Cresol)	1	4 U	**0.39 J**	4 U	4.2 U	40 U	20 U	210 U	200 U	4 U	210 U	200 U	4 U	4 U	400 U	4 U	4.2 U	4 U	800 U	4.2 U	830 U	40 U	42 U	4.3 U
4-Methylphenol (p-Cresol)	1	4 U	**0.76 J**	**0.45 J**	4.2 U	40 U	20 U	210 U	200 U	4 U	210 U	200 U	4 U	4 U	400 U	4 U	4.2 U	4 U	800 U	4.2 U	830 U	40 U	42 U	4.3 U
Phenol	1	4 U	4.2 U	**0.33 J**	4.2 U	**22 J**	**9.9 J**	210 U	200 U	4 U	210 U	200 U	4 U	4 U	400 U	4 U	4.2 U	4 U	800 U	4.2 U	830 U	40 U	**3.2 J**	4.3 U
Total SVOCs	NE	**60.52**	**38.8**	**29.52**	ND	**571.4**	**332**	**3651**	**2617**	**26.08**	**2284**	**2902**	**0.87**	**0.33**	**6266**	**126.6**	**153.1**	**8.47**	**4680**	ND	**7060**	**749.6**	**570.4**	**19.28**
PCBs (ug/L)																								
Totoal PCBs	NE	ND	NA	NA	NA	ND	ND	NA	NA	ND	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pesticides (ug/L)																								
Aldrin	ND	0.052 UJ	NA	NA	NA	**0.028 J**	**0.044 J**	NA	NA	0.05 U	NA	NA	0.05 U	0.052 U	0.05 UJ	0.054 U	0.053 U	0.052 U	0.052 U	0.052 U	0.052 UJ	0.054 U	0.053 U	0.053 U
alpha-BHC	0.01	0.052 UJ	NA	NA	NA	0.05 U	0.05 U	NA	NA	0.05 U	NA	NA	0.05 U	0.052 U	0.05 UJ	0.054 U	0.053 U	0.052 U	0.052 U	0.052 U	0.052 UJ	0.054 U	0.053 U	**0.02 J**
beta-BHC	0.04	**0.021 J**	NA	NA	NA	0.05 U	0.05 UJ	NA	NA	0.05 U	NA	NA	**0.013 J**	0.052 U	**0.092 JN**	0.054 U	0.053 U	0.052 U	0.052 U	0.052 U	0.052 UJ	0.054 U	0.053 U	0.053 U
delta-BHC	0.04	0.052 UJ	NA	NA	NA	0.05 U	0.05 UJ	NA	NA	0.05 U	NA	NA	0.05 U	0.052 U	**0.084 J**	0.054 U	0.053 U	0.052 U	**0.019 J**	0.052 U	**0.041 J**	0.054 U	0.053 U	0.053 U
alpha-chlordane	NE	0.052 UJ	NA	NA	NA	0.05 U	0.05 UJ	NA	NA	0.05 U	NA	NA	0.05 U	0.052 U	0.05 UJ	0.054 U	0.053 UJ	0.052 UJ	0.052 UJ	0.052 UJ	0.052 UJ	0.054 UJ	0.053 U	**0.029 J**
gamma-Chlordane	NE	0.052 UJ	NA	NA	NA	0.05 U	0.05 UJ	NA	NA	0.05 U	NA	NA	0.05 U	0.052 U	**0.069 JN**	0.054 U	0.053 U	0.052 U	0.052 U	0.052 U	0.052 UJ	0.054 U	0.053 U	0.053 U
4,4'-DDT	0.2	0.1 UJ	NA	NA	NA	0.1 U	0.1 UJ	NA	NA	0.1 U	NA	NA	0.1 U	0.1 U	0.1 UJ	0.11 U	0.11 U	0.1 U	**0.028 J**	0.1 U	0.1 UJ	0.11 U	0.11 U	0.11 U
Endosulfan II	NE	0.1 UJ	NA	NA	NA	**0.035 J**	0.1 UJ	NA	NA	0.1 U	NA	NA	0.1 U	0.1 U	0.1 UJ	0.11 U	0.11 U	0.1 U	0.1 U	0.1 U	0.1 UJ	0.11 U	0.11 U	0.11 U
Heptachlor epoxide	0.03	0.052 UJ	NA	NA	NA	0.05 U	0.05 UJ	NA	NA	0.05 U	NA	NA	0.05 U	0.052 U	**0.04 J**	0.054 U	0.053 U	0.052 U	0.052 U	0.052 U	0.052 UJ	0.054 U	0.053 U	0.053 U
Herbicides (ug/L)																								
Total Herbicides	NE	ND	NA	NA	NA	ND	ND	NA	NA	ND	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 5. Detected Groundwater Analytical Results
Interim Site Management Plan
Williamsburg Works Site
Brooklyn, New York

Location:	NYS AWQS	Parcel 1 - [Block 2288 Lot 1]											Adjacent to Parcel 1		Parcel 2 [Block 2287 ot 1]				Adjacent to Parcel 2	Adjacent to Parcels 3 and 4				
													N. 11th St. ROW	N. 12th St. ROW					N. 11th St.	N. 11th St. ROW		N. 12th St. ROW		
Sample Name:		WW-SB-19	WW-SB-19	Duplicate of WW-SB-19	WW-SB-19	WW-SB-21	Duplicate of WW-SB-21	WW-SB-21	WW-SB-21	WW-SB-22	WW-SB-22	WW-SB-22	WW-MW-02	WW-MW-03	WW-SB-03	WW-MW-04	Duplicate of WW-MW-04	WW-MW-17	WW-MW-08	WW-MW-14	WW-MW-11	WW-MW-10	WW-MW-13	WW-MW-15
Sample Depth (feet):		(5-15)	(25-35)	(25-35)	(40-50)	(4-14)	(4-14)	(15-25)	(40-50)	(6-16)	(35-45)	(55-65)	(7.4-17.4)	(4-14)	(5-10)	(10-20)	(10-20)	(4-14)	(0.3-10.3)	(4-14)	(4-14)	(4-14)	(4-14)	(4-14)
Sample Date:		7/28/2009	7/29/2009	7/29/2009	7/29/2009	7/8/2009	7/8/2009	7/22/2009	7/23/2009	7/8/2009	7/27/2009	7/27/2009	11/4/2009	11/4/2009	7/14/2009	11/4/2009	11/5/2009	11/5/2009	11/5/2009	11/6/2009	11/5/2009	11/5/2009	11/6/2009	11/6/2009
Total Metals (ug/L)																								
Aluminum	NE	**14100 J**	**289 J**	**289 J**	**11700 J**	250 U	250 U	**3260**	**869**	**411 J**	**1010 J**	**4900 J**	500 U	500 U	**307 J**	500 U	500 U	500 U	**128 J**	2500 U	500 U	**297**	500 U	2500 U
Arsenic	25	**6.6**	15 U	15 U	**11.9**	**14.8 J**	**10.4 J**	**4.9 J**	15 U	**8.4 J**	15 U	15 U	15 U	15 U	**17.6 J**	15 U	15 U	15 U	15 U	**32 J**	15 U	15 U	**6.4 J**	**42.8 J**
Barium	1000	**256**	**157**	**166**	**354**	**789**	**810**	**726**	**98.5**	**200**	**528**	**293**	**315**	**436**	**3440**	**91.5**	**93.3**	**50.4**	**128**	**58.9**	**195**	**119**	**137**	**100**
Beryllium	3*	**1.1 J**	5 U	5 U	**1.2 J**	5 U	5 U	**0.29 J**	5 U	5 U	5 U	**0.64 J**	5 U	5 U	5 UJ	5 U	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U
Calcium	NE	**45700**	**109000**	**112000**	**99600**	**32300**	**33700**	**41000**	**66900**	**137000**	**296000**	**85400**	**191000**	**181000**	**182000**	**59500**	**58500**	**108000**	**49700**	**266000**	**127000**	**56900**	**170000**	**247000**
Chromium	50	**33**	5 U	5 U	**31.7**	5 UJ	5 UJ	**7.6 J**	**1.1 J**	5 U	**4 J**	**20**	**1.2 J**	**0.73 J**	5 UJ	5 U	5 U	5 U	**0.92 J**	**74.2**	**0.63 J**	**0.79 J**	5 U	25 U
Cobalt	NE	**13**	**0.86 J**	**0.93 J**	**36.3**	**11.7 J**	**11.5 J**	**13.9 J**	**1.6 J**	**1.6 J**	**1 J**	**5.3**	**2.2 J**	5 U	**4.2 J**	5 U	5 U	**0.99 J**	**1.3 J**	**6.4 J**	5 U	5 U	5 U	25 U
Copper	200	**55.6 J**	**2.6 J**	**2.5 J**	**43.3 J**	10 U	10 U	10 UJ	10 U	R	**4.7 J**	**33.1 J**	10 U	10 U	10 UJ	10 U	**1.9 J**	**7.7 J**	**4.1 J**	**44.1**	10 U	**2 J**	**7.1 J**	50 U
Iron	300	**34900**	**15800**	**16500**	**40400**	**2320**	**2390**	**8890**	**2420**	**3390**	**22400**	**21000**	**9480**	**29100**	**21100**	**2330**	**2350**	**629**	**4690**	**334 J**	**1740**	**5000**	**2390**	**310 J**
Lead	25	**24.4**	15 U	15 U	**23.1**	15 UJ	15 UJ	15 UJ	15 U	15 U	15 U	**9.9**	15 U	15 U	**189**	15 U	15 U	15 U	15 U	75 U	15 U	15 U	15 U	75 U
Magnesium	35000*	**13200**	**39700**	**41100**	**38800**	**256000**	**267000**	**261000**	**29100**	**34100**	**62500**	**39300**	**37300**	**31700**	**208000**	**5730**	**5800**	**12200**	**3450**	**697000**	**19500**	**7080**	**130000**	**688000**
Manganese	300	**581**	**2800**	**2900**	**1080**	**135**	**139**	**332**	**452**	**1820**	**6270**	**466**	**3480**	**1130**	**331**	**241**	**243**	**81.5**	**216**	**48.7**	**559**	**489**	**270**	**55.3**
Nickel	100	**22.5**	5 U	5 U	**32.4**	5 U	5 U	**4.7 J**	5 U	**1.6 J**	**3.8 J**	**8.7**	**2.1 J**	**2.6 J**	**12 J**	**7.4 J**	**8.2 J**	**14.4 J**	**15.8 J**	**159 J**	**26.2 J**	**1.7 J**	5 UJ	25 UJ
Potassium	NE	**18900 J**	**16700 J**	**17600 J**	**7600 J**	**123000 J**	**126000 J**	**115000**	**15500**	**16700 J**	**32000 J**	**14800 J**	**15800 J**	**40000 J**	**182000 J**	**24500 J**	**24500 J**	**23400 J**	**42900 J**	**379000 J**	**24900 J**	**13100 J**	**71100 J**	**377000 J**
Sodium	20000	**43400 J**	**118000 J**	**122000 J**	**41400 J**	**208000 J**	**217000 J**	**205000**	**56500**	**93500 J**	**842000 J**	**106000 J**	**496000**	**735000**	**3290000 J**	**363000**	**356000**	**316000**	**525000**	**5990000**	**362000**	**343000**	**982000**	**5980000**
Vanadium	NE	**52.7**	5 U	5 U	**52.9**	**3.4 J**	**3.7 J**	**14.8 J**	**4.2 J**	**3.8 J**	**3.1 J**	**15.8**	**3.6 J**	**3.4 J**	**7.1 J**	**1.8 J**	**1.7 J**	**2.6 J**	**8.1**	**26.1**	**7.7**	**2.6 J**	**6.9**	**30.7**
Zinc	2000*	**66**	25 U	25 U	**75.9**	25 U	25 U	25 U	25 U	25 U	**7.3 J**	**26.7**	25 UJ	**6 J**	**92.2**	25 UJ	25 UJ	25 UJ	25 UJ	**459 J**	25 UJ	25 UJ	**10.2 J**	125 UJ
Cyanides (ug/L)																								
Total Cyanide	200	**29.2**	**9.7 J**	**10**	**297**	**3540**	**3900**	**3140**	**58.6**	**60.9**	**40**	**95.4**	**3.8 J**	**8 J**	**517**	**21.9**	**24.9**	**281**	**323**	10 U	**211**	**23.5**	10 U	10 U
Other (ug/L)																								
Ammonia	2000	**440**	**1300**	**1200**	**870**	**610**	**600**	**960**	**3800**	**960**	**7600**	**9200**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 5. Detected Groundwater Analytical Results
Interim Site Management Plan
Williamsburg Works Site
Brooklyn, New York

Notes:
Analytes in blue are not detected in any sample

ug/L - micrograms per liter or parts per billion (ppb)
BTEX - benzene, toluene, ethylbenzene, and xylenes
VOCs - volatile organic compounds
PAHs - polycyclic aromatic hydrocarbons
PCBs - polychlorinated biphenyls
SVOCs - semivolatile organic compounds

Total BTEX, Total VOCs, Total PAHs, Total SVOCs and Total PCBs are calculated using detects only.
Total PAH16 is calculated using the EPA16 list of analytes: Acenaphthene, Acenaphthylene, Anthracene, Benz[a]anthracene, Benzo[a]pyrene, Benzo[b]fluoranthene, Benzo[g,h,i]perylene, Benzo[k]fluoranthene, Chrysene, Dibenz[a,h]anthracene, Fluoranthene, Fluorene, Indeno[1,2,3-cd]pyrene, Naphthalene, Phenanthrene, and Pyrene
Total PAH17 is calculated using the EPA16 list of analytes plus 2-Methylnaphthalene

NYS AWQS - New York State Ambient Water Quality Standards and Guidance Values for GA groundwater
* indicates the value is a guidance value and not a standard

NE - not established
NA - not analyzed
ND - not detected; total concentration is listed as ND because no compounds were detected in the group

Bolding indicates a detected concentration
Gray shading indicates that the detected result value exceeds NYS AWQS

Validation Qualifiers:
J - estimated value
JN - analyte is presumptively present at an approximated quantity
R - rejected
U - indicates not detected to the reporting limit
UJ - not detected at or above the reporting limit shown and the reporting limit is estimated

Table 6. Detected Indoor/Outdoor Air and Sub-Slab Vapor Analytical Results
Interim Site Management Plan
Williamsburg Works Site
Brooklyn, New York

Constituents	Sub-Slab Soil Vapor				Indoor Air				Outdoor Air
	NYSDOH Air Guidance Value	WW-SV-01	WW-SV-02	Duplicate of WW-SV-02	NYSDOH Air Guidance Value	WW-IA-01	WW-IA-02	Duplicate of WW-IA-01	WW-OA-01
BTEX (ug/m3)									
Benzene	NE	**0.29**	**0.29**	**0.3**	NE	**3.7**	**1.9**	**3**	**1.2**
Toluene	NE	**15**	**15**	**17**	NE	**450**	**410**	**370**	**5**
Ethylbenzene	NE	**1.2**	**0.65**	**0.67**	NE	**2.5 J**	**1.6**	**1.1 J**	**0.88**
Xylene, m,p-	NE	**4.2**	**2.4**	**2.7**	NE	**7.3 J**	**4.9**	**2.4 J**	**2.9**
Xylene, o-	NE	**1.4**	**0.93**	**1**	NE	**2.2 J**	**1.5**	**0.68 J**	**0.85**
Other VOCs (ug/m3)									
Acetaldehyde	NE	7.2 UJ	7.2 UJ	**16 J**	NE	**12 J**	7.2 UJ	**8.8 J**	7.2 UJ
Acetone	NE	**7.6**	**3.8 J**	**22 J**	NE	**27**	**18**	**21**	**15**
Acrolein (propenal)	NE	**0.43 J**	**0.36 J**	**1.6 J**	NE	**2.2**	**1.2**	**1.7**	**1.1**
Bromomethane	NE	0.31 U	0.31 U	0.31 U	NE	0.31 U	**0.061 J**	**0.06 J**	0.31 U
Butane	NE	**1**	**0.42**	**0.37**	NE	**30**	**10**	**25**	**4.7**
Butanone, 2-	NE	**1.1 J**	**0.79 J**	**3.2 J**	NE	**3.8**	**2.2**	**2.8**	**1.9**
Carbon disulfide	NE	**0.13 J**	**0.23 J**	**0.11 J**	NE	**0.17 J**	**0.046 J**	**0.062 J**	**0.04 J**
Carbon tetrachloride	NE	**0.89**	0.5 U	0.5 U	NE	**0.67 ***	**0.54 ***	**0.51 ***	**0.55**
Chloroethane	NE	0.21 U	0.21 U	0.21 U	NE	0.21 U	0.21 U	**0.04 J**	0.21 U
Chloroform	NE	**2**	**0.64**	**0.83**	NE	**1**	**0.77**	**0.85**	**0.2 J**
Chloromethane	NE	**0.19 J**	**0.17 J**	**0.26 J**	NE	**1.5**	**1.3**	**1.3**	**1.1**
Cyclohexane	NE	**0.27 J**	**0.15 J**	**0.21 J**	NE	**1.1**	**0.62 J**	**0.88**	**0.32 J**
Decane, n-	NE	**2.9**	**2.9**	**3.5**	NE	**2.1 J**	**6.3**	**0.23 J**	**1.3 J**
Dichlorobenzene, 1,2-	NE	**0.23 J**	**0.88 J**	**0.22 J**	NE	0.48 U	0.48 U	0.48 U	0.48 U
Dichlorobenzene, 1,3-	NE	**0.43 J**	**0.37 J**	**1.5 J**	NE	0.48 U	0.48 U	0.48 U	0.48 U
Dichlorobenzene, 1,4-	NE	0.48 U	**0.23 J**	0.48 U	NE	**0.16 J**	**0.2 J**	0.48 U	0.48 U
Dichlorodifluoromethane	NE	**1.9**	**0.95 J**	**1.7 J**	NE	**3.9**	**3.4**	**3.3**	**3.4**
Dichloroethane, 1,1-	NE	0.32 U	**0.082 J**	**0.1 J**	NE	0.32 U	0.32 U	0.32 U	0.32 U
Dichloroethane, 1,2-	NE	0.32 U	0.32 U	0.32 U	NE	**0.11 J**	0.32 U	0.32 U	0.32 U
Dodecane, n-	NE	**0.31 J**	**2.8**	**2.8**	NE	2.8 U	**0.37 J**	2.8 U	2.8 U
Ethanol	NE	**5.3 J**	**2.3 J**	**3.3 J**	NE	**41 J**	**27 J**	**34 J**	**12 J**
Ethyl toluene, 4- (Ethyltoluene, p-)	NE	**2**	0.79 U	0.79 U	NE	**0.75 J**	**0.75 J**	0.79 U	**0.42 J**
Freon-113 (Trichloro-1,2,2-trifluoroethane, 1,1,2-)	NE	**0.51 J**	**0.97**	**1.2**	NE	**0.64**	**0.55 J**	**0.54 J**	**0.52 J**
Freon-114 (Cryofluorane)	NE	0.56 U	0.56 U	0.56 U	NE	**0.31 J**	**0.27 J**	**0.29 J**	**0.36 J**
Heptane, n-	NE	**0.24 J**	**0.18 J**	**0.23 J**	NE	**7.8 J**	**2.2**	**4.8 J**	**1.2**
Hexane, n-	NE	**1.2**	**0.94**	**0.95**	NE	**3.2**	**2.4**	**3.1**	**2**
Hexanone,2-	NE	**0.18 J**	0.82 U	**0.61 J**	NE	**0.41 J**	**0.15 J**	**0.23 J**	**0.11 J**
Indan	NE	**0.41 J**	0.39 UJ	0.39 UJ	NE	0.39 UJ	0.39 UJ	0.39 UJ	0.39 UJ
Isopropyl Alcohol (Propanol, 2-)	NE	**0.69 J**	**0.27 J**	**0.43 J**	NE	**42**	**24**	**33**	**2.5**
Methyl-2-pentanone,4-	NE	**0.17 J**	0.82 U	**0.21 J**	NE	**0.58 J**	**0.43 J**	**0.42 J**	**0.31 J**
Methylene chloride	60	**2.8**	0.77 U	0.72 U	60	1.1 UJ	**1.6**	**2.2 J**	**1.9**
Naphthalene	NE	1 U	1 U	**0.21 J**	NE	1 U	1 U	1 U	1 U
Nonane	NE	**0.46 J**	**0.36 J**	**0.41 J**	NE	**1.3 J**	**1.8**	**0.18 J**	**0.66 J**
Octane, n-	NE	**0.28 J**	**0.19 J**	**0.24 J**	NE	**0.85**	**0.6 J**	**0.33 J**	**0.34 J**
Pentane	NE	**0.31 J**	**0.17 J**	**0.14 J**	NE	**4.9**	**3.2**	**4.2**	**1.9**
Styrene	NE	**0.15 J**	**0.1 J**	**0.13 J**	NE	**0.37**	**0.21 J**	**0.1 J**	**0.1 J**
Tertiary butyl Alcohol (t-Butyl alcohol)	NE	**0.13 J**	**0.048 J**	**0.13 J**	NE	**0.17 J**	**0.063 J**	**0.069 J**	**0.061 J**
Tetrachloroethene	NE	**78**	**5.5**	**6.4**	100	**110 J ***	**88 ***	**78 J ***	**1.8**
Trichloroethane, 1,1,1-	NE	**7**	**8.1**	**10**	NE	**0.095 J**	**0.077 J**	**0.076 J**	**0.079 J**
Trichloroethene	NE	**1.9**	**0.13 J**	**0.12 J**	5	**12 ***	**9.9 ***	**9.2 ***	**0.16 J**
Trichlorofluoromethane	NE	**1.4**	**1.6**	**1.9**	NE	**1.7**	**1.6**	**1.6**	**1.6**
Trimethylbenzene, 1,2,3-	NE	**0.74 J**	**0.58 J**	**0.74 J**	NE	**0.45 J**	**0.9 J**	0.39 UJ	0.39 UJ
Trimethylbenzene, 1,2,4-	NE	**4.4**	**3.4**	**4.4**	NE	**1.5 J**	**2.7**	**0.24 J**	**0.99**
Trimethylbenzene, 1,3,5-	NE	**1.4**	**0.8**	**1.2**	NE	**0.52**	**0.75**	0.39 U	**0.29 J**
Trimethylpentane, 2,2,4-	NE	**0.23 J**	**0.12 J**	**0.14 J**	NE	**1.7**	**0.93**	**1.3**	**0.58 J**
Undecane, n-	NE	**1.7 J**	**3.6**	**5.3**	NE	**0.88 J**	**3.3**	2.6 U	**0.58 J**

Table 6. Detected Indoor/Outdoor Air and Sub-Slab Vapor Analytical Results
Interim Site Management Plan
Williamsburg Works Site
Brooklyn, New York

Constituents	Sub-Slab Soil Vapor				Indoor Air				Outdoor Air
	NYSDOH Air Guidance Value	WW-SV-01	WW-SV-02	Duplicate of WW-SV-02	NYSDOH Air Guidance Value	WW-IA-01	WW-IA-02	Duplicate of WW-IA-01	WW-OA-01
Other (%)									
Helium	NE	0.21 U	0.19 U	0.18 U	NE	NA	NA	NA	NA

Notes:
Samples were collected on November 18, 2009
ug/m^3 - micrograms per cubic meter
BTEX - Benzene, Toluene, Ethylbenzene, and Xylenes (a subset of VOCs)
VOCs - Volatile Organic Compounds
NE - Not Established
NA - Not Analyzed
Bolding indicates a detection
Shading and bolding indicates that the detected concentration is above the NYSDOH Air Guidance Value it was compared to
NYSDOH - New York State Department of Health
* Action required based on NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York Matrices

Data Qualifiers:
U - Not detected at or above the reporting limit shown
UJ - Not detected at or above the reporting limit shown and the reporting limit is estimated
J - Estimated value

Sample Designations:
WW-IA-01: Indoor air sample collected from the eastern corner of the 35 Kent Avenue building
WW-IA-02: Indoor air sample collected from the north west portion of the 35 Kent Avenue building
Duplicate of WW-IA-02 : Duplicate indoor air sample collected from the eastern corner of the 35 Kent Avenue building
WW-OA-01 - Outdoor: Ambient air sample collected outside the 35 Kent Avenue building on the corner of North 12th Street and Kent Avenue
WW-SV-01: Sub-slab vapor sample collected beneath the floor slab in the southern portion of the 35 Kent Avenue building (Parcel 1)
WW-SV-02: Sub-slab vapor sample collected beneath the floor slab in the central portion of the 35 Kent Avenue building (Parcel 1)
Duplicate of WW-SV-02: Duplicate sub-slab vapor sample collected beneath the floor slab in the central portion of the 35 Kent Avenue building (Parcel 1)

Table 7. Matrix of Responsibility by Property Owner, National Grid, and Governing Agency
Interim Site Management Plan
Williamsburg Works Site
Brooklyn, New York

Task	NYSDEC	National Grid	Property Owner	Responsibility		
				NYSDEC	National Grid	Property Owner
Access Agreement (AA)	✓	✓	✓	If access is not granted to National Grid by the property owner, NYSDEC to intervene.	AA will be executed between the Property Owner and National Grid for additional work and National Grid oversight during redevelopment. Reference to the ISMP to be included in the text of the AA. National Grid will request NYSDEC intervention on their behalf, if necessary.	AA will be executed between the Property Owner and National Grid for additional work and National Grid oversight during redevelopment. Access to the Site will be provided to National Grid and NYSDEC.
Annual Report	✓	✓	✓	Review and Comment.	National Grid will prepare the annual report.	Grant access to the property for the annual inspection.
Community Air Monitoring Plan (CAMP)	✓	✓		Review and Comment.	National Grid's environmental professional consultants will follow Site-specific CAMP procedures during intrusive work.	
Emergency Response	✓	✓	✓	Review, Comment, and Approve.	National Grid will review emergency activities, conduct maintenance or repair (if necessary) and submit update to NYSDEC.	Property Owner shall provide details of emergency work to National Grid and NYSDEC within 48 hours of emergency. If the emergency activities are not necessary for National Grid to conduct, the property owner will conduct.
Engineering Controls (EC) - Cover System/ Concrete Foundations		✓	✓		Inspect ECs during annual inspection and when required by NYSDEC. Notify NYSDEC of known damage.	Maintenance and repair of the existing building foundation. Notify National Grid of damage.
EC - Observed Damage or Defect to the Foundation or EC	✓	✓	✓	Review, Comment, and Approve.	National Grid's contracted qualified environmental professional conducts an inspection within 5 days of notification. National Grid provides NYSDEC with follow-up status reports for ongoing responsive action within 45 days.	Once identified, notice to National Grid and NYSDEC within 48-hours identifying damage and mitigation actions taken.
EC - Emergency Response due to EC Failure caused by Natural Disaster	✓	✓	✓	Review, Comment, and Approve.	National Grid's contracted qualified environmental professional conducts an inspection within 5 days of event. Written confirmation to NYSDEC within 7 days of event that summarizes event and actions taken. National Grid provides NYSDEC with follow-up status reports for ongoing responsive action within 45 days.	Verbal notice to National Grid and NYSDEC as soon as possible but at least by noon the following day.
Environmental Easement (EE)	✓	✓	✓	The EE will be executed between the Property Owner and the NYSDEC.	National Grid will prepare and record the EE.	The EE will be executed between the Property Owner and the NYSDEC.
Ground Intrusion Work	✓	✓	✓	Review and Comment.	National Grid will notify NYSDEC of any event planned by National Grid within 15 days prior to work starting. National Grid to review and decide if oversight is required for work completed by the Property Owner. Following work, National Grid to update ISMP and submit to NYSDEC.	Property Owner has to provide notice to National Grid and NYSDEC as soon as possible in advance of any work and 15-day notice prior to work starting. All ground intrusive activities have to follow the ISMP.
Groundwater Use and Fluids Management*			✓			Property Owner is restricted from use of groundwater as a source of potable water or process water. Property Owner is responsible for fluids management during excavation in accordance with the EWP. Discharge of water generated during construction activities will be performed according to ISMP requirements.
HASP	✓	✓	✓	Review and Comment.	Include a Site-specific HASP in the ISMP.	Direct contractors to develop a Site-specific HASP for any subsurface work.
Metes and Bounds Survey		✓			National Grid will perform a Metes and Bounds (or similar) Survey to include in the ISMP and Environmental Easement. If additional surveying is required, National Grid will perform a Metes and Bounds (or similar) Survey to include in the SMP.	
NAPL Gauging and Recovery		✓			NAPL gauging and recovery will be completed by National Grid as detailed in the ISMP. National Grid will be responsible for any maintenance related to the recovery well network.	
Owner Notification Timeline	✓	✓		Notification receipt confirmation to Property Owner in 15 days (business)	Notification receipt confirmation to Property Owner in 15 days (business).	
Property Ownership Change			✓			Property Owner has to provide at a minimum 60 days notice to National Grid and NYSDEC.
Property Use Change (currently Industrial Use for Parcel 1 and Restricted Use Residential for Parcels 2 through 4)	✓	✓	✓	Review and Comment.	National Grid to review and confer with NYSDEC if ISMP revision and/or additional ICs are required. Following use change, National Grid to update ISMP and submit to NYSDEC, if required.	Property Owner has to provide at a minimum 60 days notice to National Grid and NYSDEC.
Record Of Decision (ROD)	✓			NYSDEC Submits ROD.		
Security			✓			Property Owner is responsible for site security.
Interim Site Management Plan (ISMP) Implementation	✓	✓	✓	Review and Approve ISMP and revisions. Append revisions to ISMP.	Implement the ISMP for annual inspections, NAPL gauging and recovery, and reporting requirements.	Implement the ISMP for any ground intrusive work that will disturb cover system.

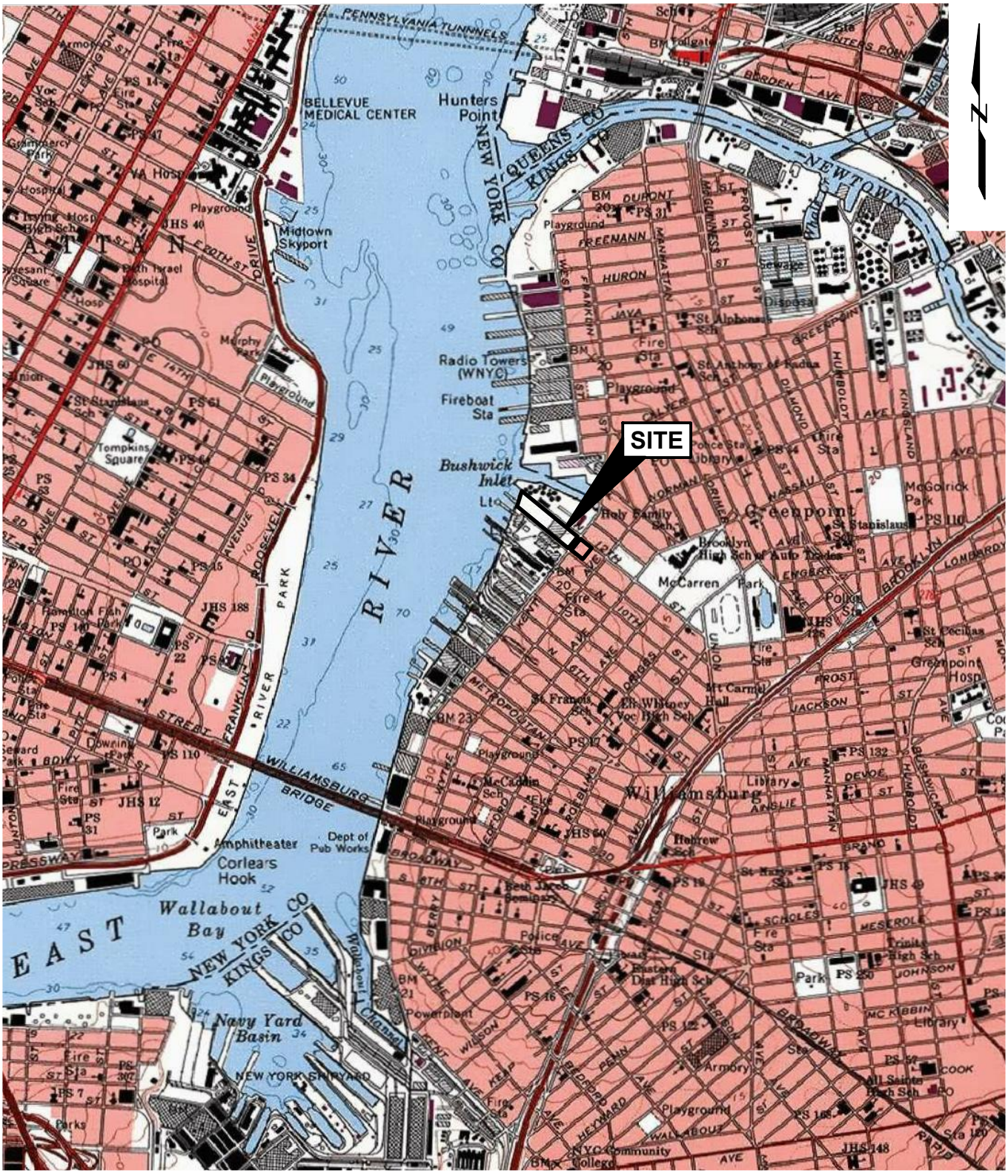
Notes:
* - The Property Owner is required to comply with the ISMP including all notifications to National Grid and provisions of the Excavation Work Plan. National Grid is only responsible for costs associated with MGP-related impacts. National Grid to reimburse Property Owner cost delta which represents the
Nothing on this page shall supersede the provisions of an Environmental Easement, Consent Order, Consent Decree, agreement, or other legally binding document that affects rights and obligations relating to the Site.

Table 8. Schedule of Interim Monitoring/Inspection Reports
Interim Site Management Plan
Williamsburg Works Site
Brooklyn, New York

Task/Report	Reporting Frequency*
NAPL Recovery Data	Quarterly Data Reports provided quarterly to NYSDEC, by email
Severe Condition Inspection Report	As Needed
Site-wide Inspection Report	Annually, or as otherwise determined by NYSDEC

* The frequency of events will be conducted as specified until otherwise approved by the NYSDEC project manager.

FIGURES



SOURCE:

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0 2000' 4000'

SCALE: 1" = 2000'

Interim Site Management Plan
Williamsburg Works Site
Borough Of Brooklyn, New York

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SITE LOCATION MAP

Project 093060 | July 2021 | Fig. 1

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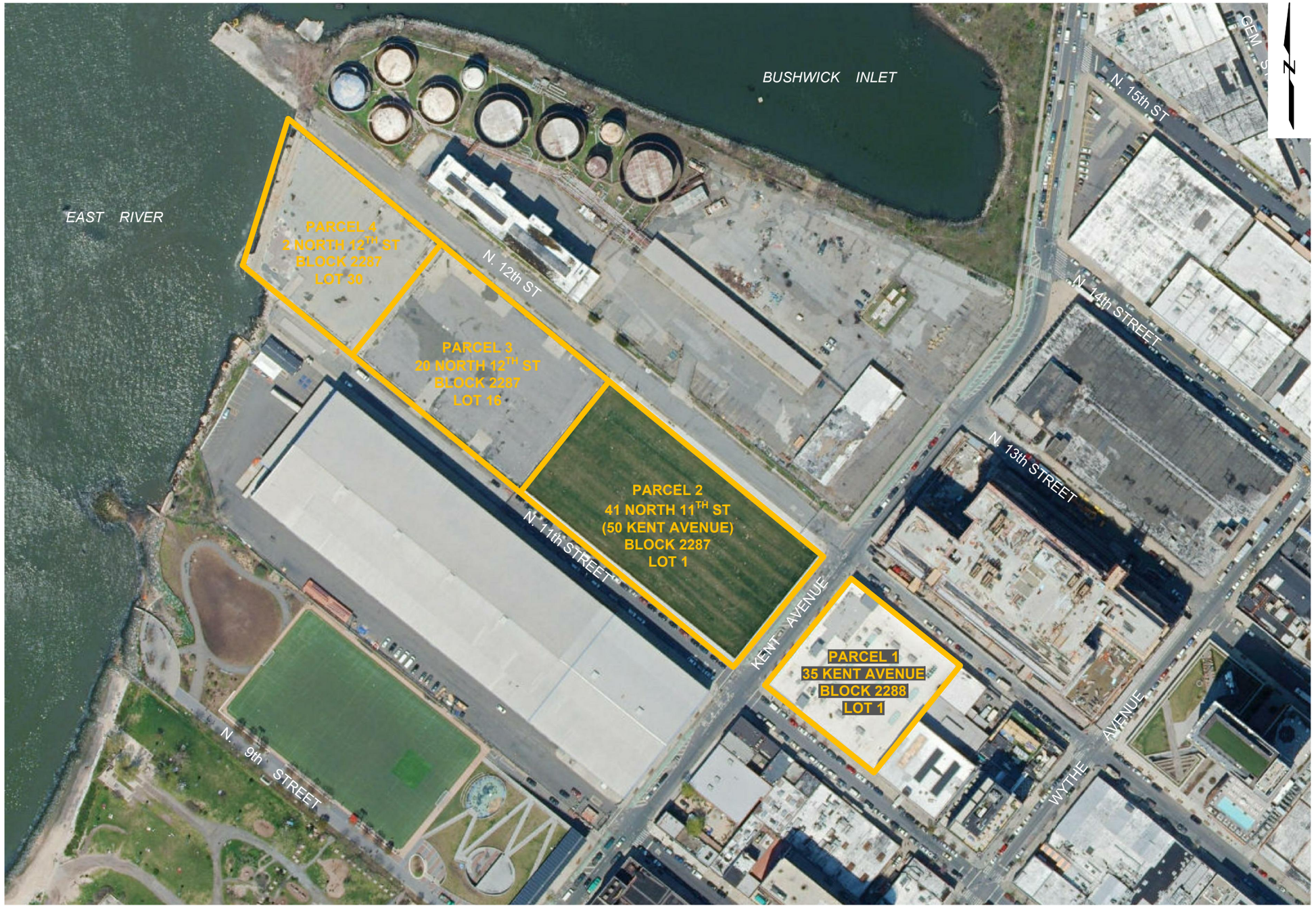

LEGEND:

APPROXIMATE SITE AND PARCEL BOUNDARIES

SOURCES:

1. AERIAL PHOTOGRAPH FROM ARCGIS WORLD IMAGERY LAYER, ACCESSED VIA ARCGISONLINE, IMAGERY DATE: 04/15/2018.
2. SANBORN FIRE INSURANCE MAPS (1887 THROUGH 1996).
3. NEW YORK CITY OPEN ACCESSIBLE SPACE INFORMATION SYSTEM HTTP://WWW.OASISNYC.NET ACCESSED JANUARY 2008.
4. SURVEY OF WILLIAMSBURG WORKS BOUNDARIES, EXISTING CONDITIONS, AND SAMPLE LOCATIONS CONDUCTED BY GEI CONSULTANTS, INC. SURVEYED BY NEW YORK STATE-LICENSED LAND SURVEYOR No. 050146.

0 150 300

SCALE: 1" = 150'

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Williamsburg Works Site
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SITE LAYOUT MAP

Project 093060 | July 2021 | Fig. 2

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LEGEND:
APPROXIMATE SITE BOUNDARY
APPROXIMATE BOUNDARY OF FORMER MGP PROPERTY
HISTORIC MGP STRUCTURES
CROSS SECTION LOCATION
REMEDIAL INVESTIGATION SAMPLES
MONITORING WELL
ABANDONED MONITORING WELL
SOIL BORING WITH TEMPORARY GROUNDWATER POINT
SOIL BORING
SURFACE SOIL SAMPLE
TEST PIT
INDOOR AIR SAMPLE
OUTDOOR AIR SAMPLE
SOIL VAPOR POINT
OTHER INVESTIGATION SAMPLES
MONITORING WELL
ABANDONED MONITORING WELL
RECOVERY WELL
ABANDONED RECOVERY WELL
SOIL BORING
TEST PIT
SOURCE:
AERIAL PHOTOGRAPH FROM ARCGIS WORLD IMAGERY LAYER, ACCESSED VIA ARCGISONLINE, IMAGERY DATE: 04/15/2018.
N. 12TH STREET
N. 11TH STREET
EAST RIVER
PARCEL 1
PARCEL 2
PARCEL 3
PARCEL 4
KENT AVENUE
GAS OIL TANK
WOODEN TAR TANK
IRON TAR TANK
COAL SHED
RETORT HOUSE/ GENERATOR HOUSE
STORAGE
OFFICE
LIME HOUSE
CONDENSER HOUSE
SALT WATER CONDENSERS
PURIFIER
PURIFYING HOUSE
EXHAUSTER HOUSE
METER HOUSE
METER/LIME HOUSE
RELIEF HOLDER
TANK
STILL HOUSE
GOVERNOR HOUSE
HOLDER NO. 1
HOLDER NO. 2
BOILER HOUSE
ENGINE BLOWER ROOM
OIL SEPARATORS
SHAVING SCRUBBERS
SCRUBBERS
TAR SEPARATING TANK
SEPARATORS
PUMP HOUSE
PAINT SHOP
BLACKSMITH SHOP
ACCOM. ROOM
IRON GAS TANK
TAR TANK
DOCK
SUMP
UNITED STATES BULKHEAD LINE
SHED
TANK PIT
HOLDER NO. 3
BROOKLYN UNION GAS CO. WILLIAMSBURG BRANCH
WW-MW-01
WW-MW-02
WW-MW-03
WW-MW-04
WW-MW-05
WW-MW-06
WW-MW-07
WW-MW-08
WW-MW-10
WW-MW-11
WW-MW-13
WW-MW-14
WW-MW-15
WW-SB-01
WW-SB-02
WW-SB-03
WW-SB-04
WW-SB-05
WW-SB-06
WW-SB-07A
WW-SB-08
WW-SB-09
WW-SB-10
WW-SB-11
WW-SB-12
WW-SB-13
WW-SB-14
WW-SB-15
WW-SB-16
WW-SB-17
WW-SB-18
WW-SB-19
WW-SB-20
WW-SB-21
WW-SB-22
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WW-SB-25
WW-SB-26
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WW-SB-28
WW-SB-29
WW-SB-30
WW-SB-31
WW-SB-32
WW-SB-33
WW-SB-34
WW-SB-35
WW-SB-36
WW-SB-37
WW-SB-38
WW-SB-39
WW-SB-40
WW-SB-41
WW-SB-42
WW-SB-100/WW-MW-100I
WW-SB-102/WW-MW-12I/D
WW-SB-103
WW-SB-104
WW-SB-105
WW-SB-106
WW-SB-107
WW-SB-108
WW-SB-109
WW-SB-110
WW-TP-01
WW-TP-02
WW-TP-03
WW-TP-04
WW-TP-05
WW-TP-06
WW-TP-07
WW-TP-08
WW-TP-09
WW-TP-10
WW-TP-11
WW-TP-12
WW-TP-13
WW-TP-14
WW-TP-15
WW-TP-16
WW-TP-17
WW-TP-18
WW-TP-19
WW-TP-20
WW-TP-21
WW-TP-22
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WW-TP-24
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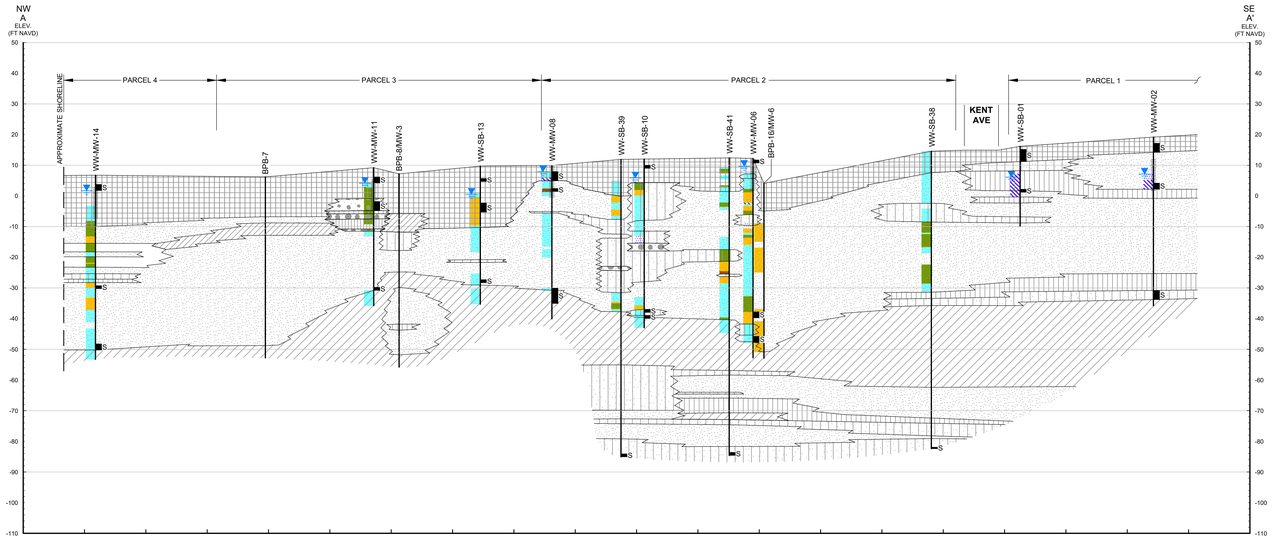
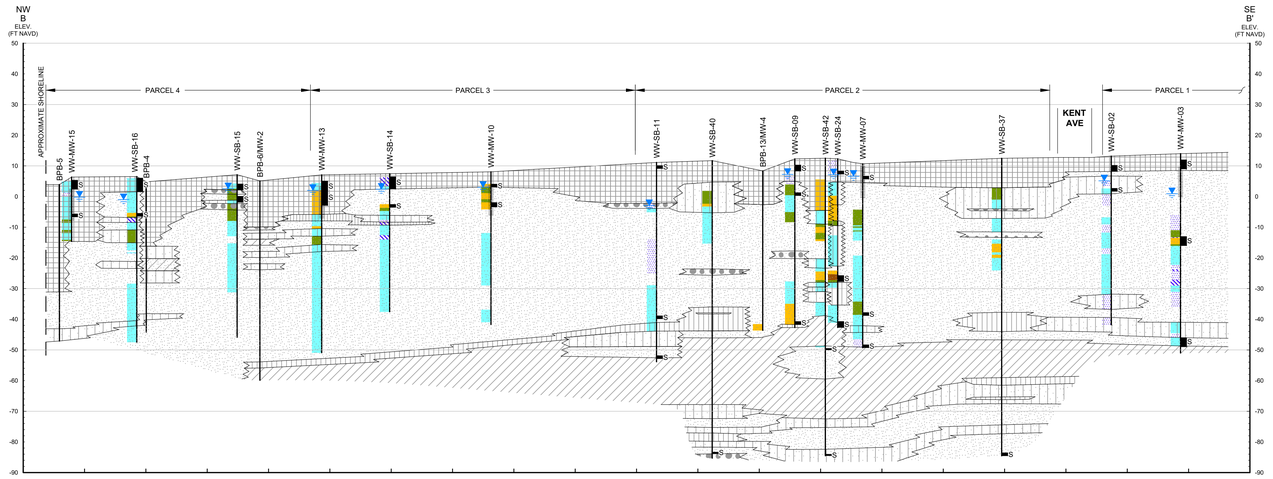
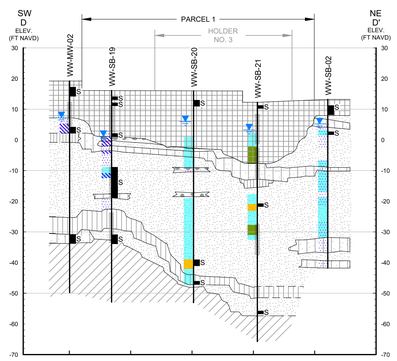
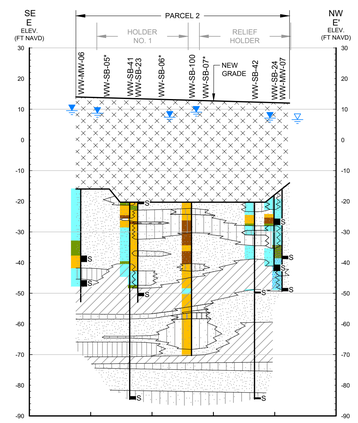
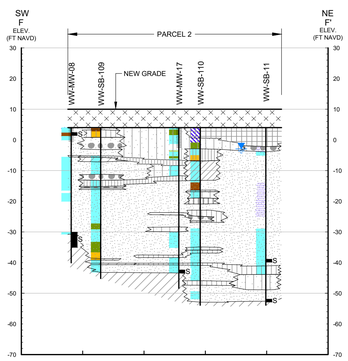
WW-TP-35
WW-TP-36
WW-TP-37
WW-TP-38
WW-TP-39
WW-TP-40

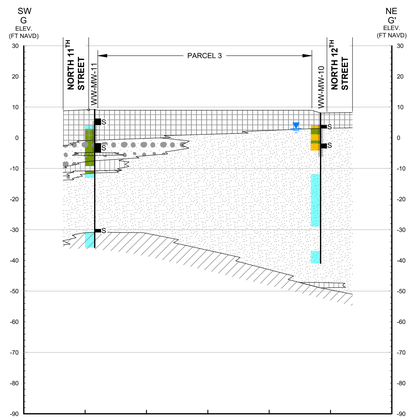


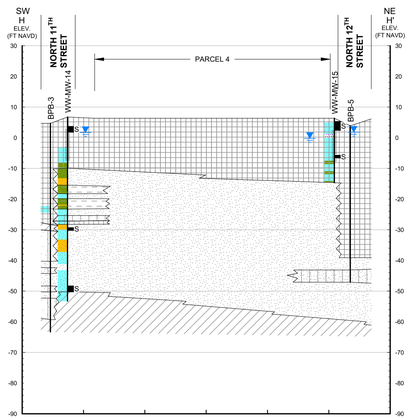


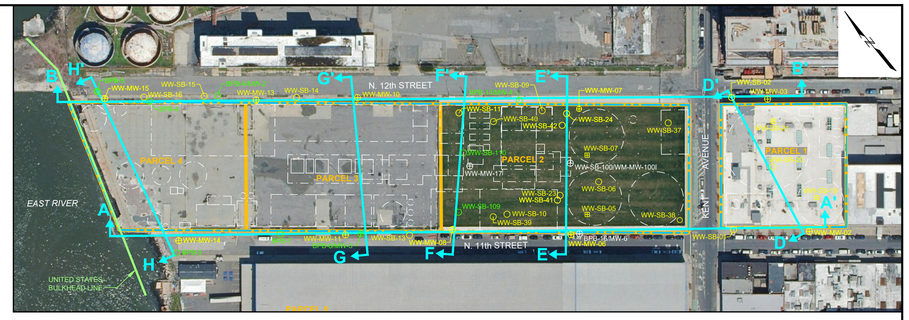












CROSS-SECTION LOCATION

0 100' 200'

SCALE: 1" = 100'

CROSS SECTION LOCATION LEGEND:

- APPROXIMATE SITE BOUNDARY
- APPROXIMATE BOUNDARY OF FORMER MGP PROPERTY
- HISTORIC MGP STRUCTURES
- CROSS SECTION LOCATION

REMEDIAL INVESTIGATION SAMPLES

- MONITORING WELL
- ABANDONED MONITORING WELL
- SOIL BORING WITH TEMPORARY GROUNDWATER POINT
- SOIL BORING

OTHER INVESTIGATION SAMPLES

- MONITORING WELL
- ABANDONED MONITORING WELL
- SOIL BORING

CROSS SECTION LEGEND

GEOLOGIC UNIT

- SOIL COVER SYSTEM
- FILL
- FILL

ALLUVIAL DEPOSITS

- ORGANIC SOIL
- PEAT
- SILT (SHALLOW)
- CLAY (SHALLOW)

GLACIAL DEPOSITS

- SAND
- SILTY SAND
- SILT (DEEP)
- GRAVEL
- SILTY GRAVEL
- CLAYEY SAND
- CLAY (DEEP)

PHYSICAL OBSERVATIONS

- TAR SATURATED
- LENSES WITH TAR SATURATION AND TAR/NAPHTHA ODORS
- BLEBS, GLOBS, LENSES, COATINGS, SHEENS AND TAR/ NAPTHA ODORS
- TAR STAINING, SHEEN AND TAR/NAPHTHA ODORS
- TAR/ NAPHTHALENE-LIKE ODORS
- PETROLEUM SHEEN/ STAINING ODORS
- PETROLEUM-LIKE ODORS
- OBSERVED APPARENT GROUNDWATER TABLE
- CONTACT
- BOUNDARY IS APPROXIMATED
- SOIL BORING, MONITORING WELL OR SEDIMENT CORING IDENTIFICATION (WW-MW-14)
- SAMPLE LOCATION
- WELL SCREEN INTERVAL

NOTE:

1. HIGH AND LOW TIDE WATERLINE MEASUREMENTS ARE FROM THE 12/19/12 GROUNDWATER GAUGING EVENT.

SOURCES:

1. AERIAL PHOTOGRAPH FROM ARCGIS WORLD IMAGERY LAYER, ACCESSED VIA ARCGISONLINE, IMAGERY DATE: 04/15/2018.
2. SANBORN FIRE INSURANCE MAPS (1887 THROUGH 1996).
3. HISTORIC MAP OF BROOKLYN UNION GAS, DATED JULY 27, 1921.
4. NEW YORK CITY OPEN ACCESSIBLE SPACE INFORMATION SYSTEM http://www.oasisnyc.net, ACCESSED JANUARY 2008.
5. SURVEY OF WILLIAMSBURG WORKS BOUNDARIES, EXISTING CONDITIONS, AND SAMPLE LOCATIONS CONDUCTED BY GEI CONSULTANTS, INC. SURVEYED BY NEW YORK STATE-LICENSED LAND SURVEYOR No. 050146.
6. URS CORPORATION IRM DESIGN INVESTIGATION BORING LOGS AND LOCATION MAP PROVIDED TO GEI CONSULTANTS, INC. VIA EMAIL ON FEBRUARY 12, 2013.

HORIZONTAL SCALE: 1" = 60'

0 60' 120'

0 20' 40'

VERTICAL SCALE: 1" = 20'

NOTE: 3x VERTICAL EXAGGERATION

Interim Site Management Plan
Williamsburg Works Site
Borough Of Brooklyn, New York

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GEOLOGIC CROSS SECTIONS

Project 093060 | July 2021 | Fig. 4

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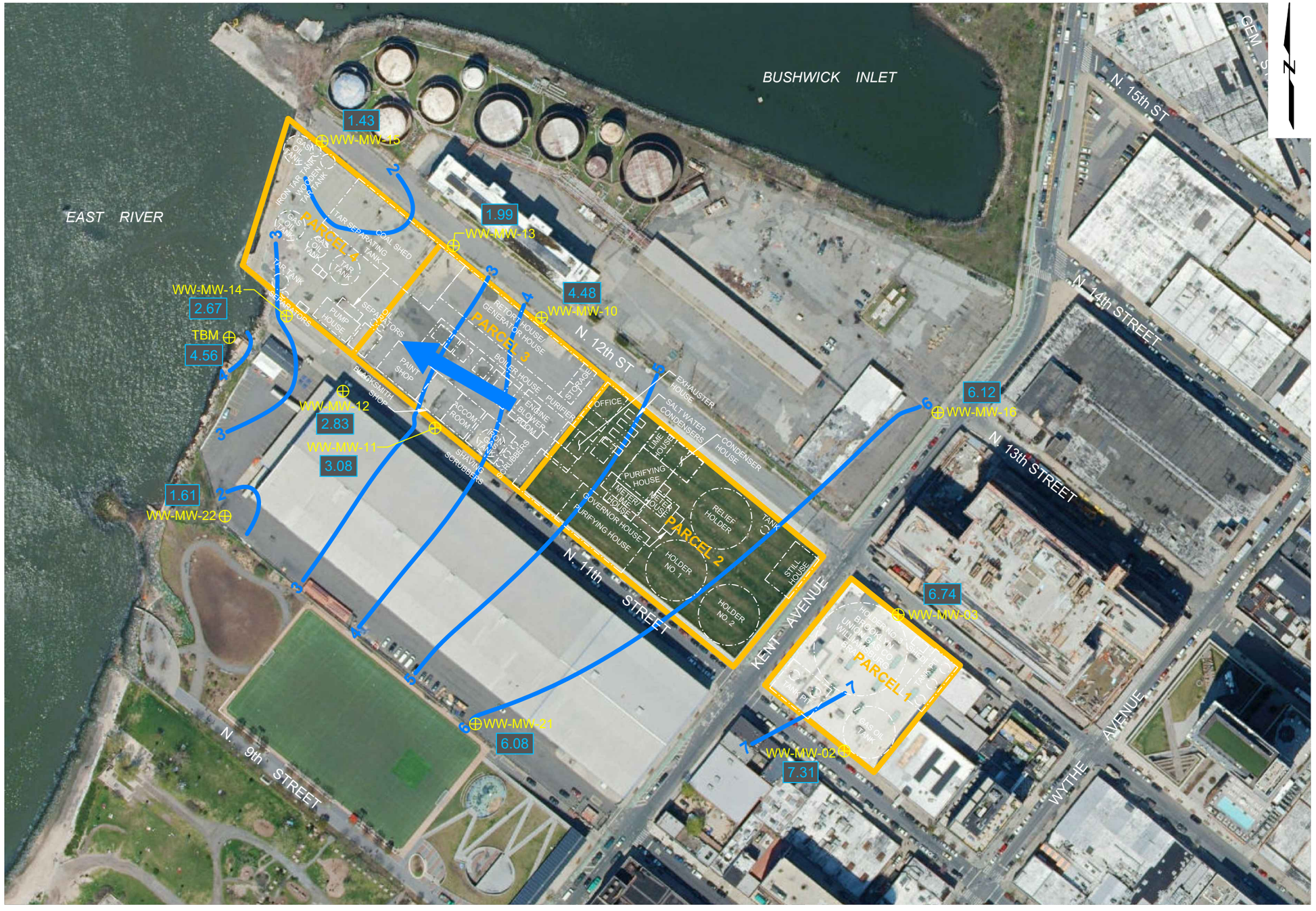

LEGEND:

- APPROXIMATE SITE BOUNDARY
- HISTORIC MGP STUCTURES
- 5 — GROUNDWATER CONTOUR (FEET NAVD88)
- GROUNDWATER FLOW DIRECTION
- ⊕WW-MW-02 — MONITORING WELL
- ⊕TBM — TIDAL BENCHMARK
- 7.38 — GROUNDWATER ELEVATION (FEET NAVD88) MEASURED 5/19/2019

NOTES:

1. CONTOURS MADE BY NATURAL NEIGHBOR INTERPOLATION WITH MANUAL SMOOTHING TO ADJUST ARTIFACTS OF INTERPOLATION BETWEEN RELATIVELY DISTANT WELLS.
2. GROUNDWATER CONTOURS AND ELEVATIONS ARE IN FEET ABOVE NORTH AMERICAN VERTICAL DATUM (NAVD88)
3. MONITORING WELLS WERE INSTALLED SPANNING THE GROUNDWATER SURFACE.
4. GROUNDWATER CONTOURS WERE GENERATED USING DATA FROM LOW TIDE GAUGING ON MARCH 19, 2019.

SOURCES:

1. AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH PRO, ©2013 GOOGLE, INC., IMAGERY DATE 9/27/2017, ACCESSED ON 1/15/2018.
2. SANBORN FIRE INSURANCE MAPS (1887 THROUGH 1996).
3. HISTORIC MAP OF BROOKLYN UNION GAS, DATED JULY 27, 1921.
4. NEW YORK CITY OPEN ACCESSIBLE SPACE INFORMATION SYSTEM HTTP://WWW.OASISNYC.NET ACCESSED JANUARY 2008.
5. SURVEY OF WILLIAMSBURG WORKS BOUNDARIES, EXISTING CONDITIONS, AND SAMPLE LOCATIONS CONDUCTED BY GEI CONSULTANTS, INC. SURVEYED BY NEW YORK STATE-LICENSED LAND SURVEYOR No. 050146.

0 150 300

SCALE: 1" = 150'

Interim Site Management Plan
Williamsburg Works Site
Borough Of Brooklyn, New York

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GROUNDWATER CONTOURS

Project 093060 | July 2021 | Fig. 5

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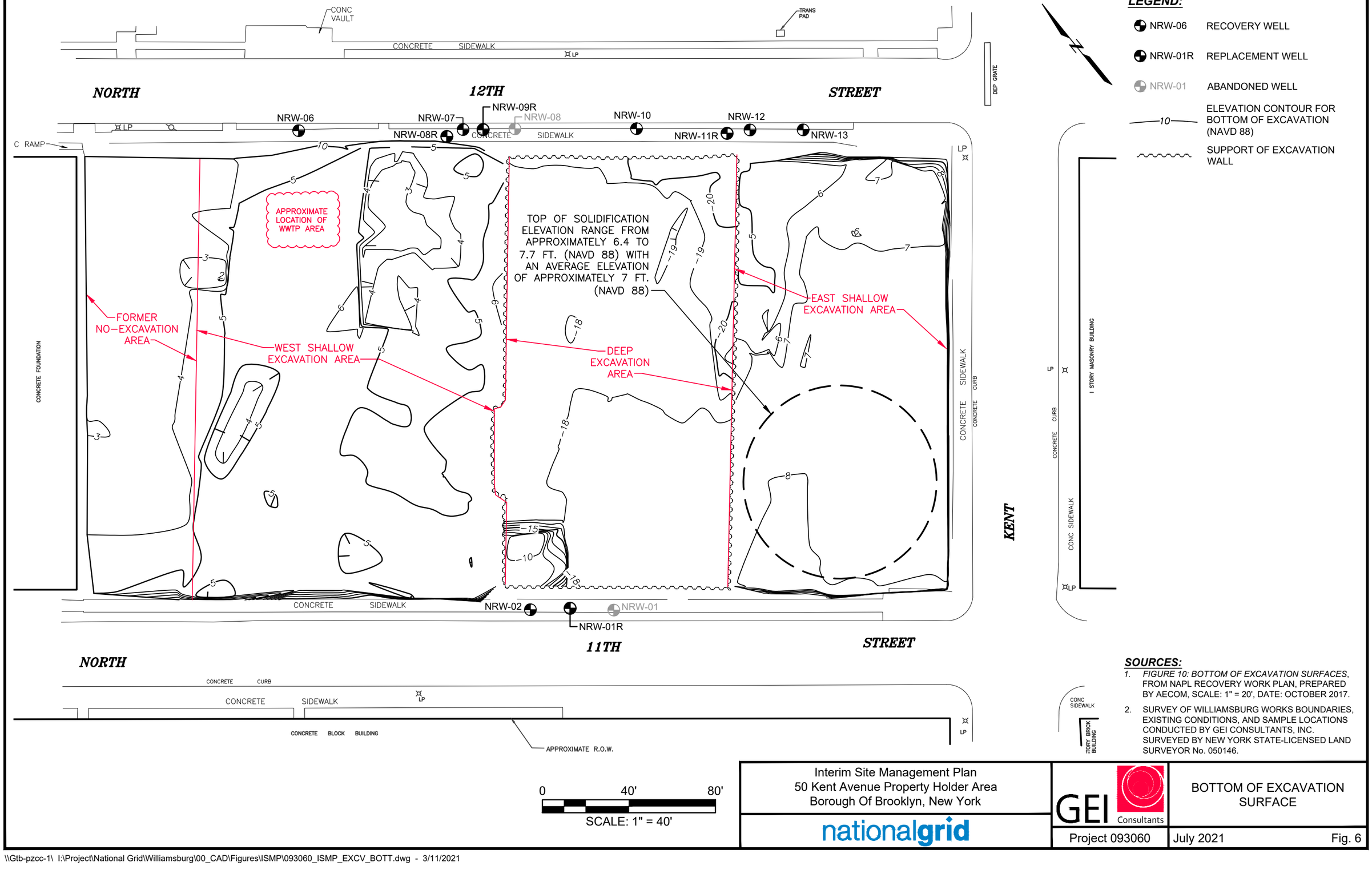

LEGEND:

- NRW-06 RECOVERY WELL
- NRW-01R REPLACEMENT WELL
- NRW-01 ABANDONED WELL
- 10 ELEVATION CONTOUR FOR BOTTOM OF EXCAVATION (NAVD 88)
- SUPPORT OF EXCAVATION WALL

SOURCES:

1. *FIGURE 10: BOTTOM OF EXCAVATION SURFACES*, FROM NAPL RECOVERY WORK PLAN, PREPARED BY AECOM, SCALE: 1" = 20', DATE: OCTOBER 2017.
2. SURVEY OF WILLIAMSBURG WORKS BOUNDARIES, EXISTING CONDITIONS, AND SAMPLE LOCATIONS CONDUCTED BY GEI CONSULTANTS, INC. SURVEYED BY NEW YORK STATE-LICENSED LAND SURVEYOR No. 050146.

Interim Site Management Plan
50 Kent Avenue Property Holder Area
Borough Of Brooklyn, New York

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BOTTOM OF EXCAVATION SURFACE

Project 093060 | July 2021 | Fig. 6

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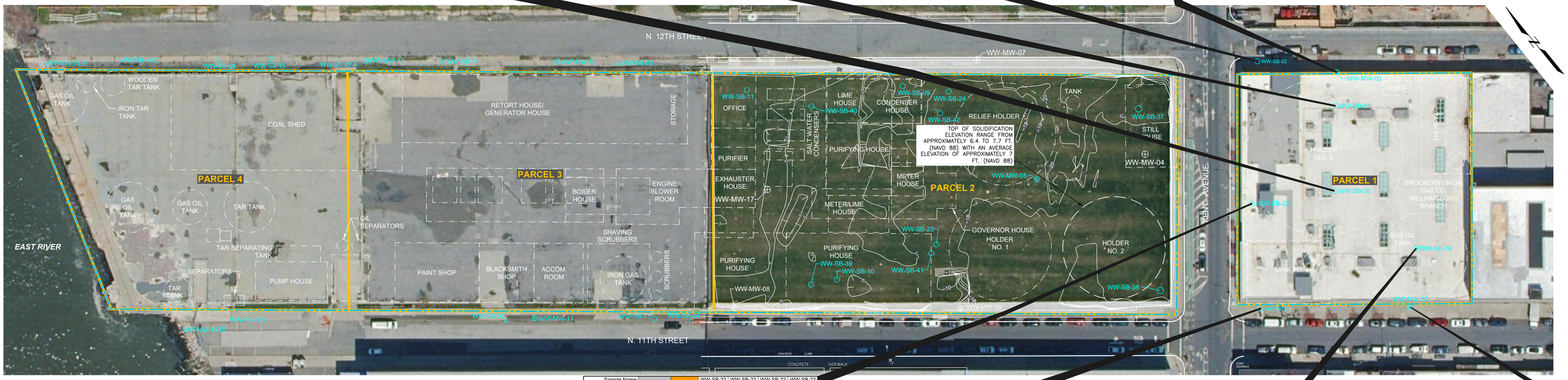
Sample Name: / Sample Depth(ft bgs): / Sample Date:	Unrestricted SCO	Industrial SCO	WW-SB-20 (3-5) 6/29/2009	WW-SB-20 (55-57) 7/21/2009	Duplicate of WW-SB-20 (55-57) 7/21/2009	WW-SB-20 (62-63) 7/21/2009
BTEX (mg/kg)						
Benzene	0.06	89	0.0057 U	**13**	**9**	**0.02**
Toluene	0.7	1000	**0.00016 J**	**16**	**20**	0.0064 U
Ethylbenzene	1	780	0.0057 U	**35**	**58**	**0.026**
Total Xylene	0.26	1000	0.0057 U	**42 J**	**71 J**	**0.03**
Total BTEX	NE	NE	**0.00016**	**106**	**158**	**0.076**
Other VOCs (mg/kg)						
Total VOC	NE	NE	**0.00016**	**106**	**158**	**0.078**
PAHs (mg/kg)						
Acenaphthene	20	1000	0.61 U	**27 J**	**130 J**	**0.054 J**
Benz[a]anthracene	1	11	0.61 U	**6.8 J**	**32 J**	**0.028 J**
Benzo[a]pyrene	1	1.1	0.61 U	**4.9 J**	**22 J**	**0.02 J**
Benzo[b]fluoranthene	1	11	0.61 U	**2.8 J**	**14 J**	0.34 U
Benzo[k]fluoranthene	0.8	110	0.61 U	**1.2 J**	67 U	0.34 U
Chrysene	1	110	0.61 U	**6.6 J**	**29 J**	0.34 U
Fluorene	30	1000	0.61 U	**15 J**	**73 J**	**0.035 J**
Indeno[1,2,3-cd]pyrene	0.5	11	0.61 U	**1.5 J**	**6.6 J**	**0.39**
Naphthalene	12	1000	0.61 U	**120 J**	**760 J**	0.34 U
Phenanthrene	100	1000	0.61 U	**47 J**	**220 J**	**0.12 J**
Total PAHs	NE	500	**0.103**	**357.6**	**1910.7**	**1.34**
Other SVOCs (mg/kg)						
Dibenzofuran	7	1000	0.61 U	**1.7 J**	**9.4 J**	0.34 U
Total SVOC	NE	NE	**9.054**	**359.86**	**1920.1**	**1.34**
Metals (mg/kg)						
Barium	350	10000	**366 J**	**12.2**	**9**	**29.7**
Lead	63	3900	**762 J**	**6.6 J**	**5.4 J**	**8.4 J**
Zinc	109	10000	**142 J**	**14.5 J**	**11 J**	**28.8 J**

Sample Name: / Sample Depth(ft bgs): / Sample Date:	Unrestricted SCO	Industrial SCO	WW-SB-21 (1-2) 7/1/2009	WW-SB-21 (33-34) 7/22/2009	WW-SB-21 (68-69) 7/22/2009
BTEX (mg/kg)					
Benzene	0.06	89	0.0057 U	**23**	0.0061 UJ
Toluene	0.7	1000	0.0057 U	**17**	0.0061 U
Ethylbenzene	1	780	0.0057 U	**160**	0.0061 UJ
Total Xylene	0.26	1000	0.0057 U	**170**	0.0061 UJ
Total BTEX	NE	NE	ND	**370**	ND
Other VOCs (mg/kg)					
Total VOC	NE	NE	ND	**370**	ND
PAHs (mg/kg)					
Acenaphthene	20	1000	**0.062 J**	**33**	0.32 U
Benz[a]anthracene	1	11	**0.67**	**7.7**	0.32 U
Benzo[a]pyrene	1	1.1	**0.93**	**6.2 J**	0.32 U
Benzo[b]fluoranthene	1	11	**0.92**	**3.1 J**	0.32 U
Benzo[k]fluoranthene	0.8	110	**0.3 J**	**1.6 J**	0.32 U
Chrysene	1	110	**0.81**	**7.5**	0.32 U
Indeno[1,2,3-cd]pyrene	0.5	11	**0.95**	**1.2 J**	0.32 U
Naphthalene	12	1000	**0.068 J**	**120**	0.32 U
Total PAHs	NE	500	**9.666**	**376.5**	ND
Other SVOCs (mg/kg)					
Total SVOC	NE	NE	**13.476**	**378.95**	**0.048**
Metals (mg/kg)					
Lead	63	3900	**839 J**	**6.8 J**	**6.9 J**
Mercury	0.18	5.7	**0.53 J**	0.062 U	0.06 U
Selenium	3.9	6800	R	11.7 UJ	**10.5 J**
Zinc	109	10000	**262 J**	**18.7 J**	**24.2 J**

Sample Name: / Sample Depth(ft bgs): / Sample Date:	Unrestricted SCO	Industrial SCO	WW-SB-02 (2-5) 7/8/2009	WW-SB-02 (10.5-11.5) 7/8/2009
BTEX (mg/kg)				
Total BTEX	NE	NE	**0.0026**	**0.142**
Other VOCs (mg/kg)				
Total VOC	NE	NE	**0.0026**	**0.342**
PAHs (mg/kg)				
Dibenz[a,h]anthracene	0.33	1.1	**0.46**	**0.12 J**
Indeno[1,2,3-cd]pyrene	0.5	11	**0.63**	**0.2 J**
Total PAHs	NE	500	**4.139**	**13.1**
Other SVOCs (mg/kg)				
Total SVOC	NE	NE	**4.769**	**13.75**
Metals (mg/kg)				
Lead	63	3900	**75.9**	**19.1**
Zinc	109	10000	**119**	**30.4**

Sample Name: / Sample Depth(ft bgs): / Sample Date:	Unrestricted SCO	Industrial SCO	WW-MW-03 (2-5) 6/23/2009	WW-MW-03 (28-30) 6/24/2009	WW-MW-03 (60-63) 6/26/2009	Duplicate of WW-MW-03 (60-63) 6/26/2009
BTEX (mg/kg)						
Benzene	0.06	89	**0.0069**	**17**	**0.0097**	**0.0092**
Toluene	0.7	1000	0.0057 U	**160**	**0.026 J**	0.0053 U
Ethylbenzene	1	780	0.0057 U	**290**	**0.033 J**	**0.011 J**
Total Xylene	0.26	1000	0.0057 U	**420**	**0.046 J**	0.0053 U
Total BTEX	NE	NE	**0.0069**	**887**	**0.1147**	**0.0202**
Other VOCs (mg/kg)						
Total VOC	NE	NE	**0.0069**	**887**	**0.1165**	**0.0202**
PAHs (mg/kg)						
Acenaphthene	20	1000	**0.18 J**	**72**	0.33 U	**0.046 J**
Benz[a]anthracene	1	11	**1.7**	**19 J**	0.33 U	**0.015 J**
Benzo[a]pyrene	1	1.1	**1.9**	**14 J**	0.33 U	**0.0081 J**
Benzo[b]fluoranthene	1	11	**1.7**	**8.7 J**	0.33 U	0.28 U
Chrysene	1	110	**1.6**	**18 J**	0.33 U	0.28 U
Dibenz[a,h]anthracene	0.33	1.1	**0.52**	66 U	0.33 U	0.28 U
Fluorene	30	1000	**0.22 J**	**43 J**	0.33 U	**0.035 J**
Indeno[1,2,3-cd]pyrene	0.5	11	**1.2**	**46 J**	0.33 U	0.28 U
Naphthalene	12	1000	**0.38**	**1000**	**0.19 J**	**1.2 J**
Phenanthrene	100	1000	**2.6**	**130**	**0.023 J**	**0.11 J**
Total PAHs	NE	500	**21.09**	**1767.2**	**0.257**	**1.7541**
Other SVOCs (mg/kg)						
Total SVOC	NE	NE	**22.35**	**1773.2**	**0.257**	**1.7541**
Pesticides (mg/kg)						
4,4'-DDT	0.0033	94	**0.0099 JN**	NA	NA	NA
Dieldrin	0.005	2.8	**0.0057 J**	NA	NA	NA
Metals (mg/kg)						
Lead	63	3900	**459 J**	**6.5 J**	**6.5 J**	**6.2 J**
Mercury	0.18	5.7	**0.65 J**	**0.0055 J**	**0.008 J**	0.053 UJ
Selenium	3.9	6800	10.4 U	11.2 U	11.6 UJ	**4.6 J**
Zinc	109	10000	**258 J**	**19.5 J**	**33**	**31.1 J**



Sample Name: / Sample Depth(ft bgs): / Sample Date:	Unrestricted SCO	Industrial SCO	WW-SB-22 (3-4) 6/29/2009	WW-SB-22 (13-15) 7/1/2009	WW-SB-22 (37-38) 7/24/2009	WW-SB-22 (65-65.5) 7/27/2009
BTEX (mg/kg)						
Benzene	0.06	89	0.0055 U	0.0059 U	**90**	**0.027**
Toluene	0.7	1000	**0.00058 J**	0.0059 U	**200**	**0.062**
Ethylbenzene	1	780	0.0055 U	0.0059 U	**150**	**0.022**
Total Xylene	0.26	1000	**0.00056 J**	0.0059 U	**260**	**0.054**
Total BTEX	NE	NE	**0.00144**	ND	**700**	**0.165**
Other VOCs (mg/kg)						
Total VOC	NE	NE	**0.00215**	**0.0011**	**726**	**0.1664**
PAHs (mg/kg)						
Benz[a]anthracene	1	11	**5.7**	0.31 U	**20 J**	0.35 U
Benzo[a]pyrene	1	1.1	**7.3**	0.31 U	**15 J**	0.35 U
Benzo[b]fluoranthene	1	11	**6**	0.31 U	**13 J**	0.35 U
Benzo[k]fluoranthene	0.8	110	**2.3**	0.31 U	65 U	0.35 U
Chrysene	1	110	**5.9**	0.31 U	**19 J**	0.35 U
Dibenz[a,h]anthracene	0.33	1.1	**1.7**	0.31 U	65 U	0.35 U
Fluorene	30	1000	**0.57 J**	0.31 U	**52 J**	0.35 U
Indeno[1,2,3-cd]pyrene	0.5	11	**6**	0.31 U	65 U	0.35 U
Naphthalene	12	1000	**1.1**	0.31 U	**840**	0.35 U
Phenanthrene	100	1000	**7.5**	0.31 U	**130**	0.35 U
Total PAHs	NE	500	**71.31**	ND	**1592.5**	ND
Other SVOCs (mg/kg)						
Total SVOC	NE	NE	**77.383**	**0.110**	**1600.8**	ND
Pesticides (mg/kg)						
4,4'-DDT	0.0033	94	**0.0047 J**	NA	NA	NA
Metals (mg/kg)						
Copper	50	10000	**54.7 J**	**24.4 J**	**14.9**	**14.6**
Lead	63	3900	**190 J**	**6.2 J**	**6.6 J**	**8.2 J**
Mercury	0.18	5.7	**0.24 J**	0.057 UJ	0.056 U	**0.011 J**
Selenium	3.9	6800	R	R	11.4 UJ	**8.1 J**
Zinc	109	10000	**270 J**	**63.4 J**	**21.1 J**	**30.8**

Sample Name: / Sample Depth(ft bgs): / Sample Date:	Unrestricted SCO	Industrial SCO	WW-SB-01 (1-5) 7/10/2009	WW-SB-01 (14-15) 7/10/2009
BTEX (mg/kg)				
Total BTEX	NE	NE	ND	**0.001**
Other VOCs (mg/kg)				
Acetone	0.05	1000	0.023 UJ	**0.064 J**
Total VOC	NE	NE	ND	**0.0966**
PAHs (mg/kg)				
Total PAHs	NE	500	ND	**8.449**
Other SVOCs (mg/kg)				
Total SVOC	NE	NE	**0.6**	**9.079**
Selenium	3.9	6800	10.5 UJ	**6.4 J**

Sample Name: / Sample Depth(ft bgs): / Sample Date:	Unrestricted SCO	Industrial SCO	WW-SB-19 (2-3) 7/27/2009	WW-SB-19 (4-5) 7/6/2009	WW-SB-19 (14-15) 7/28/2009	WW-SB-19 (25-35) 7/29/2009	WW-SB-19 (47-50) 7/29/2009
BTEX (mg/kg)							
Total BTEX	NE	NE	**0.1011**	ND	**0.0675**	**0.107**	**0.0491**
Other VOCs (mg/kg)							
Total VOC	NE	NE	**0.1011**	ND	**0.0675**	**0.1688**	**0.05597**
PAHs (mg/kg)							
Benz[a]anthracene	1	11	**2.4**	**4.7**	**0.21 J**	**0.13 J**	0.33 U
Benzo[a]pyrene	1	1.1	**4.5**	**5.4**	**0.11 J**	**0.061 J**	0.33 U
Benzo[b]fluoranthene	1	11	**3.2**	**4.6**	**0.061 J**	**0.033 J**	0.33 U
Benzo[k]fluoranthene	0.8	110	**1.2**	**1.4**	0.32 U	0.35 U	0.33 U
Chrysene	1	110	**3.3**	**5.1**	**0.26 J**	**0.18 J**	0.33 U
Dibenz[a,h]anthracene	0.33	1.1	**0.63**	**1.2**	0.32 U	0.35 U	0.33 U
Indeno[1,2,3-cd]pyrene	0.5	11	**1.3**	**3.8**	**0.037 J**	0.35 U	0.33 U
Total PAHs	NE	500	**35.15**	**65.53**	**4.866**	**6.284**	ND
Other SVOCs (mg/kg)							
Total SVOC	NE	NE	**36.04**	**67.53**	**4.866**	**6.357**	ND
Pesticides (mg/kg)							
4,4'-DDT	0.0033	94	**0.064 J**	0.004 UJ	NA	NA	NA
Dieldrin	0.005	2.8	**0.0054 J**	0.004 U	NA	NA	NA
Metals (mg/kg)							
Copper	50	10000	**49.6**	**51.1 J**	**42.2**	**9.9**	**11.9**
Lead	63	3900	**191**	**311**	**9.1**	**5**	**6.7**
Mercury	0.18	5.7	**0.34**	**1.4**	0.056 U	0.062 U	0.057 U
Zinc	109	10000	**182**	**232**	**38.2**	**24**	**25 J**

Sample Name: / Sample Depth(ft bgs): / Sample Date:	Unrestricted SCO	Industrial SCO	WW-MW-02 (2-5) 7/10/2009	Duplicate of WW-MW-02 (2-5) 7/10/2009	WW-MW-02 (15-17) 7/10/2009	WW-MW-02 (50-53) 7/13/2009
BTEX (mg/kg)						
Total BTEX	NE	NE	ND	ND	**0.00033**	ND
Other VOCs (mg/kg)						
Total VOC	NE	NE	**0.005**	ND	**0.00173**	ND
PAHs (mg/kg)						
Benz[a]anthracene	1	11	**4.4**	**3.7**	**2 J**	0.33 U
Benzo[a]pyrene	1	1.1	**6.5**	**8.8**	**0.76 J**	0.33 U
Benzo[b]fluoranthene	1	11	**6.2**	**7.3**	**0.84 J**	0.33 U
Benzo[k]fluoranthene	0.8	110	**2.3**	**2.6**	**0.29 J**	0.33 U
Chrysene	1	110	**5.7**	**4.7**	**1.7 J**	0.33 U
Dibenz[a,h]anthracene	0.33	1.1	**1.4**	**1.4**	**0.21 J**	0.33 U
Indeno[1,2,3-cd]pyrene	0.5	11	**3.2**	**3.4**	**0.22 J**	0.33 U
Total PAHs	NE	500	**61.44**	**59.04**	**24.83**	ND
Other SVOCs (mg/kg)						
Total SVOC	NE	NE	**61.98**	**59.59**	**24.94**	**0.11**
Pesticides (mg/kg)						
4,4-DDD	0.0033	180	**0.037 J**	**0.034 J**	NA	NA
4,4'-DDT	0.0033	94	**0.015 J**	**0.034 J**	NA	NA
Metals (mg/kg)						
Copper	50	10000	**59.7 J**	**62.7 J**	**11 J**	**11.3 J**
Lead	63	3900	**320**	**232**	**7.8 J**	**16 J**
Mercury	0.18	5.7	**0.55**	**0.62**	**0.0059 J**	**0.012 J**
Selenium	3.9	6800	10.4 UJ	10.9 UJ	**7.7 J**	11.4 UJ
Zinc	109	10000	**190**	**166**	**24.8**	**27.6**

LEGEND:

- APPROXIMATE SITE BOUNDARY
- APPROXIMATE BOUNDARY OF FORMER MGP PROPERTY
- HISTORIC MGP STRUCTURES
- MONITORING WELL (RI)
- ABANDONED MONITORING WELL (RI)
- SOIL BORING WITH TEMPORARY GROUNDWATER POINT (RI)
- SOIL BORING (RI)
- SURFACE SOIL SAMPLE (RI)
- 10 — ELEVATION CONTOUR FOR BOTTOM OF EXCAVATION (NAVD 88)

ANALYTICAL BOXES

- mg/kg — MILLIGRAMS/KILOGRAM OR PARTS PER MILLION (PPM)
- BTEX — BENZENE, TOLUENE, ETHYLBENZENE, AND XYLENES
- VOCs — VOLATILE ORGANIC COMPOUNDS
- PAHs — POLYCYCLIC AROMATIC HYDROCARBONS
- PCBs — POLYCHLORINATED BIPHENYLS
- SVOCs — SEMIVOLATILE ORGANIC COMPOUNDS

VALIDATION QUALIFIERS

- J — ESTIMATED VALUE
- JN — ANALYTE IS PRESUMPTIVELY PRESENT AT AN APPROXIMATED QUANTITY
- R — REJECTED
- U — INDICATES NOT DETECTED TO THE REPORTING LIMIT
- UJ — NOT DETECTED AT OR ABOVE THE REPORTING LIMIT SHOWN AND THE REPORTING LIMIT IS ESTIMATED

ANALYTICAL BOXES (CONT'D)

TOTAL BTEX, TOTAL VOCS, TOTAL PAHS, TOTAL SVOCS AND TOTAL PCBS ARE CALCULATED USING DETECTS ONLY.

TOTAL PAH16 IS CALCULATED USING THE EPA16 LIST OF ANALYTES: ACENAPHTHENE, ACENAPHTHYLENE, ANTHRACENE, BENZ[A]ANTHRACENE, BENZO[A]PYRENE, BENZO[B]FLUORANTHENE, BENZO[G,H,I]PERYLENE, BENZO[K]FLUORANTHENE, CHRYSENE, DIBENZ[A,H]ANTHRACENE, FLUORANTHENE, FLUORENE, INDENO[1,2,3-CD]PYRENE, NAPHTHALENE, PHENANTHRENE, AND PYRENE

TOTAL PAH17 IS CALCULATED USING THE EPA16 LIST OF ANALYTES PLUS 2-METHYLNAPHTHALENE

- 6NYCRR — NEW YORK STATE REGISTER AND OFFICIAL COMPILATION OF CODES, RULES AND REGULATIONS OF THE STATE OF NEW YORK

COMPARISON OF DETECTED RESULTS ARE PERFORMED AGAINST ONE OR MORE OF THE FOLLOWING NYCRR, CHAPTER IV, PART 375-6 SOIL CLEANUP OBJECTIVES (SCO)S: UNRESTRICTED USE, RESIDENTIAL, RESTRICTED-RESIDENTIAL, COMMERCIAL, INDUSTRIAL, PROTECTION OF ECOLOGICAL RESOURCES, OR PROTECTION OF GROUNDWATER

* 500 PPM TOTAL PAH SCO FOR NON-RESIDENTIAL SITES (COMMERCIAL OR INDUSTRIAL), PER NYSDEC CP-51 / SOIL CLEANUP GUIDANCE, SECTION V(H).

- NA — NOT ANALYZED
- ND — NOT DETECTED; TOTAL CONCENTRATION IS LISTED AS ND BECAUSE NO COMPOUNDS WERE DETECTED IN THE GROUP
- NE — NOT ESTABLISHED
- **BOLD** — DETECTED RESULT VALUE EXCEEDS THE UNRESTRICTED SCO
- **BOLD** — DETECTED RESULT VALUE EXCEEDS THE INDUSTRIAL SCO

SOURCES:

1. *FIGURE 10: BOTTOM OF EXCAVATION SURFACES*, FROM NAPL RECOVERY WORK PLAN, PREPARED BY AECOM, SCALE: 1" = 20', DATE: OCTOBER 2017.
2. SURVEY OF WILLIAMSBURG WORKS BOUNDARIES, EXISTING CONDITIONS, AND SAMPLE LOCATIONS CONDUCTED BY GEI CONSULTANTS, INC. SURVEYED BY NEW YORK STATE-LICENSED LAND SURVEYOR No. 050146.
3. AERIAL PHOTOGRAPH FROM ARCGIS WORLD IMAGERY LAYER, ACCESSED VIA ARCGISONLINE, IMAGERY DATE: 04/15/2018.

0 40' 80'
SCALE: 1" = 40'

Interim Site Management Plan
Williamsburg Works Site
Borough Of Brooklyn, New York

nationalgrid

GEI Consultants

REMAINING SOIL SAMPLE IMPACTS - PARCEL 1

Project 093060 | July 2021 | Fig. 7A

\\Gtb-pzcc-1\ I:\Project\National Grid\Williamsburg\00_CAD\Figures\ISMP\093060_ISMP_RSOIL.dwg - 3/22/2021

LEGEND:

- APPROXIMATE SITE BOUNDARY
- APPROXIMATE BOUNDARY OF FORMER MGP PROPERTY
- HISTORIC MGP STRUCTURES
- MONITORING WELL (RI)
- ABANDONED MONITORING WELL (RI)
- SOIL BORING WITH TEMPORARY GROUNDWATER POINT (RI)
- SOIL BORING (RI)
- SURFACE SOIL SAMPLE (RI)
- ELEVATION CONTOUR FOR BOTTOM OF EXCAVATION (NAVD 88)

ANALYTICAL BOXES

mg/kg	MILLIGRAMS/KILOGRAM OR PARTS PER MILLION (PPM)
BTEX	BENZENE, TOLUENE, ETHYLBENZENE, AND XYLENES
VOCs	VOLATILE ORGANIC COMPOUNDS
PAHs	POLYCYCLIC AROMATIC HYDROCARBONS
PCBs	POLYCHLORINATED BIPHENYLS
SVOCs	SEMIVOLATILE ORGANIC COMPOUNDS

VALIDATION QUALIFIERS

J	ESTIMATED VALUE
JN	ANALYTE IS PRESUMPTIVELY PRESENT AT AN APPROXIMATED QUANTITY
R	REJECTED
U	INDICATES NOT DETECTED TO THE REPORTING LIMIT
UJ	NOT DETECTED AT OR ABOVE THE REPORTING LIMIT SHOWN AND THE REPORTING LIMIT IS ESTIMATED

ANALYTICAL BOXES (CONT'D)

TOTAL BTEX, TOTAL VOCS, TOTAL PAHS, TOTAL SVOCS AND TOTAL PCBS ARE CALCULATED USING DETECTS ONLY.

TOTAL PAH16 IS CALCULATED USING THE EPA16 LIST OF ANALYTES: ACENAPHTHENE, ACENAPHTHYLENE, ANTHRACENE, BENZ[A]ANTHRACENE, BENZO[A]PYRENE, BENZO[B]FLUORANTHENE, BENZO[G,H,I]PERYLENE, BENZO[K]FLUORANTHENE, CHRYSENE, DIBENZ[A,H]ANTHRACENE, FLUORANTHENE, FLUORENE, INDENO[1,2,3-CD]PYRENE, NAPHTHALENE, PHENANTHRENE, AND PYRENE

TOTAL PAH17 IS CALCULATED USING THE EPA16 LIST OF ANALYTES PLUS 2-METHYLNAPHTHALENE

6NYCRR	NEW YORK STATE REGISTER AND OFFICIAL COMPILATION OF CODES, RULES AND REGULATIONS OF THE STATE OF NEW YORK

COMPARISON OF DETECTED RESULTS ARE PERFORMED AGAINST ONE OR MORE OF THE FOLLOWING NYCRR, CHAPTER IV, PART 375-6 SOIL CLEANUP OBJECTIVES (SCO)S: UNRESTRICTED USE, RESIDENTIAL, RESTRICTED-RESIDENTIAL, COMMERCIAL, INDUSTRIAL, PROTECTION OF ECOLOGICAL RESOURCES, OR PROTECTION OF GROUNDWATER

* 500 PPM TOTAL PAH SCO FOR NON-RESIDENTIAL SITES (COMMERCIAL OR INDUSTRIAL), PER NYSDEC CP-51 / SOIL CLEANUP GUIDANCE, SECTION V(H).

NA	NOT ANALYZED
ND	NOT DETECTED; TOTAL CONCENTRATION IS LISTED AS NO DECREASE OR NO COMPOUNDS WERE DETECTED IN THE GROUP
NE	NOT ESTABLISHED
BOLD	DETECTED RESULT VALUE EXCEEDS THE UNRESTRICTED SCO
BOLD	DETECTED RESULT VALUE EXCEEDS THE RESTRICTED - RESIDENTIAL SCO

Sample Name: Sample Depth(ft bgs): Sample Date:	Unrestricted SCO	Restricted-Residential SCO	WWS-09 (0-0.2) 10/6/2009
BTEX (mg/kg)			
Total BTEX	NE	NE	ND
Other VOCs (mg/kg)			
Total VOC	NE	NE	ND
PAHs (mg/kg)			
Indeno[1,2,3-cd]pyrene	0.5	0.5	**1 J**
Total PAHs	NE	NE	**8.35**
Other SVOCs (mg/kg)			
Total SVOC	NE	NE	**8.88**
Pesticides (mg/kg)			
4,4'-DDT	0.0033	7.9	**0.011 J**
Metals (mg/kg)			
Copper	50	270	**130**
Lead	63	400	**106**
Zinc	109	10000	**336**

Sample Name: Sample Depth(ft bgs): Sample Date:	Unrestricted SCO	Restricted-Residential SCO	WW-SB-16 (0.5-5) 9/22/2009	WW-SB-16 (12-13) 9/23/2009
BTEX (mg/kg)				
Benzene	0.06	4.8	**0.046 J**	**0.22 J**
Total BTEX	NE	NE	**0.064**	**0.330**
Other VOCs (mg/kg)				
Acetone	0.05	100	**0.065 J**	0.13 UJ
Total VOC	NE	NE	**0.226**	**0.355**
PAHs (mg/kg)				
Acenaphthene	20	100	**6.9**	**23**
Benz[a]anthracene	1	1	**5.1 J**	**19**
Benzo[a]pyrene	1	1	**6.3**	**17**
Benzo[b]fluoranthene	1	1	**5.6**	**16**
Benzo[k]fluoranthene	0.8	100	**2.3 J**	**5.6 J**
Chrysene	1	3.9	**5.1 J**	**16**
Dibenz[a,h]anthracene	0.33	0.33	5.6 U	**2.1 J**
Indeno[1,2,3-cd]pyrene	0.5	0.5	**3.8 J**	**11**
Naphthalene	12	100	5.6 U	**22**
Total PAHs	NE	NE	**86.9**	**322.3**
Other SVOCs (mg/kg)				
2-Methylphenol (o-Cresol)	0.33	100	5.6 U	**0.42 J**
4-Methylphenol (p-Cresol)	0.33	100	5.6 U	**1.2 J**
Total SVOC	NE	NE	**88.7**	**332.72**
Metals (mg/kg)				
Arsenic	13	16	**14.4 J**	**17.7 J**
Copper	50	270	**50.6**	**57.8**
Lead	63	400	**90.7 J**	**369 J**
Mercury	0.18	0.81	**0.41 J**	**6.9 J**

Sample Name: Sample Depth(ft bgs): Sample Date:	Unrestricted SCO	Restricted-Residential SCO	WW-SB-15 (3-5) 9/17/2009	WW-SB-15 (7-9) 9/17/2009
BTEX (mg/kg)				
Benzene	0.060	4.8	**0.017 J**	**0.061 J**
Total BTEX	NE	NE	**0.017**	**0.061**
Other VOCs (mg/kg)				
Total VOC	NE	NE	**0.017**	**0.061**
PAHs (mg/kg)				
Acenaphthene	20	100	**16**	**120**
Benz[a]anthracene	1	1	**26**	**52**
Benzo[a]pyrene	1	1	**39**	**72 J**
Benzo[b]fluoranthene	1	1	**34**	**60 J**
Benzo[k]fluoranthene	0.8	100	**15**	**30 J**
Chrysene	1	3.9	**25**	**47**
Dibenz[a,h]anthracene	0.33	0.33	**7.9**	**9.1 J**
Fluorene	30	100	**8.8**	**56**
Indeno[1,2,3-cd]pyrene	0.5	0.5	**47**	**49 J**
Naphthalene	12	100	**39**	**72**
Phenanthrene	100	100	**32**	**150**
Pyrene	100	100	**52**	**130**
Total PAHs	NE	NE	**456.1**	**1051.1**
Other SVOCs (mg/kg)				
Dibenzofuran	7	59	**2.8 J**	**7.9 J**
Total SVOC	NE	NE	**461.45**	**1062.1**
Metals (mg/kg)				
Arsenic	13	16	**6.6**	**16.9**
Copper	50	270	**54.1**	**123**
Lead	63	400	**353**	**320**
Mercury	0.18	0.81	**0.84 J**	**8.6 J**
Zinc	109	10000	**6.6 J**	**216**

Sample Name: Sample Depth(ft bgs): Sample Date:	Unrestricted SCO	Restricted-Residential SCO	WW-MW-13 (2-5) 9/15/2009	WW-MW-13 (5-10) 9/15/2009	Duplicate of WW-MW-13 (5-10) 9/15/2009
BTEX (mg/kg)					
Benzene	0.06	4.8	**0.0016 J**	**1.1 J**	**2.8 J**
Ethylbenzene	1	41	0.0059 U	**25**	0.0056 U
Total BTEX	NE	NE	**0.0016**	**71.1**	**194.8**
Other VOCs (mg/kg)					
2-Butanone (Methyl ethyl ketone)	0.12	100	0.012 U	7.1 UJ	**230 J**
Total VOC	NE	NE	**0.0016**	**71.1**	**424.8**
PAHs (mg/kg)					
Acenaphthene	20	100	**19**	**510**	**520**
Anthracene	100	100	**12**	**160**	**190**
Benz[a]anthracene	1	1	**24**	**83**	**110**
Benzo[a]pyrene	1	1	**30**	**70**	**99**
Benzo[b]fluoranthene	1	1	**23**	**76**	**74**
Benzo[k]fluoranthene	0.8	100	**9.9**	**25 J**	**34 J**
Chrysene	1	3.9	**24**	**82**	**100**
Dibenz[a,h]anthracene	0.33	0.33	**6.9**	**3.7 J**	44 U
Fluoranthene	100	100	**26**	**150**	**180**
Fluorene	30	100	**9.7**	**210**	**230**
Indeno[1,2,3-cd]pyrene	0.5	0.5	**31**	38 U	**29 J**
Naphthalene	12	100	**10**	**610**	**550**
Phenanthrene	100	100	**85**	**520**	**540**
Pyrene	100	100	**97**	**220**	**290**
Total PAHs	NE	NE	**349.3**	**2958.7**	**3223**
Other SVOCs (mg/kg)					
Dibenzofuran	7	59	**1.1 J**	**27 J**	**34 J**
Total SVOC	NE	NE	**351.72**	**2987.9**	**3257**
Pesticides (mg/kg)					
4,4-DDT	0.0033	13	**0.081 J**	NA	NA
Metals (mg/kg)					
Arsenic	13	16	**4.3**	**88.2 J**	**207 J**
Copper	50	270	**29.6**	**86.9 J**	**233 J**
Lead	63	400	**108**	**233 J**	**576 J**
Mercury	0.18	0.81	**0.22 J**	**0.42 J**	**0.86 J**
Nickel	30	310	**4.1 J**	**23.2 J**	**40.9 J**
Zinc	109	10000	**15.9**	**311 J**	**539 J**

Sample Name: Sample Depth(ft bgs): Sample Date:	Unrestricted SCO	Restricted-Residential SCO	WW-SB-14 (1-5) 9/11/2009	Duplicate of WW-SB-14 (1-5) 9/11/2009	WW-SB-14 (10-11) 9/11/2009
BTEX (mg/kg)					
Ethylbenzene	1	41	**0.1 J**	**0.3 J**	**270**
Total BTEX	NE	NE	**0.1**	**0.3**	**270**
Other VOCs (mg/kg)					
Total VOC	NE	NE	**0.1**	**0.303**	**270**
PAHs (mg/kg)					
Acenaphthene	20	100	**89**	**92**	**200**
Benz[a]anthracene	1	1	**37**	**60**	**32 J**
Benzo[a]pyrene	1	1	**32**	**60**	**28 J**
Benzo[b]fluoranthene	1	1	**27**	**50**	**21 J**
Benzo[k]fluoranthene	0.8	100	**10 J**	**21**	**9.5 J**
Chrysene	1	3.9	**37**	**67**	**31 J**
Dibenz[a,h]anthracene	0.33	0.33	**2.5 J**	**4.3 J**	55 U
Fluorene	30	100	**67**	**100**	**96**
Indeno[1,2,3-cd]pyrene	0.5	0.5	**9.4 J**	**17**	**6.5 J**
Naphthalene	12	100	16 U	16 U	**930**
Phenanthrene	100	100	**190**	**280**	**200**
Pyrene	100	100	**87**	**140**	**87**
Total PAHs	NE	NE	**720.9**	**1108.3**	**2185**
Other SVOCs (mg/kg)					
Dibenzofuran	7	59	**7.4 J**	**9.6 J**	**9.9 J**
Total SVOC	NE	NE	**729.8**	**1120.4**	**2194.9**
Metals (mg/kg)					
Lead	63	400	**219 J**	**243 J**	**10.3 J**
Mercury	0.18	0.81	**0.18**	**0.19**	**0.014 J**
Zinc	109	10000	**317**	**345**	**31.1**

Sample Name: Sample Depth(ft bgs): Sample Date:	Unrestricted SCO	Restricted-Residential SCO	WW-SB-11 (50-51) 7/14/2009	WW-SB-11 (63-64) 7/14/2009
BTEX (mg/kg)				
Benzene	0.06	4.8	**0.25**	**0.0029 J**
Total BTEX	NE	NE	**0.305**	**0.0029**
Other VOCs (mg/kg)				
Total VOCs	NE	NE	**0.305**	**0.0029**
PAHs (mg/kg)				
Total PAHs	NE	NE	**0.935**	ND
Other SVOCs (mg/kg)				
Total SVOCs	NE	NE	**1.035**	**0.042**

Sample Name: Sample Depth(ft bgs): Sample Date:	Unrestricted SCO	Restricted-Residential SCO	WW-MW-17 (7-8) 6/8/2009	WW-MW-17 (54-55) 6/9/2009
BTEX (mg/kg)				
Benzene	0.06	4.8	**0.37 J**	**0.13**
Toluene	0.7	100	**0.74 J**	**0.0027 J**
Ethylbenzene	1	41	**15 J**	**0.12**
Total Xylene	0.26	100	**22 J**	**0.12**
Total BTEX	NE	NE	**38.11**	**0.3727**
Other VOCs (mg/kg)				
Total VOCs	NE	NE	**38.72**	**0.3727**
PAHs (mg/kg)				
Acenaphthene	20	100	**95**	**0.36 J**
Benz[a]anthracene	1	1	**17 J**	0.61 U
Benzo[a]pyrene	1	1	**19 J**	0.61 U
Benzo[b]fluoranthene	1	1	**13 J**	0.61 U
Benzo[k]fluoranthene	0.8	3.9	**6.2 J**	0.61 U
Chrysene	1	3.9	**16 J**	0.61 U
Dibenz[a,h]anthracene	0.33	0.33	**29 J**	0.61 U
Fluorene	30	100	**35**	0.61 U
Indeno[1,2,3-cd]pyrene	0.5	0.5	**38**	0.61 U
Naphthalene	12	100	**540**	**7.3**
Total PAHs	NE	NE	**1340.2**	**9.201**
Other SVOCs (mg/kg)				
Total SVOCs	NE	NE	**1340.2**	**9.931**
Metals (mg/kg)				
Lead	63	400	**548 J**	**6.7 J**
Mercury	0.18	0.81	**1.2**	0.053 U

Sample Name: Sample Depth(ft bgs): Sample Date:	Unrestricted SCO	Restricted-Residential SCO	WW-SB-09 (11-12) 7/13/2009	WW-SB-09 (53-54) 7/14/2009
BTEX (mg/kg)				
Benzene	0.06	4.8	**0.73 J**	**14**
Toluene	0.7	100	**7.6**	**15**
Ethylbenzene	1.00	41	**38**	**16**
Total Xylene	0.26	100	**87**	**19**
Total BTEX	NE	NE	**133.33**	**64**
Other VOCs (mg/kg)				
Total VOCs	NE	NE	**133.33**	**64.24**
PAHs (mg/kg)				
Acenaphthene	20	100	**24 J**	**0.55 J**
Benz[a]anthracene	1	1	**16 J**	**0.92 J**
Benzo[a]pyrene	1	1	**11 J**	**0.68 J**
Benzo[b]fluoranthene	1	1	**7.3 J**	**0.42 J**
Chrysene	1	3.9	**15 J**	**0.88 J**
Indeno[1,2,3-cd]pyrene	0.5	0.5	**46 J**	**0.83 J**
Naphthalene	12	100	**610**	**15**
Total PAHs	NE	NE	**1242.3**	**44.48**
Other SVOCs (mg/kg)				
Total SVOCs	NE	NE	**1247.1**	**44.48**

Sample Name: Sample Depth(ft bgs): Sample Date:	Unrestricted SCO	Restricted-Residential SCO	WW-SB-07 (46.5-49.5) 6/23/2009	WW-SB-07 (58-60) 6/23/2009
BTEX (mg/kg)				
Benzene	0.06	4.8	**230**	**2.8**
Toluene	0.7	100	**400**	0.6 U
Ethylbenzene	1	41	**64**	**0.89**
Total Xylene	0.26	100	**550**	0.6 U
Total BTEX	NE	NE	**1244**	**3.69**
Other VOCs (mg/kg)				
Total VOC	NE	NE	**1664**	**3.69**
PAHs (mg/kg)				
Acenaphthene	20	100	**46 J**	**0.028 J**
Acenaphthylene	100	100	**460**	**0.13 J**
Anthracene	100	100	**130 J**	**0.051 J**
Benz[a]anthracene	1	1	**83 J**	**0.04 J**
Benzo[a]pyrene	1	1	**58 J**	**0.03 J**
Benzo[b]fluoranthene	1	1	**34 J**	0.32 U
Chrysene	1	3.9	**75 J**	**0.028 J**
Fluoranthene	100	100	**130 J**	**0.057 J**
Fluorene	30	100	**220 J**	**0.068 J**
Naphthalene	12	100	**3300**	**1**
Phenanthrene	100	100	**490**	**0.2 J**
Pyrene	100	100	**190 J**	**0.086 J**
Total PAHs	NE	NE	**6416**	**2.086**
Other SVOCs (mg/kg)				
Dibenzofuran	7	59	**27 J**	0.32 U
Total SVOC	NE	NE	**6443**	**2.086**

Sample Name: Sample Depth(ft bgs): Sample Date:	Unrestricted SCO	Restricted-Residential SCO	WW-SB-24 (38-40) 7/16/2009	WW-SB-24 (53-55) 7/16/2009
BTEX (mg/kg)				
Benzene	0.06	4.8	**840**	**0.063**
Toluene	0.7	100	**1300**	**0.0033 J**
Ethylbenzene	1	41	**120**	**0.014**
Total Xylene	0.26	100	**1200**	**0.014**
Total BTEX	NE	NE	**3460**	**0.0943**
Other VOCs (mg/kg)				
Total VOCs	NE	NE	**4460**	**0.09449**
PAHs (mg/kg)				
Acenaphthene	20	100	**44 J**	0.33 U
Acenaphthylene	100	100	**470**	0.33 U
Anthracene	100	100	**140 J**	0.33 U
Benz[a]anthracene	1	1	**82 J**	0.33 U
Benzo[a]pyrene	1	1	**64 J**	0.33 U
Benzo[b]fluoranthene	1	1	**40 J**	0.33 U
Benzo[k]fluoranthene	0.8	3.9	**21 J**	0.33 U
Chrysene	1	3.9	**78 J**	0.33 U
Fluoranthene	100	100	**140 J**	0.33 U
Fluorene	30	100	**220**	0.33 U
Indeno[1,2,3-cd]pyrene	0.5	0.5	**24 J**	0.33 U
Naphthalene	12	100	**3100**	0.33 U
Phenanthrene	100	100	**540**	0.33 U
Pyrene	100	100	**220**	0.33 U
Total PAHs	NE	NE	**6406**	ND
Other SVOCs (mg/kg)				
Dibenzofuran	7	59	**31 J**	0.33 U
Total SVOCs	NE	NE	**6437**	**0.268**

Sample Name: Sample Depth(ft bgs): Sample Date:	Unrestricted SCO	Restricted-Residential SCO	WW-SB-42 (62-62.5) 12/22/2009	WW-SB-42 (96.5-97) 12/22/2009
BTEX (mg/kg)				
Benzene	0.06	4.8	**0.33 J**	0.0062 U
Toluene	0.7	100	**5**	0.0062 U
Ethylbenzene	1	41	**2.5**	0.0062 U
Total Xylene	0.26	100	**18**	0.0062 U
Total BTEX	NE	NE	**25.83**	ND
Other VOCs (mg/kg)				
Total VOCs	NE	NE	**33.13**	**0.0031**
PAHs (mg/kg)				
Benz[a]anthracene	1	1	**3.6 J**	0.33 U
Benzo[a]pyrene	1	1	**2.5 J**	0.33 U
Benzo[b]fluoranthene	1	1	**1.9 J**	0.33 U
Benzo[k]fluoranthene	0.8	3.9	**0.81 J**	0.33 U
Chrysene	1	3.9	**3.6 J**	0.33 U
Indeno[1,2,3-cd]pyrene	0.5	0.5	**0.54 J**	0.33 U
Naphthalene	12	100	**90**	0.33 U
Total PAHs	NE	NE	**216.8**	ND
Other SVOCs (mg/kg)				
Total SVOCs	NE	NE	**217.9**	ND
Metals (mg/kg)				
Copper	50	270	**5.8 J**	**264**
Manganese	1600	2000	**4820**	**11.3**
Nickel	30	310	**4.3 J**	**231 J**
Zinc	109	10000	**22.8 J**	**161**

Sample Name: Sample Depth(ft bgs): Sample Date:	Unrestricted SCO	Restricted-Residential SCO	WW-SB-37 (96-97) 12/28/2009
BTEX (mg/kg)			
Total BTEX	NE	NE	ND
Other VOCs (mg/kg)			
Total VOCs	NE	NE	ND
PAHs (mg/kg)			
Total PAHs	NE	NE	ND
Other SVOCs (mg/kg)			
Total SVOCs	NE	NE	**0.044**

Sample Name: Sample Depth(ft bgs): Sample Date:	Unrestricted SCO	Restricted-Residential SCO	WW-MW-04 (5-10) 6/15/2009	WW-MW-04 (31-33) 6/15/2009	WW-MW-04 (58-59) 6/15/2009
BTEX (mg/kg)					
Benzene	0.06	4.80	**0.021 J**	**62 J**	**0.0042 J**
Toluene	0.70	100.00	**0.0014 J**	**220 J**	**0.003 J**
Ethylbenzene	1.00	41.00	0.0056 UJ	**220 J**	**0.018**
Total Xylene	0.26	100.00	**0.0011 J**	**320 J**	**0.02**
Total BTEX	NE	NE	**0.0235**	**822**	**0.0452**
Other VOCs (mg/kg)					
Total VOCs	NE	NE	**0.0795**	**883.5**	**0.0842**
PAHs (mg/kg)					
Acenaphthene	20	100	0.3 U	**31 J**	0.31 UJ
Acenaphthylene	100	100	**0.069 J**	**280**	0.31 UJ
Anthracene	100	100	**0.054 J**	**110 J**	0.31 UJ
Benz[a]anthracene	1	1	**0.088 J**	**56 J**	0.31 UJ
Benzo[a]pyrene	1	1	**0.088 J**	**42 J**	0.31 UJ
Benzo[b]fluoranthene	1	1	**0.14 J**	**26 J**	0.31 UJ
Chrysene	1	3.9	**0.1 J**	**56 J**	0.31 UJ
Fluorene	30	100	**0.042 J**	**150**	0.31 UJ
Naphthalene	12	100	**0.054 J**	**2100**	**0.13 J**
Phenanthrene	100	100	**0.22 J**	**390**	**0.033 J**
Pyrene	100	100	**0.23 J**	**150 J**	0.31 UJ
Total PAHs	NE	NE	**2.231**	**4355**	**0.235**
Other SVOCs (mg/kg)					
Dibenzofuran	7	59	0.3 U	**16 J**	0.31 UJ
Total SVOCs	NE	NE	**2.381**	**4371**	**0.235**
Pesticides (mg/kg)					
4,4'-DDT	0.0033	7.9	**0.0071 J**	NA	NA
Metals (mg/kg)					
Copper	50	270	**88**	**10.4**	**17.4 J**
Lead	63	400	**99.9**	**2.3 J**	**5.9**
Zinc	109	10000	**1020 J**	**13.5 J**	**21.8 J**

Sample Name: Sample Depth(ft bgs): Sample Date:	Unrestricted SCO	Restricted-Residential SCO	WW-MW-05 (12-13) 6/10/2009	WW-MW-05 (63-64) 6/11/2009
BTEX (mg/kg)				
Benzene	0.06	4.8	**84**	0.0057 U
Toluene	0.7	100	**220**	**0.00068 J**
Ethylbenzene	1	41	**320**	**0.002 J**
Total Xylene	0.26	100	**1700**	**0.002 J**
Total BTEX	NE	NE	**964**	**0.00468**
Other VOCs (mg/kg)				
Total VOC	NE	NE	**964**	**0.00494**
PAHs (mg/kg)				
Acenaphthene	20	100	**73**	0.3 U
Benz[a]anthracene	1	1	**14 J**	**0.045 J**
Benzo[a]pyrene	1	1	**11 J**	0.3 U
Benzo[b]fluoranthene	1	1	**7.9 J**	0.33 U
Chrysene	1	3.9	**12 J**	**0.038 J**
Fluorene	30	100	**40**	**0.075 J**
Indeno[1,2,3-cd]pyrene	0.5	0.5	**7.7 J**	0.3 U
Naphthalene	12	100	**500**	**0.27 J**
Total PAHs	NE	NE	**1059.6**	**1.148**
Other SVOCs (mg/kg)				
Total SVOC	NE	NE	**1063.8**	**1.179**
Metals (mg/kg)				
Lead	63	400	**108 J**	**9.8 J**

Sample Name: Sample Depth(ft bgs): Sample Date:	Unrestricted SCO	Restricted-Residential SCO	WW-SB-23 (31-33) 7/17/2009	WW-SB-23 (62-63) 7/17/2009
BTEX (mg/kg)				
Benzene	0.06	4.8	**1100**	**13**
Toluene	0.7	100	**1800**	**32**
Ethylbenzene	1	41	**200**	**35**
Total Xylene	0.26	100	**1700**	**69**
Total BTEX	NE	NE	**4800**	**149**
Other VOCs (mg/kg)				
Total VOCs	NE	NE	**5900**	**170**
PAHs (mg/kg)				
Acenaphthene	20.0	100.0	**400 J**	**5.1 J**
Acenaphthylene	100.0	100.0	**3200**	**32**
Anthracene	100.0	100.0	**1300**	**14**
Benz[a]anthracene	1.0	1.0	**710 J**	**7.5**
Benzo[a]pyrene	1.0	1.0	**530 J**	**5.5 J**
Benzo[b]fluoranthene	1.0	1.0	**430 J**	**3.5 J**
Benzo[g,h,i]perylene	100.0	100.0	**620 J**	**4.3 J**
Benzo[k]fluoranthene	0.8	3.9	**140 J**	**1.1 J**
Chrysene	1	3.9	**700 J**	**6.9**
Dibenz[a,h]anthracene	0.33	0.33	1200 U	**2.9 J**
Fluoranthene	100	100	**1600**	**14**
Fluorene	30	100	**2000**	**19**
Indeno[1,2,3-cd]pyrene	0.5	0.5	1200 U	**4.2 J**
Naphthalene	12	100	**17000**	**120**
Phenanthrene	100	100	**4800**	**50**
Pyrene	100	100	**1700**	**19**
Total PAHs	NE	NE	**42930**	**373**
Other SVOCs (mg/kg)				
Dibenzofuran	7	59	**400 J**	**2.8 J**
Total SVOCs	NE	NE	**43330**	**376.57**

Sample Name: Sample Depth(ft bgs): Sample Date:	Unrestricted SCO	Restricted-Residential SCO	WW-SB-38 (96-97) 12/29/2009
BTEX (mg/kg)			
Total BTEX	NE	NE	**0.00019**
Other VOCs (mg/kg)			
Total VOCs	NE	NE	**0.00019**
PAHs (mg/kg)			
Total PAHs	NE	NE	ND
Other SVOCs (mg/kg)			
Total SVOCs	NE	NE	ND

Sample Name: Sample Depth(ft bgs): Sample Date:	Unrestricted SCO	Restricted-Residential SCO	WWS-08 (0-0.2) 10/6/2009
BTEX (mg/kg)			
Total BTEX	NE	NE	ND
Other VOCs (mg/kg)			
Total VOC	NE	NE	ND
PAHs (mg/kg)			
Benzo[a]pyrene	1	1	**1.1 J**
Benzo[b]fluoranthene	1	1	**1.4**
Chrysene	1	3.9	**1.1 J**
Indeno[1,2,3-cd]pyrene	0.5	0.5	**1.2 J**
Total PAHs	NE	NE	**15.12**
Other SVOCs (mg/kg)			
Total SVOC	NE	NE	**15.95**
Pesticides (mg/kg)			
4,4-ODD	0.0033	13	**0.0068 J**
4,4'-ODE	0.0033	8.9	**0.0047 J**
4,4'-DDT	0.0033	7.9	**0.011 J**
Metals (mg/kg)			
Copper	50	270	**347**
Lead	63	400	**251**
Zinc	109	10000	**462**

Sample Name: Sample Depth(ft bgs): Sample Date:	Unrestricted SCO	Restricted-Residential SCO	WW-MW-11 (4-5) 8/21/2009	WW-MW-11 (12-15) 8/24/2009	WW-MW-11 (39-40) 8/25/2009
BTEX (mg/kg)					
Benzene	0.1	4.8	0.0059 U	**0.34 J**	0.0056 U
Ethylbenzene	1	41	0.0059 U	**25**	0.0056 U
Total BTEX	NE	NE	ND	**25.340**	ND
Other VOCs (mg/kg)					
Total VOC	NE	NE	**0.0001**	**25.340**	ND
PAHs (mg/kg)					
Acenaphthene	20	100	**1.4 J**	**110**	**0.35**
Benz[a]anthracene	1	1	**19**	**35 J**	**0.14 J**
Benzo[a]pyrene	1	1	**41 J**	**36 J**	**0.12 J**
Benzo[b]fluoranthene	1	1	**47 J**	**30 J**	**0.13 J**
Benzo[k]fluoranthene	0.8	100	**20 J**	**12 J**	**0.043 J**
Chrysene	1	3.9	**25**	**36 J**	**0.13 J**
Dibenz[a,h]anthracene	0.33	0.33	**8.2 J**	60 U	0.29 U
Fluorene	30	100	**1.2 J**	**69 J**	**0.2 J**
Indeno[1,2,3-cd]pyrene	0.5	0.5	**33 J**	**14 J**	**0.11 J**
Naphthalene	12	100	6.2 U	**740**	0.29 U
Phenanthrene	100	100	**10**	**160**	**0.67**
Total PAHs	NE	NE	**271.270**	**1717.000**	**3.665**
Other SVOCs (mg/kg)					
Dibenzofuran	7	59	**1 J**	**11 J**	**0.032 J**
Total SVOC	NE	NE	**273.370**	**1813.200**	**3.697**
Metals (mg/kg)					
Zinc	109.000	10000.000	**178**	**23.3**	**31.4**

Sample Name: Sample Depth(ft bgs): Sample Date:	Unrestricted SCO	Restricted-Residential SCO	WWS-04 (0-0.2) 10/6/2009	Duplicate of WWS-04 (0-0.2) 10/6/2009
BTEX (mg/kg)				
Total BTEX	NE	NE	ND	ND
Other VOCs (mg/kg)				
Total VOC	NE	NE	ND	ND
PAHs (mg/kg)				
Benz[a]anthracene	1	1	**2.1 J**	**0.28 J**
Benzo[a]pyrene	1	1	**2.9 J**	**0.37 J**
Benzo[b]fluoranthene	1	1	**2.9 J**	**0.47 J**
Benzo[k]fluoranthene	0.8	100	**1.2 J**	**0.14 J**
Chrysene	1	3.9	**2.6 J**	**0.33 J**
Dibenz[a,h]anthracene	0.33	0.33	**0.73 J**	1.3 UJ
Indeno[1,2,3-cd]pyrene	0.5	0.5	**2.9 J**	**0.52 J**
Total PAHs

LEGEND:

- APPROXIMATE SITE BOUNDARY
- APPROXIMATE BOUNDARY OF FORMER MGP PROPERTY
- HISTORIC MGP STRUCTURES
- MONITORING WELL (RI)
- ABANDONED MONITORING WELL (RI)
- SOIL BORING WITH TEMPORARY GROUNDWATER POINT (RI)
- 10 — ELEVATION CONTOUR FOR BOTTOM OF EXCAVATION (NAVD 88)

ANALYTICAL BOXES

µg/L	MICROGRAMS PER LITER OR PARTS PER BILLION (ppb)
BTEX	BENZENE, TOLUENE, ETHYLBENZENE, AND XYLENES
VOCs	VOLATILE ORGANIC COMPOUNDS
PAHs	POLYCYCLIC AROMATIC HYDROCARBONS
SVOCs	SEMIVOLATILE ORGANIC COMPOUNDS

ANALYTICAL BOXES (CONT'D)

VALIDATION QUALIFIERS

J	ESTIMATED VALUE
JN	ANALYTE IS PRESUMPTIVELY PRESENT AT AN APPROXIMATED QUANTITY
U	INDICATES NOT DETECTED TO THE REPORTING LIMIT

TOTAL BTEX, TOTAL VOCS, TOTAL PAHS AND TOTAL SVOCS ARE CALCULATED USING DETECTS ONLY.

TOTAL PAHS ARE CALCULATED USING THE FOLLOWING ANALYTES: ACENAPHTHENE, ACENAPHTHYLENE, ANTHRACENE, BENZ[A]ANTHRACENE, BENZO[A]PYRENE, BENZO[B]FLUORANTHENE, BENZO[G,H,I]PERYLENE, BENZO[K]FLUORANTHENE, CHRYSENE,DIBENZ[A,H]ANTHRACENE, FLUORANTHENE, FLUORENE, INDENO[1,2,3-CD]PYRENE, 2-METHYLNAPHTHALENE, NAPHTHALENE, PHENANTHRENE, AND PYRENE

TOTAL PAH17 IS CALCULATED USING THE EPA16 LIST OF ANALYTES PLUS 2-METHYLNAPHTHALENE

ANALYTICAL BOXES (CONT'D)

NYS AWQS	NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES FOR GA GROUNDWATER
*	INDICATES THE VALUE IS A GUIDANCE VALUE AND NOT A STANDARD
ND	NOT DETECTED, TOTAL CONCENTRATION IS LISTED AS ND BECAUSE NO COMPOUNDS WERE DETECTED IN THE GROUP
NE	NOT ESTABLISHED
BOLD	INDICATES A DETECTED CONCENTRATION
BOLD	DETECTED RESULT VALUE EXCEED NYS AWQS

Sample Name: / Sample Depth (feet): / Sample Date:	NYS AWQS	WW-MW-15 (4-14) 11/6/2009
BTEX (ug/L)		
Benzene	1	**1.7 J**
Total BTEX	NE	**1.7**
Other VOCs (ug/L)		
Total VOCs	NE	**1.7**
PAHs (ug/L)		
Total PAHs	NE	**17.28**
Other SVOCs (ug/L)		
Total SVOCs	NE	**19.28**
Pesticides (ug/L)		
alpha-BHC	0.01	**0.02 J**
Total Metals (ug/L)		
Arsenic	25	**42.8 J**
Iron	300	**310 J**
Magnesium	35000*	**688000**
Sodium	20000	**5980000**

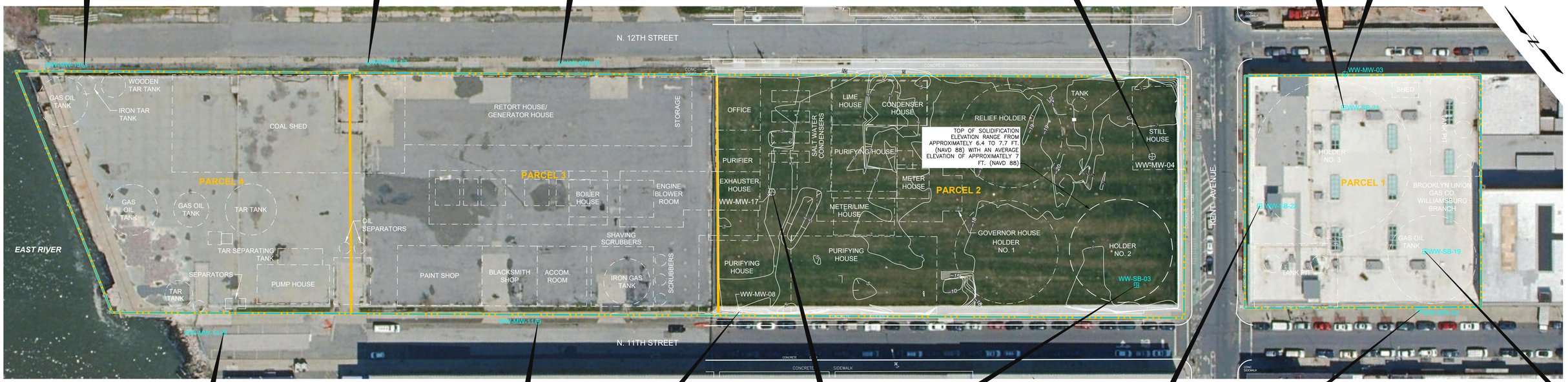
Sample Name: / Sample Depth (feet): / Sample Date:	NYS AWQS	WW-MW-13 (4-14) 11/6/2009
BTEX (ug/L)		
Benzene	1	**540**
Toluene	5	**7 J**
Ethylbenzene	5	**190**
Total Xylene	5	**100**
Total BTEX	NE	**837**
Other VOCs (ug/L)		
Total VOCs	NE	**837**
PAHs (ug/L)		
Acenaphthene	20*	**100**
Naphthalene	10*	**370**
Total PAHs	NE	**556.2**
Other SVOCs (ug/L)		
Phenol	1	**3.2 J**
Total SVOCs	NE	**570.4**
Total Metals (ug/L)		
Iron	300	**2390**
Magnesium	35000*	**130000**
Sodium	20000	**982000**

Sample Name: / Sample Depth (feet): / Sample Date:	NYS AWQS	WW-MW-10 (4-14) 11/5/2009
BTEX (ug/L)		
Benzene	1	**29**
Ethylbenzene	5	**330**
Total Xylene	5	**200**
Total BTEX	NE	**562.1**
Other VOCs (ug/L)		
Total VOCs	NE	**578.1**
PAHs (ug/L)		
Acenaphthene	20*	**28 J**
Naphthalene	10*	**580**
Total PAHs	NE	**749.6**
Other SVOCs (ug/L)		
Total SVOCs	NE	**749.6**
Total Metals (ug/L)		
Iron	300	**5000**
Manganese	300	**489**
Sodium	20000	**343000**

Sample Name: / Sample Depth (feet): / Sample Date:	NYS AWQS	WW-MW-04 (10-20) 11/4/2009	Duplicate of WW-MW-04 (10-20) 11/5/2009
BTEX (ug/L)			
Benzene	1	**8.7**	**9.2**
Toluene	5	**5.2**	**5.4**
Ethylbenzene	5	**16**	**17**
Total Xylene	5	**21**	**23**
Total BTEX	NE	**50.9**	**54.6**
Other VOCs (ug/L)			
Total VOCs	NE	**61.91**	**66.9**
PAHs (ug/L)			
Naphthalene	10*	**43**	**56**
Total PAHs	NE	**124.4**	**150.2**
Other SVOCs (ug/L)			
Total SVOCs	NE	**126.6**	**153.1**
Total Metals (ug/L)			
Iron	300	**2330**	**2350**
Sodium	20000	**363000**	**356000**

Sample Name: / Sample Depth (feet): / Sample Date:	NYS AWQS	WW-SB-21 (4-14) 7/8/2009	Duplicate of WW-SB-21 (4-14) 7/8/2009	WW-SB-21 (15-25) 7/22/2009	WW-SB-21 (40-50) 7/23/2009
BTEX (ug/L)					
Benzene	1	**330**	**370**	**4000**	**8300**
Toluene	5	**3.7 J**	**4.5 J**	**2000**	**2700**
Ethylbenzene	5	**46**	**50**	**850**	**1600**
Total Xylene	5	**58**	**65**	**3200**	**1800**
Total BTEX	NE	**437.7**	**489.5**	**10050**	**14400**
Other VOCs (ug/L)					
cis-1,2-Dichloroethene	5	20 U	20 U	250 U	**130 J**
trans-1,2-Dichloroethene	5	20 U	20 U	250 U	**240 J**
Styrene	5	20 U	20 U	**400**	500 U
Total VOCs	NE	**440.6**	**489.5**	**10450**	**14770**
PAHs (ug/L)					
Acenaphthene	20*	**42**	**58**	**29 J**	**42 J**
Naphthalene	10*	**440 J**	**180 J**	**3400**	**2200**
Total PAHs	NE	**543.4**	**308.5**	**3651**	**2617**
Other SVOCs (ug/L)					
Phenol	1	**22 J**	**9.9 J**	210 U	200 U
Total SVOCs	NE	**571.4**	**332**	**3651**	**2617**
Total Metals (ug/L)					
Iron	300	**2320**	**2390**	**8890**	**2420**
Magnesium	35000*	**256000**	**267000**	**261000**	**29100**
Manganese	300	**135**	**139**	**332**	**452**
Sodium	20000	**208000 J**	**217000 J**	**205000**	**56500**
Cyanides (ug/L)					
Total Cyanide	200	**3540**	**3900**	**3140**	**58.6**
Other (ug/L)					
Ammonia	2000	**610**	**600**	**960**	**3800**

Sample Name: / Sample Depth (feet): / Sample Date:	NYS AWQS	WW-MW-03 (4-14) 11/4/2009
BTEX (ug/L)		
Total BTEX	NE	ND
Other VOCs (ug/L)		
Total VOCs	NE	ND
PAHs (ug/L)		
Total PAHs	NE	**0.33**
Other SVOCs (ug/L)		
Total SVOCs	NE	**0.33**
Total Metals (ug/L)		
Iron	300	**29100**
Manganese	300	**1130**
Sodium	20000	**735000**



Sample Name: / Sample Depth (feet): / Sample Date:	NYS AWQS	WW-MW-14 (4-14) 11/6/2009
BTEX (ug/L)		
Total BTEX	NE	ND
Other VOCs (ug/L)		
Total VOCs	NE	ND
PAHs (ug/L)		
Total PAHs	NE	ND
Other SVOCs (ug/L)		
Total SVOCs	NE	ND
Total Metals (ug/L)		
Arsenic	25	**32 J**
Chromium	50	**74.2**
Iron	300	**334 J**
Magnesium	35000*	**697000**
Nickel	100	**159 J**
Sodium	20000	**5990000**

Sample Name: / Sample Depth (feet): / Sample Date:	NYS AWQS	WW-MW-11 (4-14) 11/5/2009
BTEX (ug/L)		
Benzene	1	**320**
Toluene	5	**38 J**
Ethylbenzene	5	**1600**
Total Xylene	5	**280**
Total BTEX	NE	**2238**
Other VOCs (ug/L)		
Total VOCs	NE	**2238**
PAHs (ug/L)		
Acenaphthene	20*	**140 J**
Naphthalene	10*	**6300**
Total PAHs	NE	**7060**
Other SVOCs (ug/L)		
Total SVOCs	NE	**7060**
Pesticides (ug/L)		
delta-BHC	0.04	**0.041 J**
Total Metals (ug/L)		
Iron	300	**1740**
Manganese	300	**559**
Sodium	20000	**362000**
Cyanides (ug/L)		
Total Cyanide	200	**211**

Sample Name: / Sample Depth (feet): / Sample Date:	NYS AWQS	WW-MW-08 (0.3-10.3) 11/5/2009
BTEX (ug/L)		
Benzene	1	**570**
Toluene	5	**64 J**
Ethylbenzene	5	**2800**
Total Xylene	5	**3100**
Total BTEX	NE	**6534**
Other VOCs (ug/L)		
Total VOCs	NE	**6534**
PAHs (ug/L)		
Acenaphthene	20*	**140 J**
2-Methylnaphthalene	NE	**540 J**
Naphthalene	10*	**4000**
Total PAHs	NE	**4680**
Other SVOCs (ug/L)		
Total SVOCs	NE	**4680**
Total Metals (ug/L)		
Iron	300	**4690**
Sodium	20000	**525000**
Cyanides (ug/L)		
Total Cyanide	200	**323**

Sample Name: / Sample Depth (feet): / Sample Date:	NYS AWQS	WW-MW-17 (4-14) 11/5/2009
BTEX (ug/L)		
Total BTEX	NE	ND
Other VOCs (ug/L)		
Total VOCs	NE	ND
PAHs (ug/L)		
Total PAHs	NE	**8.470**
Other SVOCs (ug/L)		
Total SVOCs	NE	**8.470**
Total Metals (ug/L)		
Iron	300	**629**
Sodium	20000	**316000**
Cyanides (ug/L)		
Total Cyanide	200	**281**

Sample Name: / Sample Depth (feet): / Sample Date:	NYS AWQS	WW-SB-03 (5-10) 7/14/2009
BTEX (ug/L)		
Benzene	1	**3700**
Toluene	5	**110 J**
Ethylbenzene	5	**3000**
Total Xylene	5	**1800**
Total BTEX	NE	**8610**
Other VOCs (ug/L)		
Total VOCs	NE	**8610**
PAHs (ug/L)		
Acenaphthene	20*	**86 J**
Naphthalene	10*	**5800**
Total PAHs	NE	**6266**
Other SVOCs (ug/L)		
Total SVOCs	NE	**6266**
Pesticides (ug/L)		
beta-BHC	0.04	**0.092 JN**
delta-BHC	0.04	**0.084 J**
Heptachlor epoxide	0.03	**0.04 J**
Total Metals (ug/L)		
Barium	1000	**3440**
Iron	300	**21100**
Lead	25	**189**
Magnesium	35000*	**208000**
Manganese	300	**331**
Sodium	20000	**3290000 J**
Cyanides (ug/L)		
Total Cyanide	200	**517**

Sample Name: / Sample Depth (feet): / Sample Date:	NYS AWQS	WW-SB-22 (6-16) 7/8/2009	WW-SB-22 (35-45) 7/27/2009	WW-SB-22 (55-65) 7/27/2009
BTEX (ug/L)				
Benzene	1	**43**	**1300**	**9600**
Toluene	5	5 U	**360**	**1100**
Ethylbenzene	5	**1 J**	**160**	**1400**
Total Xylene	5	5 U	**290**	**1500**
Total BTEX	NE	**44**	**2110**	**13600**
Other VOCs (ug/L)				
Acetone	50*	10 U	**55 J**	1000 U
cis-1,2-Dichloroethene	5	5 U	**97**	500 U
Styrene	5	5 U	**16 J**	500 U
Vinyl chloride	2	5 U	**14 J**	500 U
Total VOCs	NE	**44**	**2292**	**13600**
PAHs (ug/L)				
Acenaphthene	20*	**3.1 J**	**40 J**	**82 J**
Indeno[1,2,3-cd]pyrene	0.002*	**5.3**	210 U	200 U
Naphthalene	10*	4 U	**2000**	**2600**
Total PAHs	NE	**18.82**	**2284**	**2902**
Other SVOCs (ug/L)				
Total SVOCs	NE	**26.08**	**2284**	**2902**
Total Metals (ug/L)				
Iron	300	**3390**	**22400**	**21000**
Magnesium	35000*	**34100**	**62500**	**39300**
Manganese	300	**1820**	**6270**	**466**
Sodium	20000	**93500 J**	**842000 J**	**106000 J**
Other (ug/L)				
Ammonia	2000	**960**	**7600**	**9200**

Sample Name: / Sample Depth (feet): / Sample Date:	NYS AWQS	WW-MW-02 (7.4-17.4) 11/4/2009
BTEX (ug/L)		
Total BTEX	NE	ND
Other VOCs (ug/L)		
cis-1,2-Dichloroethene	5	**14**
Total VOCs	NE	**14**
PAHs (ug/L)		
Total PAHs	NE	**0.87**
Total Metals (ug/L)		
Iron	300	**9480**
Magnesium	35000*	**37300**
Manganese	300	**3480**
Sodium	20000	**496000**

Sample Name: / Sample Depth (feet): / Sample Date:	NYS AWQS	WW-SB-19 (5-15) 7/28/2009	WW-SB-19 (25-35) 7/29/2009	Duplicate of WW-SB-19 (25-35) 7/29/2009	WW-SB-19 (40-50) 7/29/2009
BTEX (ug/L)					
Benzene	1	**79**	**44**	**36**	5 U
Toluene	5	**170**	**91 J**	**59 J**	**64**
Ethylbenzene	5	**35**	**45**	**40**	**11**
Total Xylene	5	**190**	**95**	**75**	**55**
Total BTEX	NE	**474**	**275**	**210**	**130**
Other VOCs (ug/L)					
Chloroform	7	**7.8**	**7.6**	**7.1**	**3.1 J**
1,1-Dichloroethene	0.07	5 U	**1.4 J**	**1.5 J**	5 U
cis-1,2-Dichloroethene	5	**1.1 J**	**21**	**19**	**4.9 J**
trans-1,2-Dichloroethene	5	5 U	**30 J**	**29 J**	5 U
Trichloroethene	5	5 U	**42**	**38**	5 U
Total VOCs	NE	**483**	**378.4**	**305.9**	**138**
PAHs (ug/L)					
Benz[a]anthracene	0.002*	**0.8 J**	4.2 U	4 UJ	4.2 U
Chrysene	0.002*	**0.92 J**	4.2 U	4 UJ	4.2 U
Naphthalene	10*	**6.8**	**28**	**21 J**	4.2 U
Total PAHs	NE	**54.72**	**37.16**	**27.44**	ND
Other SVOCs (ug/L)					
Total SVOCs	NE	**60.52**	**38.8**	**29.52**	ND
Total Metals (ug/L)					
Iron	300	**34900**	**15800**	**16500**	**40400**
Magnesium	35000*	**13200**	**39700**	**41100**	**38800**
Manganese	300	**581**	**2800**	**2900**	**1080**
Sodium	20000	**43400 J**	**118000 J**	**122000 J**	**41400 J**
Cyanides (ug/L)					
Total Cyanide	200	**29.2**	**9.7 J**	**10**	**297**

0 40' 80'

SCALE: 1" = 40'

SOURCES:

1. *FIGURE 10: BOTTOM OF EXCAVATION SURFACES*, FROM NAPL RECOVERY WORK PLAN, PREPARED BY AECOM, SCALE: 1" = 20', DATE: OCTOBER 2017.
2. SURVEY OF WILLIAMSBURG WORKS BOUNDARIES, EXISTING CONDITIONS, AND SAMPLE LOCATIONS CONDUCTED BY GEI CONSULTANTS, INC. SURVEYED BY NEW YORK STATE-LICENSED LAND SURVEYOR No. 050146.
3. AERIAL PHOTOGRAPH FROM ARCGIS WORLD IMAGERY LAYER, ACCESSED VIA ARCGISONLINE, IMAGERY DATE: 04/15/2018.

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GROUNDWATER SAMPLE IMPACTS

Project 093060 | July 2021 | Fig. 8

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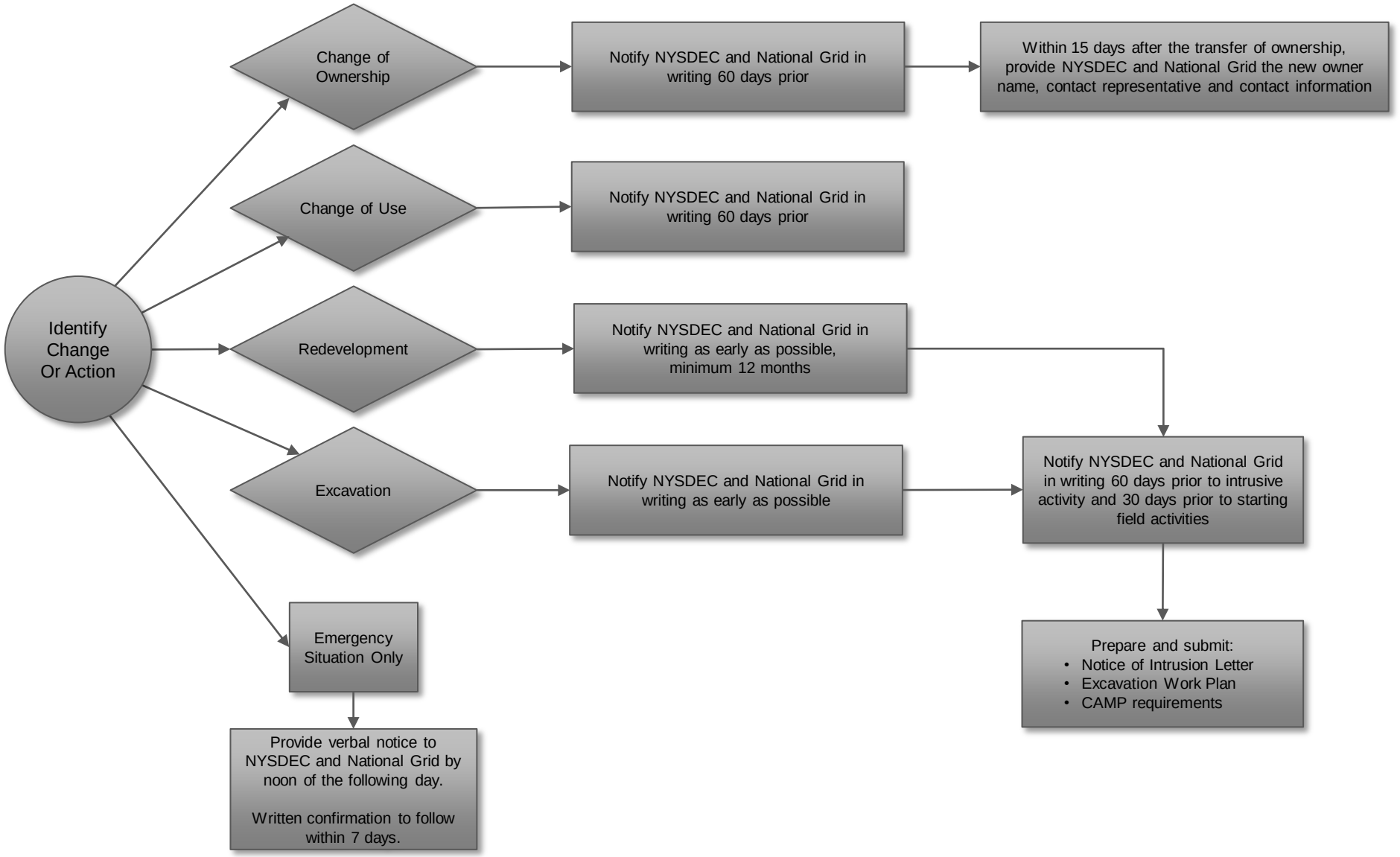

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DECISION TREE FOR
INTRUSIVE ACTIVITIES ON SITE

Project 093060 | July 2021 | Fig. 9

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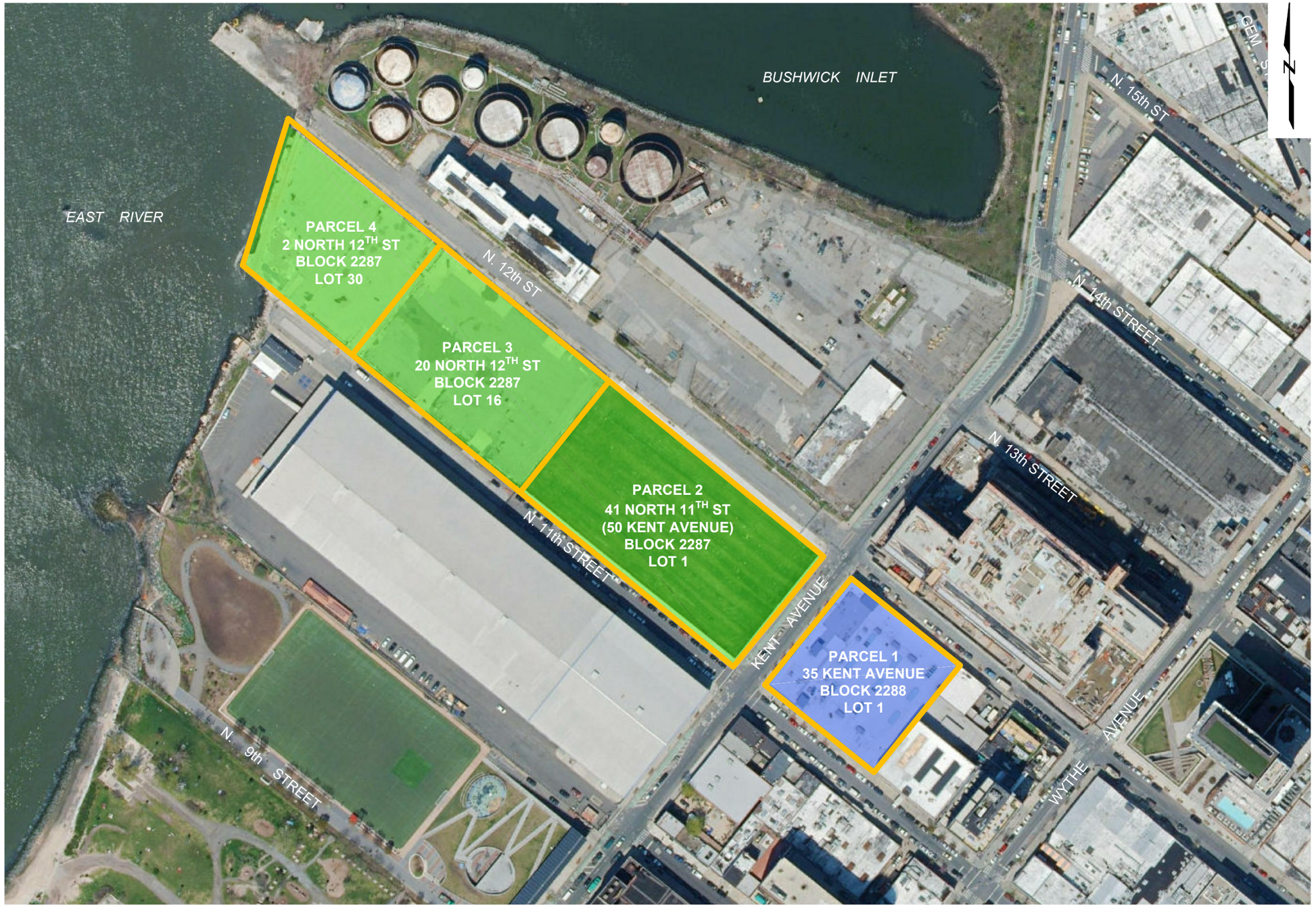

LEGEND:

- APPROXIMATE SITE AND PARCEL BOUNDARIES
- RESTRICTED RESIDENTIAL OR COMMERCIAL USE
- INDUSTRIAL USE

SOURCES:

1. AERIAL PHOTOGRAPH FROM ARCGIS WORLD IMAGERY LAYER, ACCESSED VIA ARCGISONLINE, IMAGERY DATE: 04/15/2018.
2. SANBORN FIRE INSURANCE MAPS (1887 THROUGH 1996).
3. NEW YORK CITY OPEN ACCESSIBLE SPACE INFORMATION SYSTEM HTTP://WWW.OASISNYC.NET ACCESSED JANUARY 2008.
4. SURVEY OF WILLIAMSBURG WORKS BOUNDARIES, EXISTING CONDITIONS, AND SAMPLE LOCATIONS CONDUCTED BY GEI CONSULTANTS, INC. SURVEYED BY NEW YORK STATE-LICENSED LAND SURVEYOR No. 050146.

0 150 300

SCALE: 1" = 150'

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INSTITUTIONAL CONTROL BOUNDARIES

Project 093060 | July 2021 | Fig. 10

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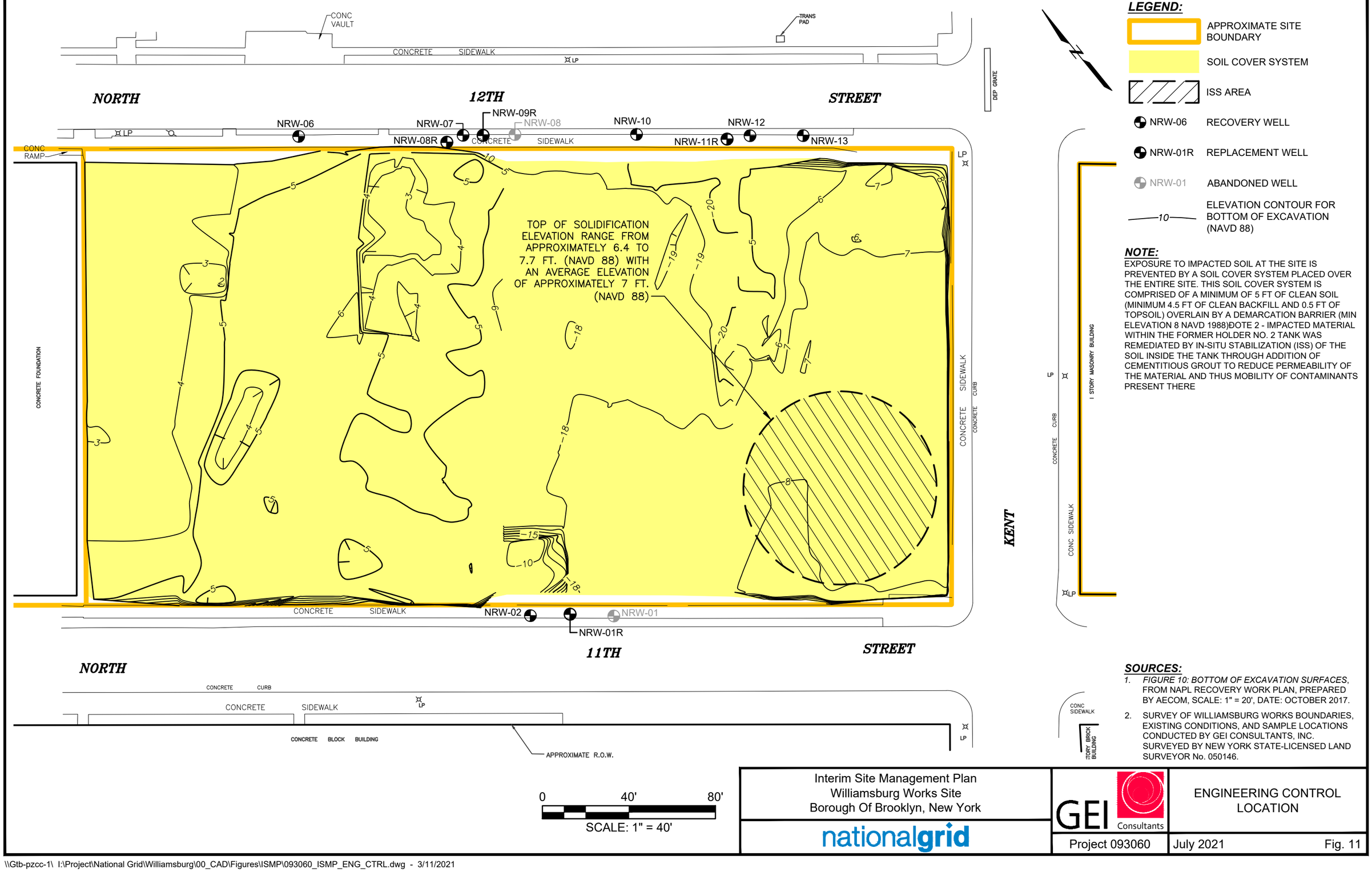

LEGEND:

- APPROXIMATE SITE BOUNDARY
- SOIL COVER SYSTEM
- ISS AREA
- NRW-06 RECOVERY WELL
- NRW-01R REPLACEMENT WELL
- NRW-01 ABANDONED WELL
- 10 ELEVATION CONTOUR FOR BOTTOM OF EXCAVATION (NAVD 88)

NOTE:

EXPOSURE TO IMPACTED SOIL AT THE SITE IS PREVENTED BY A SOIL COVER SYSTEM PLACED OVER THE ENTIRE SITE. THIS SOIL COVER SYSTEM IS COMPRISED OF A MINIMUM OF 5 FT OF CLEAN SOIL (MINIMUM 4.5 FT OF CLEAN BACKFILL AND 0.5 FT OF TOPSOIL) OVERLAIN BY A DEMARCATION BARRIER (MIN ELEVATION 8 NAVD 1988)ÐOTE 2 - IMPACTED MATERIAL WITHIN THE FORMER HOLDER NO. 2 TANK WAS REMEDIATED BY IN-SITU STABILIZATION (ISS) OF THE SOIL INSIDE THE TANK THROUGH ADDITION OF CEMENTITIOUS GROUT TO REDUCE PERMEABILITY OF THE MATERIAL AND THUS MOBILITY OF CONTAMINANTS PRESENT THERE

SOURCES:

1. *FIGURE 10: BOTTOM OF EXCAVATION SURFACES*, FROM NAPL RECOVERY WORK PLAN, PREPARED BY AECOM, SCALE: 1" = 20', DATE: OCTOBER 2017.
2. SURVEY OF WILLIAMSBURG WORKS BOUNDARIES, EXISTING CONDITIONS, AND SAMPLE LOCATIONS CONDUCTED BY GEI CONSULTANTS, INC. SURVEYED BY NEW YORK STATE-LICENSED LAND SURVEYOR No. 050146.

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ENGINEERING CONTROL LOCATION

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TRUCK TRANSPORT ROUTE

Project 093060 | July 2021 | Fig. 12

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LEGEND:

ROUTE ENTERING SITE

ROUTE EXITING SITE

TRUCK ROUTE NOTES:

1. DO NOT QUEUE TRUCKS AND EQUIPMENT IN LOCAL STREETS.
2. DO NOT IDLE TRUCKS DELIVERING MATERIALS OR AWAITING LOADING ON SITE OR ON LOCAL STREETS.
3. PROVIDE ALL NECESSARY FLAGGING FOR TRUCKS ENTERING/EXITING THE SITE.
4. INFORM ALL AUTHORITIES REQUIRED AS TO THE TRUCK TRAFFIC AND ROUTES.
5. FOLLOW APPROVED LOCAL ROUTE TO/FROM I-287.
6. USE ONLY NYCDOT-APPROVED THROUGH TRUCK ROUTES TO ENTER AND EXIT NEW YORK CITY.

DIRECTIONS ENTERING THE SITE

FROM THE SOUTH:

1. FROM I-278 E, TAKE EXIT 32 TOWARD METROPOLITAN AVE/WILLIAMSBURG BRIDGE/MANHATTAN
2. MERGE ONTO RODNEY ST
3. CONTINUE ONTO MEEKER AVE
4. TURN LEFT ONTO UNION AVE
5. TURN LEFT ONTO N 10TH ST
6. TURN RIGHT ONTO KENT AVE
7. TURN LEFT INTO SITE

FROM THE NORTH:

1. FROM I-278 W, TAKE EXIT 32B TOWARD METROPOLITAN AVE
2. CONTINUE STRAIGHT ONTO MEEKER AVE
3. TURN RIGHT ONTO N 8TH ST/PADRE PIO WAY
4. TURN RIGHT AT THE 1ST CROSS STREET ONTO HAVEMEYER ST
5. HAVEMEYER ST TURNS RIGHT AND BECOMES WITHERS ST
6. TURN LEFT ONTO UNION AVE
7. TURN LEFT ONTO N 10TH AVE
8. TURN RIGHT ONTO KENT AVE
9. TURN LEFT INTO SITE

DIRECTIONS LEAVING THE SITE

SOUTHBOUND:

1. TURN LEFT ONTO KENT AVE TOWARD N 12 ST
2. CONTINUE ONTO FRANKLIN ST
3. TURN RIGHT ONTO GREENPONIT AVE
4. TURN RIGHT ONTO MCGUINNESS BLVD
5. SLIGHT RIGHT TO MERGE ONTO I-278 W TOWARD BKLYN-QNS EXPRESSWAY/STATEN ISLAND.

NORTHBOUND:

1. TURN LEFT ONTO KENT AVE TOWARD N 12TH ST
2. CONTINUE ONTO FRANKLIN ST
3. TURN RIGHT ONTO GREENPOINT AVE
4. TURN LEFT ONTO MCGUINNESS BLVD
5. KEEP LEFT TO CONTINUE ON PULASKI BRIDGE
6. SLIGHT RIGHT TOWARD 49TH AVE
7. TURN RIGHT ONTO 49TH AVE
8. TURN RIGHT ONTO 11TH PL
9. TURN RIGHT ONTO 50TH AVE
10. TURN LEFT ONTO I-495 W RAMP

SOURCE:

WORLD STREET MAP: ESRI, HERE, DELORME, USGS, INTERMAP, INCREMENT P CORP., NRCAN, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), ESRI (THAILAND), MAPMYINDIA, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY, ACCESSED VIA ARCGIS ONLINE, ACCESSED ON 03/15/18.

0 400' 800'

SCALE: 1" = 400'

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LOCAL TRUCK ROUTES

Project 093060 | July 2021 | Fig. 13

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APPENDIX A – ENVIRONMENTAL EASEMENT

APPENDIX B – EXCAVATION WORK PLAN (EWP)

This EWP will be implemented to address any intrusive activities at the Site. The property owners, their tenants, consultants, and contractors are required to comply with this EWP.

B-1 NOTIFICATION

At least 15 days prior to the start of any activity, the property owner or their representative will notify the NYSDEC and National Grid. Table 2 includes contact information for the above notification. The information on this table will be updated as necessary to provide accurate contact information. A full listing of Site-related contact information is provided in Appendix C.

All intrusive activities must be approved by NYSDEC. Notification must be made to NYSDEC in accordance with Section 1.3 of the ISMP.

Notification to NYSDEC via a Notice of Intrusion letter will be prepared. This notification will include:

- A detailed description of the work to be performed, including the location and areal extent of excavation, plans/drawings for Site re-grading, intrusive elements or utilities to be installed below the soil cover system, estimated volumes of impacted soil to be excavated, any modifications of truck routes, and any work that may impact the engineering control;
- Whether proposed activities will require dewatering, proposed containment of dewatering liquids and planned disposal options for dewatering liquids;
- A summary of environmental conditions anticipated to be encountered in the work areas, including the nature and concentration levels of contaminants of concern, potential presence of grossly impacted media, and plans for any pre-construction sampling;
- A schedule for the work, detailing the start and completion of all intrusive work;
- A summary of the applicable components of this EWP;
- A statement from the party performing the work that the work will be performed in compliance with this EWP and 29 Code of Federal Regulations (CFR) 1910.120;

- A copy of the contractor's HASP, in electronic format, if it differs from the HASP provided in Appendix F of this ISMP;
- Identification of disposal facilities for potential waste streams; and
- Identification of sources of any anticipated backfill, along with the required request to import form and all supporting documentation including, but not limited to, chemical testing results.

B-2 SOIL SCREENING METHODS

Visual, olfactory and instrument-based (e.g. photoionization detector) soil screening will be performed during all excavations into known or potentially impacted material. A QEP as defined in 6 NYCRR Part 375, a PE who is licensed and registered in New York State, or a qualified person who directly reports to a PE who is licensed and registered in New York State will perform the screening. Soil screening will be performed when invasive work is done and will include all excavation and invasive work performed during development, such as excavations for foundations and utility work.

Based on existing environmental data and screening results, soils will be segregated into material that requires off-site disposal and material that requires testing to determine if the material can be reused as soil beneath a cover. Further discussion of off-site disposal of materials and on-site reuse is provided in Sections B-5 and B-6 of this Appendix.

B-3 SOIL STAGING METHODS

Soil stockpiles will be continuously encircled with a berm and/or silt fence. Hay bales will be used as needed near catch basins, surface waters and other discharge points. Stockpiles will be located and sized to minimize potential for material or run-off to enter discharge points.

Stockpiles will be kept covered at all times with appropriately anchored tarps. Stockpiles will be routinely inspected, and damaged tarp covers will be promptly replaced. Stockpiles will be segregated on-site based on the soil/material type. These soil/material types will include impacted soils, reuse soil, and imported fill.

Stockpiles will be inspected at a minimum once each week and after every storm event. Results of inspections will be recorded in a logbook and maintained at the Site and available for inspection by the NYSDEC.

B-4 MATERIALS EXCAVATION AND LOAD-OUT

A QEP as defined in 6 NYCRR Part 375, a PE who is licensed and registered in New York State, or a qualified person who directly reports to a PE who is licensed and registered in New York State will oversee all invasive work at the Site and the excavation and load-out of all excavated material.

To the extent that they perform work under this EWP, the property owner(s) and their contractors are responsible for safe execution of all invasive and other work; including the structural integrity of excavations and structures; such as subsurface utilities and buildings that may be affected by excavations.

The presence of utilities and easements on the Site will be investigated. Based on this investigation, it will be determined whether a risk or impediment to the work planned under this EWP is posed by utilities or easements on the Site. A site utility stakeout will be completed for all utilities prior to any ground intrusive activities at the site.

Loaded vehicles leaving the Site will be appropriately lined, tarped, securely covered, manifested, and placarded in accordance with appropriate Federal, State, local, and New York State Department of Transportation (NYSDOT) requirements (and all other applicable transportation requirements).

A truck wash will be operated on- Site, as appropriate. The QEP will be responsible for ensuring that all outbound trucks will be washed at the truck wash before leaving the Site until the activities performed under this section are complete Truck wash waters will be collected and disposed off-site in an appropriate manner.

Locations where vehicles enter or exit the Site shall be inspected daily for evidence of off-site soil tracking.

The QEP will be responsible for ensuring that all egress points for truck and equipment transport from the Site are clean of dirt and other materials derived from the Site during intrusive excavation activities. Cleaning of the adjacent streets will be

performed as needed to maintain a clean condition with respect to Site-derived materials. Material accumulated from the street cleaning and egress cleaning activities will be disposed off-site at a permitted landfill facility in accordance with all applicable local, State, and Federal regulations.

B-5 MATERIALS TRANSPORT OFF-SITE

All transport of materials will be performed by licensed haulers in accordance with appropriate local, State, and Federal regulations, including 6 NYCRR Part 364. Haulers will be appropriately licensed and trucks properly placarded.

Material transported by trucks exiting the Site will be secured with tight-fitting covers. Loose-fitting canvas-type truck covers will be prohibited. If loads contain wet material capable of producing free liquid, truck liners will be used.

The NYSDOT-approved truck transport routes are included in Figure 12. A site-specific truck route is included in Figure 13. All trucks loaded with Site materials will exit the vicinity of the Site using only these approved truck routes. This is the most appropriate route and takes into account: (a) limiting transport through residential areas and past sensitive sites; (b) use of city mapped truck routes; (c) prohibiting off-site queuing of trucks entering the facility; (d) limiting total distance to major highways; (e) promoting safety in access to highways; (f) overall safety in transport; and (g) community input.

Trucks will be prohibited from stopping and idling in the neighborhood outside the project Site.

Egress points for truck and equipment transport from the Site will be kept clean of dirt and other materials during Site remediation and development.

Queuing of trucks will be performed on-site in order to minimize off-site disturbance. Off-site queuing will be prohibited.

B-6 MATERIALS DISPOSAL OFF-SITE

All material below the demarcation layer or the water table excavated and removed from the Site will be treated as impacted and regulated material and will be transported and disposed off-site in a permitted facility in accordance with all local, State

and Federal regulations. If disposal of material from this Site is proposed for unregulated off-site disposal (i.e. clean soil removed for development purposes), a formal request with an associated plan will be made to the NYSDEC project manager. Unregulated off-site management of materials from this Site will not occur without formal NYSDEC project manager approval.

Regulated soils will be stockpiled and transported to a National Grid approved facility. Off-site disposal locations for excavated soils will be identified in the pre-excavation notification prepared by the owner and provided to National Grid for review and submittal to NYSDEC. This will include estimated quantities and a breakdown by class of disposal facility if appropriate. Actual disposal quantities and associated documentation will be reported to the NYSDEC. This documentation will include, but will not be limited to: waste profiles, test results, facility acceptance letters, manifests, bills of lading and facility receipts.

Non-hazardous historic fill and impacted soils taken off-site will be handled consistent with 6NYCRR Parts 360- 361, 362, 363, 364, and 365. Material that does not meet Unrestricted Use SCOs is prohibited from being taken to a New York State recycling facility (6NYCRR Subpart 360-5 registered or permitted facility).

B-7 MATERIALS REUSE ON-SITE

A Request to Import/Reuse Fill or Soil form, which can be found in Appendix J and at http://www.dec.ny.gov/regulations/67386.html, will be prepared by the owner and submitted to the NYSDEC project manager by National Grid allowing a minimum of 5 business days for review.

Material that meets the Restricted Residential Use SCOs listed in Table 375-6.8(b)] of 6 NYCRR Part 375 meet the chemical criteria for on-Site reuse. Prior to reuse, samples will be collected and analyzed by an Environmental Laboratory Approval Program (ELAP)-certified laboratory for:

- Total VOCs via U.S. Environmental Protection Agency (EPA) Method 8260
- Total SVOCs via EPA Method 8270C
- Polychlorinated biphenyls (PCBs) via EPA Method 8082/8082A/8080

- Total cyanide via EPA Method 9010/9014
- Total Metals (RCRA+Cu, Ni, Zn, Va, Cn HexChrome) via EPA Method 6010B and 6010
- Total Mercury via EPA Method 7471.

The QEP as defined in 6 NYCRR part 375 will ensure that procedures defined for materials reuse in this EWP are followed and that unacceptable material does not remain on-Site. Impacted soil that is acceptable for reuse on-site will be placed below the demarcation layer or impervious surface and will not be reused within a cover soil layer, within landscaping berms, or as backfill for subsurface utility lines.

Proposed materials for reuse on-site must be sampled for full suite analytical parameters including per- and polyfluoroalkyl substances (PFAS) and 1,4-dioxane. The sampling frequency will be in accordance with DER-10 Table 5.4(e)10 unless prior approval is obtained from the NYSDEC project manager for modification of the sampling frequency. The analytical results of soil/fill material testing must meet the site use criteria presented in NYSDEC DER-10 Appendix 5 – Allowable Constituent Levels for Imported Fill or Soil for all constituents listed, and the NYSDEC Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances [October 2020 or date of current version, whichever is later] guidance values. Approvals for modifications to the analytical parameters must be obtained from the NYSDEC project manager prior to the sampling event.

Soil/fill material for reuse on-site will be segregated and staged as described in Sections B-2 and B-3 of this EWP. The anticipated size and location of stockpiles will be provided in the 15-day notification to the NYSDEC project manager. Stockpile locations will be based on the location of site excavation activities and proximity to nearby site features. Material reuse on-site will comply with requirements of NYSDEC DER-10 Section 5.4(e)4. Any modifications to the requirements of DER-10 Section 5.4(e)4 must be approved by the NYSDEC project manager.

Any demolition material proposed for reuse on- site will be sampled for asbestos and the results will be reported to the NYSDEC for acceptance. Concrete crushing or processing on- site will not be performed without prior NYSDEC approval. Organic

matter (wood, roots, stumps, etc.) or other solid waste derived from clearing and grubbing of the Site will not be reused on- site.

B-8 FLUIDS MANAGEMENT

All impacted liquids to be removed from the Site, including but not limited to, excavation dewatering, decontamination waters and groundwater monitoring well purge and development waters, will be handled, transported and disposed off-site at a permitted facility in accordance with applicable local, State, and Federal regulations. Impacted liquids removed from the Site will be disposed of at a National Grid approved disposal facility. Dewatering, purge and development fluids will not be recharged back to the land surface or subsurface of the Site, and will be managed off-site, unless prior approval is obtained from NYSDEC.

Discharge of water generated during construction activities to surface waters (i.e. a local pond, stream or river) will be performed under a State Pollutant Discharge Elimination System (SPDES) permit.

B-9 SOIL COVER SYSTEM RESTORATION

After the completion of soil removal and any other invasive activities the soil cover system on Parcel 2 and; and/or the concrete foundations on Parcels 1, 3, or 4 will be restored. The existing soil cover system on Parcel 2 is comprised of a minimum of 5-feet of clean soil (minimum 4.5 ft of clean backfill and 0.5 ft of topsoil) that extends to elevation 8 NAVD, at a minimum. The demarcation layer, consisting of orange demarcation fabric will be replaced to provide a visual reference to the top of the remaining impact zone, the zone that requires adherence to special conditions for disturbance of impacted soils defined in this EWP. The property owner shall not change the components of the cover system without prior written approval from the NYSDEC and National Grid. Following excavation activities, the property owner will replace the cover system in kind.

B-10 BACKFILL FROM OFF-SITE SOURCES

All materials proposed for import onto the Site will be approved by National Grid's QEP, as defined in 6 NYCRR Part 375, and will be in compliance with provisions in this EWP prior to receipt at the Site. A Request to Import/Reuse Fill or Soil form, which can be found in Appendix J and at http://www.dec.ny.gov/regulations/67386.html, will be prepared by the owner and submitted to the NYSDEC project manager by National Grid allowing a minimum of 5 business days for review. This will include analytical sampling of the borrow source or existing documentation of agency approvals of the source (i.e. NYSDOT virgin source certification and latest analytical sampling results). NYSDEC approval must be received before material is imported to the Site.

Material from industrial sites, spill sites, other environmental remediation sites, or potentially impacted sites will not be imported to the Site.

All imported soils on Parcel 1 will meet the backfill and cover soil quality standards established in 6NYCRR 375-6.7(d) and DER-10 Appendix 5 for restricted residential, commercial or industrial use. All imported soils on Parcels 2 through 4 will meet the backfill and cover soil quality standards established in 6NYCRR 375-6.7(d) and DER-10 Appendix 5 for restricted residential use. Based on an evaluation of the land use, protection of groundwater and protection of ecological resources criteria, the resulting soil quality standards are the Restricted Residential Use SCOs listed in Table 375-6.8(a) of 6 NYCRR Part 375. Soils that meet 'general' fill requirements under 6 NYCRR Part 360.13, but do not meet backfill or cover soil objectives for this Site, will not be imported onto the Site without prior approval by NYSDEC project manager. Solid waste will not be imported onto the Site.

Samples will be collected from imported fill in accordance with the analytical sampling requirements of DER-10 and the frequency requirements in NYSDEC's Soil Cleanup Guidance, CP-51. At a minimum, samples will be analyzed for Inorganics, Pesticides, PCBs, VOCs, SVOCs, per- and polyfluoroalkyl substances (PFAS), and 1,4-dioxane in accordance with the analytes for the Restricted Residential, Residential Use SCOs listed in Table 375-6.8(a) of 6 NYCRR Part 375. The frequency and type of the sampling (i.e. discrete or composite) will be based on the quantity of material imported in accordance with Table 4 of CP-51.

Trucks entering the Site with imported soils will be securely covered with tight fitting covers. Imported soils will be stockpiled separately from excavated materials and covered to prevent dust releases (Section B-3).

B-11 STORMWATER POLLUTION PREVENTION

For excavations less than 1 acre that are not part of a larger disturbance, the following stormwater management practices will be completed in accordance with the requirements in the New York State Stormwater Management Design Manual, latest revision.

Silt fencing and/or hay bale checks will be installed around the entire perimeter of the construction area and will be inspected once a week and after every storm event. Results of inspections will be recorded in a logbook and maintained at the Site and available for inspection by the NYSDEC. All necessary repairs shall be made immediately.

Accumulated sediments will be removed as required to keep the silt fencing and/or hay bale check functional.

All undercutting or erosion of the silt fence toe anchor shall be repaired immediately with appropriate backfill materials.

Manufacturer's recommendations will be followed for replacing silt fencing damaged due to weathering.

Erosion and sediment control measures identified in the EWP shall be observed to ensure that they are operating correctly. Where discharge locations or points are accessible, they shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters.

In the event that the work on the property is part of a larger plan that disturbs more than 1 acre, the respective property owner must obtain coverage under the NYSDEC SPDES General Permit for Stormwater Discharges from Construction Activity.

B-12 EXCAVATION CONTINGENCY PLAN

Identification of unknown or unexpected potentially impacted media identified by screening during invasive site work will be promptly communicated by phone to the

NYSDEC project manager and the National Grid project manager. NYSDEC should be notified first or concurrent with National Grid in all cases of unexpected conditions during excavations. Reportable quantities of petroleum product will also be reported to the NYSDEC spills hotline.

If underground tanks or other previously unidentified contaminant sources are found during post-remedial subsurface excavations, excavation activities will be suspended until sufficient equipment is mobilized to address the condition. The NYSDEC project manager will be promptly notified of the discovery.

In the event that potential impacts are encountered at unexpected depth or locations, Site activities will be suspended and NYSDEC and National Grid will be notified and will evaluate the observed conditions in a manner and timeframe that does not interfere with the property owner's construction schedule, to the extent reasonably feasible. National Grid may determine that laboratory testing is required to evaluate the observed conditions for concentrations and characteristics. If the encountered materials are determined to be MGP-impacted, then the encountered materials will be segregated and stockpiled for disposal at a National Grid approved facility.

Sampling will be performed on product, sediment and surrounding soils, etc. as necessary to determine the nature of the material and proper disposal method. Chemical analysis will be performed for a full list of analytes [TAL metals, Target Compound List (TCL) volatiles and semi-volatiles (including 1,4-dioxane), pesticides and PCBs, and PFAS]. In the event that future sampling results provide a sufficient justification to limit the list of analytes, a reduced list of analytes will be proposed to the NYSDEC project manager for approval prior to sampling. Any tanks will be closed as per NYSDEC regulations and guidance.

B-13 COMMUNITY AIR MONITORING PLAN

The CAMP will consist of a real-time monitoring and action level reporting system. The CAMP will be conducted during all intrusive activity on the Site that are located within areas of remaining MGP- impacted material. This includes any activity below the demarcation barrier (minimum elevation 8 feet NAVD) or the water table, whichever is encountered first. Air sampling station locations will be chosen based on

generally prevailing wind conditions and adjusted on a daily or more frequent basis based on actual wind directions to provide an upwind and at least two downwind monitoring stations.

Exceedances of action levels listed in the CAMP (Appendix G) will be reported to NYSDEC and NYSDOH Project Managers.

B-14 ODOR CONTROL PLAN

Odors which derive from site impacts may cause a nuisance to some site workers and the surrounding community, even though the impacts are at levels well below the safety limits defined in the CAMP. This odor control plan is capable of controlling emissions of nuisance odors off-site. Specific odor control methods to be used on a routine basis will include all reasonable and necessary means as described in the following paragraph. If nuisance odors are identified at the Site boundary, or if odor complaints are received, work will be halted, and the source of odors will be identified and corrected. Work will not resume until all nuisance odors have been abated. NYSDEC and NYSDOH will be notified by National Grid of all odor events and of any other complaints about the project. Implementation of all odor controls, including the halt of work, is the responsibility of the contractor.

All necessary means will be employed to prevent on- and off-site nuisances. At a minimum, these measures will include: (a) limiting the area of open excavations and size of soil stockpiles; (b) shrouding open excavations with tarps and other covers; and (c) using foams to cover exposed odorous soils. If odors develop and cannot be otherwise controlled, additional means to eliminate odor nuisances will include: (d) direct load-out of soils to trucks for off-site disposal; (e) use of chemical odorants in spray or misting systems; and, (f) use of staff to monitor odors in surrounding neighborhoods.

If nuisance odors that cannot be corrected develop during intrusive work, or where the control of nuisance odors cannot otherwise be achieved due to on-site conditions or close proximity to sensitive receptors, odor control will be achieved by sheltering the excavation and handling areas in a temporary containment structure equipped with appropriate air venting/filtering systems.

B-15 DUST CONTROL PLAN

Particulate monitoring must be conducted according to the Community Air Monitoring Plan (CAMP) provided in Section B-13. If particulate levels at the Site exceed the thresholds listed in the CAMP or if airborne dust is observed on the Site or leaving the Site, the dust suppression techniques listed below will be employed. The remedial party will also take measures listed below to prevent dust production on the Site.

Dust which derives from site impacts may cause a nuisance to some site workers and the surrounding community, even though the impacts are at levels well below the safety limits defined in the CAMP. A dust suppression plan that addresses dust management during invasive on-site work will include, at a minimum, the items listed below:

- Dust suppression will be achieved using a dedicated on-site water truck for road wetting. The truck will be equipped with a water cannon capable of spraying water directly onto off-road areas including excavations and stockpiles.
- Clearing and grubbing of larger sites will be done in stages to limit the area of exposed, unvegetated soils vulnerable to dust production.
- Gravel will be used on roadways to provide a clean and dust-free road surface.
- On-site roads will be limited in total area to minimize the area required for water truck sprinkling.

In the event that complaints are received for dust, the contractor will take the appropriate response actions for dust suppression.

APPENDIX C – LIST OF SITE CONTACTS

Name	Phone/Email Address
Mary Salig Parks and Recreation 41 North 11th Street Brooklyn, NY 11249	(718) 218-6130 Mary.Salig@parks.nyc.gov
Deborah Howe Parks and Recreation Senior Associate Council, Capital Projects	(718) 760-6746 Deborah.Howe@parks.nyc.gov
35 Kent LLC c/o Louis Silverman G4 Capital Partners 14 Skillman Street Roslyn, NY 11576	(516) 320-8720 louis@g4cap.com
Donald Campbell National Grid Project Manager	(718) 963-5453 donald.campbell@nationalgrid.com
Francis J. Murphy National Grid Senior Counsel	(516) 545-3745 francis.murphy@nationalgrid.com
Melissa Felter GEI Consultants Project Manager	(860) 368-5328 mfelter@geiconsultants.com
Jeffrey Parillo, PE GEI Consultants Project Engineer	(860) 368-5402 jparillo@geiconsultants.com
Gerald Pratt NYSDEC Project Manager	(518) 402-8246 gerald.pratt@dec.ny.gov
Samsudeen (Sam) Arakhan NYSDEC Regional HW Engineer	(718) 482-4931 samsudeen.arakahan@ dec.ny.gov
Kelly Lewandowski Chief, NYSDEC Site Control	(518) 402-9569 kelly.lewandowski@ dec.ny.gov
Arunesh Ghosh NYSDOH Project Manager	(518) 402-7860 beei@health.ny.gov

APPENDIX D – BORING LOGS

GEI Consultants, Inc.
455 Winding Brook Road
Glastonbury, CT 06033
(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 1 of 3
WW-MW-02

GROUND SURFACE ELEVATION (FT): 19.19 **LOCATION:** North 11th Street
NORTHING (FT): 688484 **EASTING (FT):** 642129 **TOTAL DEPTH (FT):** 55.0
DRILLED BY: Zebra Environmental / Luke Caballero **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Melissa Felter **DATE START / END:** 7/10/2009 - 7/13/2009
DRILLING DETAILS: Geoprobe
WATER LEVEL DEPTHS (FT): ▽ 12.00 7/10/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
	0								(0'- 2') CONCRETE.	
15		S1	36/22	1.9				WWMW-02 (2-5)	(2'- 5') WIDELY GRADED SAND (SW); ~85% sand, fine to coarse, ~10% gravel, fine to coarse, ~5% fines; ~5% to 10% brick and coal, dry, brown and gray, loose, hand cleared. FILL.	
	5	S2	60/25	0.6					(5'- 10') WIDELY GRADED SAND (SW); ~85% sand, fine to coarse, ~10% gravel, fine to coarse, ~5% fines; ~5% to 10% brick and coal, dry to moist, brown and gray, loose. FILL.	
10	10	S3	60/51						(10'- 12') NARROWLY GRADED SAND (SP); ~90% sand, fine to medium, ~5% gravel, fine, ~5% fines; ~5% brick and coal, moist, brown, loose. FILL.	
▽				224			PLO		(12'- 14') WIDELY GRADED SAND WITH SILT (SW-SM); ~85% sand, fine to medium, ~10% fines, ~5% gravel, fine; slight petroleum-like odor, wet, gray, dense.	
5	15	S4	60/48	315			PLO	WWMW-02 (15-17)	(14'- 17') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines; moderate petroleum-like odor, wet, gray, loose, gray stained.	
0	20								(17'- 20') SANDY SILT (ML); ~60% fines, ~35% sand, fine to coarse, ~5% gravel, fine; moist, reddish brown, dense.	

NOTES:

PEN = PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC = RECOVERY LENGTH OF SAMPLE
PID = PHOTOIONIZATION DETECTOR READING (PPM)
JHS = JAR HEADSPACE PID READING (PPM)

NA = NOT APPLICABLE
NM = NOT MEASURED
Q_P = POCKET PENETROMETER
S_V = TORVANE PEAK

ppm = PARTS PER MILLION
IN. = INCHES
FT. = FEET

NLO = NAPHTHALENE LIKE ODOR
PLO = PETROLEUM LIKE ODOR
TLO = TAR LIKE ODOR
CLO = CHEMICAL LIKE ODOR
ALO = ASPHALT LIKE ODOR
CrLO= CREOSOTE LIKE ODOR
OLO = ORGANIC LIKE ODOR
SLO = SULFUR LIKE ODOR
MLO = MUSTY LIKE ODOR

ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

GEI Consultants

GEI Consultants, Inc.
455 Winding Brook Road
Glastonbury, CT 06033
(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG

WW-MW-02

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
	20	S5	60/48	5.7					(20'- 21.5') WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); ~70% sand, fine to medium, ~20% gravel, fine to coarse, ~10% fines; moist, brown and reddish brown, dense. (21.5'- 35') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines; wet, brown, loose.	
-5	25	S6	60/51	7.8						
-10	30	S7	60/NM	14.2						
-15	35	S8	60/53	1.9					(35'- 44') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine to coarse, ~5% fines; wet, brown, lens of gravel at 37.5 feet.	
-20	40	S9	60/58	9.5						
-25									(44'- 44.5') WIDELY GRADED SAND (SW); ~95% sand,	

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JHS = JAR HEADSPACE PID READING (PPM)

NA = NOT APPLICABLE
NM = NOT MEASURED
Q_P = POCKET PENETROMETER
S_V = TORVANE PEAK

ppm = PARTS PER MILLION
IN. = INCHES
FT. = FEET

NLO = NAPHTHALENE LIKE ODOR
PLO = PETROLEUM LIKE ODOR
TLO = TAR LIKE ODOR
CLO = CHEMICAL LIKE ODOR
ALO = ASPHALT LIKE ODOR
CrLO= CREOSOTE LIKE ODOR
OLO = ORGANIC LIKE ODOR
SLO = SULFUR LIKE ODOR
MLO = MUSTY LIKE ODOR

ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

GEI Consultants

GEI Consultants, Inc.
455 Winding Brook Road
Glastonbury, CT 06033
(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 3 of 3
WW-MW-02

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
	45	S10	60/60	2.2					fine to medium, ~5% fines; wet, gray, loose. (44.5'- 45') SILT (ML); ~90% fines, ~10% sand, fine; moist, reddish brown, dense, layered. (45'- 50') SILT WITH SAND (ML); ~60% fines, ~40% sand, fine; moist, brownish gray, dense, non cohesive.	
-30	50	S11	60/60					WWMW-02 (50-53)	(50'- 53') SILTY SAND (SM); ~80% sand, fine to medium, ~20% fines; wet, grayish brown, dense.	
-35	55								(53'- 55') SANDY LEAN CLAY (CL); moist, red and gray, very dense, cohesive. End of Boring at 55 feet. Grouted	

NOTES:

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PID = PHOTOIONIZATION DETECTOR READING (PPM)
JHS = JAR HEADSPACE PID READING (PPM)

NA = NOT APPLICABLE
NM = NOT MEASURED
Q_P = POCKET PENETROMETER
S_V = TORVANE PEAK

ppm = PARTS PER MILLION
IN. = INCHES
FT. = FEET

NLO = NAPHTHALENE LIKE ODOR
PLO = PETROLEUM LIKE ODOR
TLO = TAR LIKE ODOR
CLO = CHEMICAL LIKE ODOR
ALO = ASPHALT LIKE ODOR

CrLO= CREOSOTE LIKE ODOR
OLO = ORGANIC LIKE ODOR
SLO = SULFUR LIKE ODOR
MLO = MUSTY LIKE ODOR

ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

GEI Consultants, Inc.
455 Winding Brook Road
Glastonbury, CT 06033
(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 1 of 3
WW-MW-03

GROUND SURFACE ELEVATION (FT): 13.99 **LOCATION:** North 12th Street
NORTHING (FT): 688684 **EASTING (FT):** 642208 **TOTAL DEPTH (FT):** 65.0
DRILLED BY: Zebra Environmental / Luke Caballero **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Maura MacLeod **DATE START / END:** 6/23/2009 - 6/26/2009
DRILLING DETAILS: Geoprobe
WATER LEVEL DEPTHS (FT): ▽ 13.00 6/23/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
	0	S1	24/NM						(0'- 0.5') CONCRETE.	
			36/22	0.0				WWMW-03 (2-5)	(0.5'- 5.5') WIDELY GRADED SAND (SW); ~85% sand, fine to coarse, ~10% gravel, fine to coarse, ~5% fines, non plastic; max. size 1, brown, dry, brick fragments, hand cleared from 0-5 ft. FILL.	
10										
	5	S2	60/46	0.0					(5.5'- 9.8') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to coarse, ~10% fines, non plastic; light brown.	
5										
	10	S3	60/47				OLO		(9.8'- 10') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moderate organic-like odor.	
									(10'- 14.1') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to coarse, ~10% fines, non plastic; light brown.	
0 ▽										
							OLO		(14.1'- 15') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moderate organic-like odor.	
	15	S4	60/49	5.7					(15'- 15.4') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to coarse, ~10% fines, non plastic; light brown.	
-5									(15.4'- 20') NARROWLY GRADED SAND (SP); ~95% sand, fine, ~5% fines, low plasticity; moderate organic-like odor, moist, brown, organics, roots.	
							OLO			
	20									

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FT. = FEET

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

GEI Consultants, Inc.
455 Winding Brook Road
Glastonbury, CT 06033
(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 2 of 3
WW-MW-03

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
	20	S5	60/NM				PLO		(20'- 25') NARROWLY GRADED SAND (SP); ~95% sand, fine, ~5% fines, low plasticity; slight petroleum-like odor, wet, brown, organics, roots, lens of gray sand.	
-10				61.2						
	25	S6	60/38				NLO		(25'- 27.2') NARROWLY GRADED SAND (SP); ~95% sand, fine, ~5% fines, low plasticity; moderate naphthalene-like odor, wet, brown, organics, roots, sheen, moderate petroleum-like odor.	
							PLO		(27.2'- 27.5') NARROWLY GRADED SAND (SP); ~95% sand, fine, ~5% fines, low plasticity; moderate petroleum-like odor, wet, brown, black staining.	
-15				>9999			NLO	WWMW-03 (28-30)	(27.5'- 29.5') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, moist, brown, tar-like staining with lenses of coating.	
							NLO		(29.5'- 30') NARROWLY GRADED SAND (SP); ~95% sand, fine, ~5% fines, low plasticity; moderate naphthalene-like odor, moist, brown, organics, roots, sheen.	
	30	S7	60/35	777					(30'- 35') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, moist, brown, slight petroleum-like odor.	
-20							NLO			
	35	S8	60/60	161			NLO		(35'- 36.2') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, moist, brown.	
							PLO		(36.2'- 37.8') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight petroleum-like odor, moist, brown.	
							PLO		(37.8'- 38.2') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moderate petroleum-like odor, moist, brown, black staining.	
-25							PLO		(38.2'- 40') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight petroleum-like odor, moist, brown.	
	40	S9	60/42	149			PLO		(40'- 41.2') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight petroleum-like odor, moist, brown.	
							PLO		(41.2'- 43.1') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moderate petroleum-like odor, moist, brown, sheen.	
-30							NLO		(43.1'- 45') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, moist, brown.	

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

GEI Consultants

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455 Winding Brook Road
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(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG

WW-MW-03

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
	45						NLO			
		S10	60/60	9.9			PLO		(45'- 50') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight petroleum-like odor, moist, brown.	
-35	50	S11	60/54	19.1			OLO		(50'- 55') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight organic-like odor, brown, two 1 inch silt lenses.	
-40	55	S12	60/50	131			NLO		(55'- 58.5') SILTY SAND (SM); ~85% sand, fine to medium, ~15% fines, non plastic; slight naphthalene-like odor, brown, slight petroleum-like odor.	
-45							PLO		(58.5'- 60') SILTY SAND (SM); ~85% sand, fine to medium, ~15% fines, non plastic; slight petroleum-like odor, brown.	
	60	S13	60/37	26.4			NLO	WWMW-03 (60-63)	(60'- 62.7') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, brown, slight petroleum-like odor.	
-50									(62.7'- 65') LEAN CLAY (CL); ~95% fines, medium plasticity, ~5% sand, fine; red.	
	65								End of Boring at 65 feet. Grouted	

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 1 of 3
WW-MW-05

GROUND SURFACE ELEVATION (FT): 12.48 **LOCATION:** 50 Kent Ave
NORTHING (FT): 688776 **EASTING (FT):** 641946 **TOTAL DEPTH (FT):** 65.0
DRILLED BY: Zebra Environmental / Luke Caballero **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Maura MacLeod **DATE START / END:** 6/10/2009 - 6/11/2009
DRILLING DETAILS: Geoprobe
WATER LEVEL DEPTHS (FT): ▽ 10.00 6/10/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
10	0	S1	60/NM	377			NLO	WWMW-05 (0.75-5)	(0'- 0.75') ASPHALT. (0.75'- 5') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine to coarse, ~5% fines, non plastic; max. size 1.5, moderate naphthalene-like odor, dry, brown, hand cleared.
5	5	S2	60/56	>9999			NLO NLO NLO		(5'- 7.4') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to coarse, ~10% fines, non plastic; moderate naphthalene-like odor, dry, brown, organics/wood fragments, lens of black color with sulfur/petroleum-like odor from 6.5 t0 6.7 ft. (7.4'- 7.9') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to coarse, ~10% fines, non plastic; moderate naphthalene-like odor, dry, brown, organics/wood fragments, sheen. (7.9'- 10') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to coarse, ~10% fines, non plastic; moderate naphthalene-like odor, dry, brown, organics/wood fragments.
0	10 ▽	S3	60/60	>9999			NLO NLO	WWMW-05 (12-13)	(10'- 11.7') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to coarse, ~10% fines, non plastic; moderate naphthalene-like odor, wet, brown, organics/wood fragments, sheen, tar-like blebs, faint sulfur-like odor. (11.7'- 15') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to coarse, ~10% fines, non plastic; moderate naphthalene-like odor, wet, brown, organics/wood fragments, sheen with interbedded layers of tar-like staining and coating.
-5	15	S4	60/22	973			NLO NLO		(15'- 16.4') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to coarse, ~10% fines, non plastic; moderate naphthalene-like odor, brown, organics/wood fragments, sheen, tar-like staining. (16.4'- 20') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to coarse, ~10% fines, non plastic; slight naphthalene-like odor, brown, organics/wood fragments.
	20								

WELL DETAILS

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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455 Winding Brook Road
Glastonbury, CT 06033
(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 2 of 3
WW-MW-05

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
	20	S5	60/35				NLO		(20'- 22.3') SILTY SAND (SM); ~80% sand, fine to coarse, ~20% fines, non plastic; slight naphthalene-like odor, reddish brown.	
-10				>9999			NLO		(22.3'- 24') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, brown, tar-like staining.	
							NLO		(24'- 25') SILTY SAND (SM); ~80% sand, fine to coarse, ~20% fines, non plastic; slight naphthalene-like odor, reddish brown.	
	25	S6	60/36				NLO		(25'- 26.7') SILTY SAND (SM); ~80% sand, fine to coarse, ~20% fines, non plastic; slight naphthalene-like odor, reddish brown.	
				479			NLO		(26.7'- 28.1') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, brown, tar-like staining.	
-15							NLO		(28.1'- 30') SILTY SAND (SM); ~80% sand, fine to coarse, ~20% fines, non plastic; slight naphthalene-like odor, reddish brown.	
	30	S7	60/29				NLO		(30'- 31.6') SILTY SAND WITH GRAVEL (SM); ~35% sand, fine to coarse, ~35% fines, ~30% gravel, fine; max. size 0.5, moderate naphthalene-like odor, brown, dense.	
-20				2891			NLO		(31.6'- 33.4') SILTY SAND WITH GRAVEL (SM); ~60% sand, fine to coarse, ~25% gravel, ~15% fines; max. size 0.75, strong naphthalene-like odor, brown, tar-like staining.	
							NLO		(33.4'- 35') SILTY SAND WITH GRAVEL (SM); ~60% sand, fine to coarse, ~25% gravel, ~15% fines; max. size 0.75, strong naphthalene-like odor, brown.	
	35	S8	60/30	575			NLO		(35'- 40') SILTY SAND WITH GRAVEL (SM); ~35% sand, fine to coarse, ~35% fines, ~30% gravel, fine; max. size 0.5, moderate naphthalene-like odor, brown, dense.	
-25										
	40	S9	60/21	877			NLO		(40'- 40.5') SILTY SAND WITH GRAVEL (SM); ~60% sand, fine to coarse, ~25% gravel, ~15% fines; max. size 0.75, strong naphthalene-like odor, brown, tar-like staining.	
-30							NLO		(40.5'- 45') SILTY SAND WITH GRAVEL (SM); ~40% fines, ~30% gravel, fine to coarse, ~30% sand, fine to medium; max. size 1, moderate naphthalene-like odor, brown.	

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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BORING LOG
PAGE 3 of 3
WW-MW-05

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
	45	S10	60/32				NLO		(45'- 48') SILTY SAND WITH GRAVEL (SM); ~40% fines, ~30% gravel, fine to coarse, ~30% sand, fine to medium; max. size 1, moderate naphthalene-like odor, brown.	
-35							NLO			
				4673			NLO		(48'- 50') WIDELY GRADED SAND WITH SILT (SW-SM); ~80% sand, fine to coarse, ~10% gravel, fine, ~10% fines; max. size 0.25, strong naphthalene-like odor, brown with reddish brown, tar-like staining.	
	50	S11	60/39				NLO		(50'- 50.9') WIDELY GRADED SAND WITH SILT (SW-SM); ~80% sand, fine to coarse, ~10% gravel, fine, ~10% fines; max. size 0.25, strong naphthalene-like odor, brown with reddish brown, tar-like staining.	
				3595			NLO		(50.9'- 51.5') WIDELY GRADED SAND WITH SILT (SW-SM); ~80% sand, fine to coarse, ~10% gravel, fine, ~10% fines; max. size 0.25, strong naphthalene-like odor, brown with reddish brown, tar-like coating.	
-40							NLO		(51.5'- 53.2') WIDELY GRADED SAND WITH SILT (SW-SM); ~80% sand, fine to coarse, ~10% gravel, fine, ~10% fines; max. size 0.25, strong naphthalene-like odor, brown with reddish brown, tar-like staining.	
							NLO		(53.2'- 54.9') SILT (ML); ~90% fines, ~5% gravel, fine, ~5% sand, fine; moderate naphthalene-like odor, brown gray, dense.	
	55	S12	60/25				NLO		(54.9'- 55') WIDELY GRADED SAND WITH SILT (SW-SM); ~80% sand, fine to coarse, ~10% gravel, fine, ~10% fines; max. size 0.25, strong naphthalene-like odor, brown with reddish brown.	
-45				218			NLO		(55'- 60') SILT (ML); ~90% fines, ~5% gravel, fine, ~5% sand, fine; slight naphthalene-like odor, brown gray, dense.	
	60	S13	60/31	10.4			NLO		(60'- 63.2') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine, ~5% fines; max. size 0.25, slight naphthalene-like odor, brown.	
-50								WWMW-05 (63-64)	(63.2'- 65') LEAN CLAY (CL); ~95% fines, ~5% sand, fine; red and gray.	
	65								End of Boring at 65 feet. Grouted	

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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CITY/STATE: Brooklyn, New York
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BORING LOG
PAGE 1 of 3
WW-MW-06

GROUND SURFACE ELEVATION (FT): 12.23 **LOCATION:** North 11th Street
NORTHING (FT): 688730 **EASTING (FT):** 641824 **TOTAL DEPTH (FT):** 65.0
DRILLED BY: Zebra Environmental / Luke Caballero **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Maura MacLeod **DATE START / END:** 6/17/2009 - 6/18/2009
DRILLING DETAILS: Geoprobe
WATER LEVEL DEPTHS (FT): ▽ 2.50 6/17/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
	0	S1	60/NM	0.4				WWMW-06 (0.5-1.5)	(0'- 5') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine, ~5% fines, non plastic; max. size 0.5, brown, hand cleared.	
▽ 10										
	5	S2	60/60				NLO		(5'- 6.5') SILTY SAND (SM); ~80% sand, fine to coarse, ~20% fines, non plastic; slight naphthalene-like odor, brown.	
5							NLO		(6.5'- 10') WIDELY GRADED SAND (SW); ~85% sand, fine to coarse, ~10% gravel, fine to coarse, ~5% fines, non plastic; max. size 1, moderate naphthalene-like odor, brown, black stained interbeds, lenses of petroleum-like odor.	
				581						
	10	S3	60/51				NLO		(10'- 11') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to medium, ~10% fines, non plastic; moderate naphthalene-like odor, brown, sheen.	
0							NLO		(11'- 13') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, brown, sheen, tar-like blebs, staining, and pockets of coating.	
				1601			NLO		(13'- 14.4') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, brown, tar-like coating.	
	15	S4	60/36				PLO		(14.4'- 15') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong petroleum-like odor, black, sheen, black petroleum-like staining.	
							NLO		(15'- 15.6') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; moderate naphthalene-like odor, brown, moderate petroleum and sulfur-like odor.	
-5				3194			NLO		(15.6'- 17.1') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; strong naphthalene-like odor, brown, tar-like coating.	
							OLO		(17.1'- 18.3') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; strong	
	20						OLO			

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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BORING LOG
PAGE 2 of 3
WW-MW-06

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
	20	S5	60/36				SLO		naphthalene-like odor, brown, tar-like staining.	
							PLO		(18.3'- 19.3') SILTY SAND (SM); ~80% sand, fine, ~20% fines, non plastic; slight organic-like odor, brown, slight burnt/sulfur-like odor.	
-10							PLO		(19.3'- 20') NARROWLY GRADED SAND (SP); ~95% sand, fine, ~5% fines, non plastic; slight organic-like odor, brown, slight burnt/sulfur-like odor.	
				2567			NLO		(20'- 21') SILT (ML); ~90% fines, medium plasticity, ~10% sand, fine; slight sulfur-like odor, brown, slight burnt-like odor.	
							NLO		(21'- 21.9') SILTY SAND (SM); ~80% sand, fine, ~20% fines, non plastic; slight petroleum-like odor, brown.	
	25	S6	60/53				NLO		(21.9'- 22.5') WIDELY GRADED SAND (SW); ~85% sand, fine to coarse, ~10% gravel, fine to coarse, ~5% fines, non plastic; max. size 1.5, slight petroleum-like odor, brown, slight sulfur-like odor.	
				2310			NLO		(22.5'- 22.9') WIDELY GRADED GRAVEL (GW); fine to coarse; orange and reddish brown.	
-15									(22.9'- 23.1') WIDELY GRADED GRAVEL (GW); fine to coarse; strong naphthalene-like odor, orange and reddish brown, tar-like coating.	
							NLO		(23.1'- 24.2') WIDELY GRADED SAND (SW); ~85% sand, fine to coarse, ~10% gravel, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, brown, tar-like coating.	
	30	S7	60/45	2205					(24.2'- 25') WIDELY GRADED SAND (SW); ~85% sand, fine to coarse, ~10% gravel, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, brown.	
-20									(25'- 25.8') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to medium, ~10% fines, non plastic; strong naphthalene-like odor, brown, bands of tar-like staining.	
									(25.8'- 28.1') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, brown, tar-like coating.	
	35	S8	60/27	1300			NLO		(28.1'- 30') SILTY SAND (SP); ~70% sand, fine to medium, ~30% fines, medium plasticity; strong naphthalene-like odor, brown.	
-25									(30'- 40') SILTY SAND (SP); ~70% sand, fine to medium, ~30% fines, medium plasticity; strong naphthalene-like odor, brown, dense.	
	40	S9	60/23	286					(40'- 45') SILTY SAND (SP); ~70% sand, fine to medium, ~30% fines, medium plasticity; strong naphthalene-like odor, brown.	
-30							NLO			

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

GEI Consultants

GEI Consultants, Inc.
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(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 3 of 3
WW-MW-06

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
	45	S10	60/16	9316			NLO		(45'- 50') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; strong naphthalene-like odor, brown, sheen, tar-like staining.	
-35							NLO			
	50	S11	60/50	>9999				WWMW-06 (50-52)	(50'- 54') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; strong naphthalene-like odor, brown, sheen, lens of fine sand from 53.3 to 53.6 ft, tar-like coating.	
-40							NLO			
							NLO		(54'- 55') SILT (ML); ~90% fines, medium plasticity, ~10% sand, fine; strong naphthalene-like odor, brown.	
	55	S12	60/27						(55'- 57.6') SILT (ML); ~90% fines, medium plasticity, ~10% sand, fine; moderate naphthalene-like odor, brown.	
-45							NLO			
				94.9			NLO	WWMW-06 (58-60)	(57.6'- 59.1') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; moderate naphthalene-like odor, brown.	
							NLO		(59.1'- 59.8') SILT (ML); ~90% fines, medium plasticity, ~10% sand, fine; moderate naphthalene-like odor, brown.	
	60	S13	60/27	0.0			NLO		(59.8'- 60') LEAN CLAY (CL); ~90% fines, medium plasticity, ~10% sand, fine; moderate naphthalene-like odor, reddish brown.	
-50									(60'- 65') LEAN CLAY (CL); ~90% fines, medium plasticity, ~10% sand, fine; reddish brown.	
	65								End of Boring at 65 feet. Grouted	

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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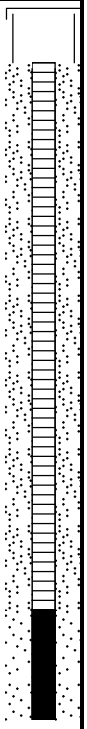
CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 1 of 3
WW-MW-07

GROUND SURFACE ELEVATION (FT): 10.69 **LOCATION:** North 12th Street
NORTHING (FT): 688890 **EASTING (FT):** 641971 **TOTAL DEPTH (FT):** 60.0
DRILLED BY: Zebra Environmental / Luke Caballero **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Maura MacLeod **DATE START / END:** 6/22/2009 - 6/23/2009
DRILLING DETAILS: Geoprobe
WATER LEVEL DEPTHS (FT): ▽ 4.00 6/22/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
10	0	S1	60/NM	2.3				WWMW-07 (4-5)	(0'- 5') WIDELY GRADED SAND (SW); ~85% sand, fine to coarse, ~10% gravel, fine, ~5% fines, non plastic; max. size 0.5, wet, brown, hand cleared.	
5	5	S2	60/0						(5'- 10') no recovery.	
0	10	S3	60/0						(10'- 15') no recovery.	
-5	15	S4	60/60				NLO		(15'- 16.8') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, medium plasticity; moderate naphthalene-like odor, wet, gray, sheen.	
							NLO		(16.8'- 19.1') NARROWLY GRADED SAND (SP); ~95% sand, fine, ~5% fines, medium plasticity; moderate naphthalene-like odor, gray, lens of widely graded sand from 17.6 to 17.8 ft, tar-like staining, moderate petroleum-like odor.	
				> 9999			NLO		(19.1'- 20') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, medium plasticity; strong	
	20									



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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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BORING LOG
PAGE 2 of 3
WW-MW-07

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
-10	20	S5	60/20	3372			NLO		naphthalene-like odor, wet, gray, sheen, tar-like staining. (20'- 20.5') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; moderate naphthalene-like odor, brown, dense. (20.5'- 20.8') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, brown, dense, tar-like staining. (20.8'- 21.8') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; moderate naphthalene-like odor, brown, dense. (21.8'- 22') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, brown, dense, tar-like staining. (22'- 25') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; moderate naphthalene-like odor, brown, dense. (25'- 30') WIDELY GRADED SAND WITH SILT (SP-SM); ~85% sand, fine to coarse, ~10% fines, medium plasticity, ~5% gravel, fine; max. size 0.5, brown, dense, slight solvent/ burnt-like odor.	
							NLO			
							NLO			
							NLO			
-15	25	S6	60/56	784			NLO			
-20	30	S7	60/56	1982			NLO		(30'- 31.9') WIDELY GRADED SAND (SW); ~85% sand, fine to coarse, ~10% fines, medium plasticity, ~5% gravel, fine; max. size 0.5, moderate naphthalene-like odor, brown, dense. (31.9'- 35') WIDELY GRADED SAND (SW); ~85% sand, fine to coarse, ~10% gravel, fine to coarse, ~5% fines, non plastic; max. size 1, slight naphthalene-like odor, brown.	
							NLO			
-25	35	S8	60/NM	565			NLO		(35'- 45') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moderate naphthalene-like odor, brown.	
-30	40	S9	60/NM	401						

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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BORING LOG
PAGE 3 of 3
WW-MW-07

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
	45						NLO			
-35		S10	60/53	> 9999			NLO	WWMW-07 (48.5-49.5)	(45'- 49.2') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, brown, strong petroleum-like odor from 46.3 to 49.4 ft, tar-like staining.	
	50						NLO		(49.2'- 50') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, brown.	
-40		S11	60/46	1269			NLO		(50'- 52.8') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, brown, moderate petroleum-like odor.	
							NLO		(52.8'- 54.1') SILTY SAND (SM); ~85% sand, fine, ~15% fines, medium plasticity; slight naphthalene-like odor, brown, slight petroleum-like odor.	
							NLO		(54.1'- 54.3') WIDELY GRADED SAND (SW); fine to coarse; moderate naphthalene-like odor, brown, moderate petroleum-like odor.	
	55						NLO		(54.3'- 55') SILTY SAND (SM); ~85% sand, fine, ~15% fines, medium plasticity; slight naphthalene-like odor, brown, slight petroleum-like odor.	
-45		S12	60/48	0.0			NLO		(55'- 57.1') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight naphthalene-like odor, wet, brown, slight petroleum-like odor.	
							PLO		(57.1'- 59.6') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight petroleum-like odor, wet, brown.	
	60							WWMW-07 (59-60)	(59.6'- 59.8') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; wet, brown, slight solvent-like odor.	
									(59.8'- 60') LEAN CLAY (CL); ~90% fines, medium plasticity, ~10% sand, fine; red gray.	
									End of Boring at 60 feet.	
									Grouted	

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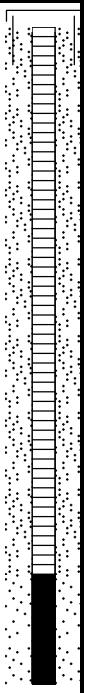
BORING LOG
PAGE 1 of 3
WW-MW-08

GROUND SURFACE ELEVATION (FT): 9.93 **LOCATION:** North 11th Street
NORTHING (FT): 688854 **EASTING (FT):** 641671 **TOTAL DEPTH (FT):** 50.0
DRILLED BY: Zebra Environmental / Luke Caballero **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Maura MacLeod **DATE START / END:** 6/19/2009 - 6/19/2009
DRILLING DETAILS: Geoprobe
WATER LEVEL DEPTHS (FT): ▽ 2.00 6/19/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	0		24/NM						(0'- 2') hand cleared f. FILL.
		S1	36/19	540			NLO	WWMW-08 (2-5)	(2'- 3.9') WIDELY GRADED SAND WITH GRAVEL (SW); ~75% sand, fine to coarse, ~20% gravel, fine to coarse, ~5% fines, non plastic; max. size 1, moderate naphthalene-like odor, brown, brick fragments, hand cleared. FILL.
							PLO		(3.9'- 5') WIDELY GRADED SAND WITH GRAVEL (SW); ~75% sand, fine to coarse, ~20% gravel, fine to coarse, ~5% fines, non plastic; max. size 1, moderate petroleum-like odor, brown, black staining, hand cleared.
5	5	S2	60/50				NLO		(5'- 7') WIDELY GRADED SAND WITH GRAVEL (SW); ~75% sand, fine to coarse, ~20% gravel, fine to coarse, ~5% fines, non plastic; max. size 1, moderate naphthalene-like odor, brown, black staining from 5 to 5.9 ft, wood fragments from 6.8 to 7 ft, moderate petroleum-like odor.
							NLO		
				3038			NLO	WWMW-08 (7.5-8.5)	
0	10	S3	60/0				NLO		(7'- 7.6') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to medium, ~10% fines, non plastic; moderate naphthalene-like odor, brown, petroleum-like odor. (7.6'- 8.6') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; strong naphthalene-like odor, brown, sheen, tar-like saturation, petroleum-like odor. (8.6'- 10') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to medium, ~10% fines, non plastic; moderate naphthalene-like odor, brown. (10'- 15') No Recovery.
-5	15	S4	60/32	197					(15'- 15.5') SILTY SAND (SM); black. (15.5'- 20') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight naphthalene-like odor, light brown and brown.
							NLO		
	20								

WELL DETAILS



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BORING LOG

WW-MW-08

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
	20	S5	60/19	221			NLO		(20'- 25') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight naphthalene-like odor, light brown and brown, color change at 22.9 ft to brown.	
-15	25	S6	60/33	56.2			NLO NLO NLO NLO		(25'- 25.8') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, brown. (25.8'- 26.4') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight naphthalene-like odor, light brown and brown. (26.4'- 26.7') LEAN CLAY (CL); ~90% fines, medium plasticity, ~10% sand, fine; reddish brown, 0.5 inch of widely graded fine to medium sand lens. (26.7'- 27.3') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight naphthalene-like odor, light brown and brown.	
-20	30	S7	60/32	178			NLO		(27.3'- 30') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, brown, color change at 28.9 ft to blackish brown. (30'- 35') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight naphthalene-like odor, light brown and brown, silty lenses up to 0.5 inch throughout sample.	
-25	35	S8	60/32	0.1					(35'- 40') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; light brown and brown, silty lenses up to 1 inch throughout sample, varved clay from 36.7 to 37 ft.	
-30	40	S9	60/23				NLO	WWMW-08 (40-45)	(40'- 40.7') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight naphthalene-like odor, light brown and brown. (40.7'- 45') LEAN CLAY (CL); ~90% fines, medium plasticity, ~10% sand, fine; red, gray silt varves, 2 inches of the clay has ~30% fine sand content.	

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BORING LOG

WW-MW-08

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
-35	45	S10	60/19						(45'- 50') LEAN CLAY (CL); ~90% fines, medium plasticity, ~10% sand, fine; red, gray silt varves, higher silt content 5 to 15 inches.	
-40	50								End of Boring at 50 feet. Grouted	

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

GEI Consultants, Inc.
455 Winding Brook Road
Glastonbury, CT 06033
(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 1 of 3
WW-MW-10

GROUND SURFACE ELEVATION (FT): 8.07 **LOCATION:** North 12th Street
NORTHING (FT): 689119 **EASTING (FT):** 641686 **TOTAL DEPTH (FT):** 49.0
DRILLED BY: Zebra Environmental / Quincy Brandt **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Maura MacLeod **DATE START / END:** 9/8/2009 - 9/9/2009
DRILLING DETAILS: Geoprobe
WATER LEVEL DEPTHS (FT): ▽ 5.00 9/8/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
	0	S1	60/NM						(0'- 0.5') ASPHALT. (0.5'- 2') WIDELY GRADED SAND WITH GRAVEL (SW); ~75% sand, fine to coarse, ~20% gravel, fine to coarse, ~5% fines, non plastic; max. size 2, dry, brown, hand cleared. (2'- 4') WIDELY GRADED SAND (SW); ~85% sand, fine to coarse, ~10% gravel, fine to coarse, ~5% fines, non plastic; max. size 1, dry, light brown, hand cleared.	
5				62.6			NLO	WWMW-10 (4-5)	(4'- 5') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine, ~5% fines, non plastic; max. size 0.5, slight naphthalene-like odor, moist, brown, sheen, tar-like blebs, black staining, moderate petroleum-like odor, hand cleared.	
▽	5	S2	60/38				NLO		(5'- 7') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to medium, ~10% fines, non plastic; slight naphthalene-like odor, wet, gray brown, sheen, slight petroleum-like odor.	
0				253			NLO		(7'- 8.9') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, wet, gray brown, sheen, tar-like blebs, slight petroleum-like odor.	
	10	S3	60/54	119			NLO	WWMW-10 (10-11.5)	(8.9'- 10') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, wet, gray brown, sheen, slight petroleum-like odor. (10'- 12.2') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, wet, brown, sheen and tar-like blebs, slight petroleum-like odor. (12.2'- 18.5') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moist, brown, slightly silty lenses.	
-5										
	15	S4	60/55	11.3					(18.5'- 18.8') SILTY SAND (SM); ~70% sand, fine, ~30% fines, low plasticity; moist, brown. (18.8'- 19.1') SANDY SILT (ML); ~70% fines, low	
-10										
	20									

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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455 Winding Brook Road
Glastonbury, CT 06033
(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 2 of 3
WW-MW-10

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
	20	S5	60/40						plasticity, ~30% sand, fine; moist, black. (19.1'- 20') WIDELY GRADED SAND WITH SILT (SW-SM); ~85% sand, fine to coarse, ~10% fines, low plasticity, ~5% gravel, fine; max. size 0.5, moist, brown. (20'- 25') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, wet, brown, loose, slight burnt-like odor.	
-15				51.7			NLO			
	25	S6	60/27						(25'- 30') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, wet, brown, loose, slight burnt-like odor.	
-20				65.9			NLO			
	30	S7	60/35						(30'- 35') WIDELY GRADED SAND WITH SILT (SW-SM); ~85% sand, fine to coarse, ~10% fines, low plasticity, ~5% gravel, fine; max. size 0.5, slight naphthalene-like odor, moist, brown, dense, slight petroleum-like odor.	
-25				69.6			NLO			
	35	S8	60/41	36.1			NLO		(35'- 35.7') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, moist, brown. (35.7'- 37') WIDELY GRADED SAND WITH SILT (SW-SM); ~85% sand, fine to coarse, ~10% fines, low plasticity, ~5% gravel, fine; max. size 0.5, slight naphthalene-like odor, moist, brown, dense. (37'- 45') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moist, brown.	
-30							NLO			
	40	S9	60/44	9.0						
-35										

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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PROJECT: Williamsburg MGP RI
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BORING LOG
PAGE 3 of 3
WW-MW-10

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
	45	S10	48/45	6.2			NLO		(45'- 49') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight naphthalene-like odor, moist, brown.	
-40									End of Boring at 49 feet. Refusal at 49 feet. Grouted	

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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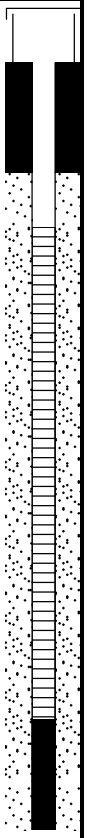
BORING LOG
PAGE 1 of 3
WW-MW-11

GROUND SURFACE ELEVATION (FT): 9.20 **LOCATION:** North 11th Street
NORTHING (FT): 688957 **EASTING (FT):** 641530 **TOTAL DEPTH (FT):** 45.0
DRILLED BY: Zebra Environmental / Quincy Brandt **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Maura MacLeod **DATE START / END:** 8/21/2009 - 8/25/2009
DRILLING DETAILS: Geoprobe
WATER LEVEL DEPTHS (FT): ▽ 5.00 8/21/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
	0	S1	60/NM	35.0				WWMW-11 (3-5)	(0'- 0.2') ASPHALT. (0.2'- 2.3') NARROWLY GRADED SAND WITH SILT AND GRAVEL (SP-SM); ~75% sand, fine, ~15% gravel, fine, ~10% fines, non plastic; ~40% concrete fragments up to 4 inches, max. size 0.5, dry, olive brown, hand cleared. FILL. (2.3'- 5') WIDELY GRADED GRAVEL WITH SAND (GW); ~55% gravel, fine to coarse, ~40% sand, fine to coarse, ~5% fines, non plastic; max. size 1.5, moist, gray to black, hand cleared. FILL.	
5	5	S2	60/37				NLO		(5'- 6.4') WIDELY GRADED SAND WITH GRAVEL (SW); ~70% sand, fine to coarse, ~25% gravel, fine to coarse, ~5% fines, non plastic; max. size 1, slight naphthalene-like odor, brown black, coal and brick fragments. FILL.	
							NLO		(6.4'- 8.8') WIDELY GRADED SAND WITH GRAVEL (SW); ~70% sand, fine to coarse, ~25% gravel, fine to coarse, ~5% fines, non plastic; max. size 1, slight naphthalene-like odor, moist, brown black, coal and brick fragments, sheen. FILL.	
0				479			NLO		(8.8'- 10') WIDELY GRADED SAND WITH GRAVEL (SW); ~70% sand, fine to coarse, ~25% gravel, fine to coarse, ~5% fines, non plastic; max. size 1, moderate naphthalene-like odor, moist, brown black, coal and brick fragments, tar-like staining. FILL.	
	10	S3	60/29	608			NLO	WWMW-11 (11-14)	(10'- 14') WIDELY GRADED GRAVEL WITH SAND (GW); ~60% gravel, fine to coarse, ~35% sand, fine to coarse, ~5% fines, non plastic; max. size 1, moderate naphthalene-like odor, wet, black, coal fragments, sheen, tar-like staining.	
-5							NLO		(14'- 15') SILT (ML); ~90% fines, low plasticity, ~10% sand, fine; moderate naphthalene-like odor, moist, black, tar-like staining, slight petroleum-like odor.	
	15	S4	60/47				NLO		(15'- 16.7') WIDELY GRADED GRAVEL WITH SAND (GW); ~60% gravel, fine to coarse, ~35% sand, fine to coarse, ~5% fines, non plastic; max. size 1, moderate naphthalene-like odor, wet, black, coal fragments, sheen, tar-like staining.	
							NLO		(16.7'- 18.4') SILT (ML); ~90% fines, low plasticity, ~10% sand, fine; slight naphthalene-like odor, moist, black, tar-like staining, slight petroleum-like odor.	
-10				5.6					(18.4'- 20') SILT (ML); ~90% fines, low plasticity, ~10% sand, fine; moist, gray.	
	20									



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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

GEI Consultants

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(860) 368-5300

CLIENT: National Grid
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BORING LOG
PAGE 2 of 3
WW-MW-11

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
	20	S5	60/61	4.3			NLO		(20'- 20.7') WIDELY GRADED GRAVEL WITH SAND (GW); ~60% gravel, fine to coarse, ~35% sand, fine to coarse, ~5% fines, non plastic; max. size 1, moderate naphthalene-like odor, wet, black, coal fragments, sheen, tar-like staining.	
							NLO		(20.7'- 22.2') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to coarse, ~10% fines, low plasticity; slight naphthalene-like odor, moist, brown, gray petroleum-like staining, moderate petroleum-like odor.	
-15									(22.2'- 27.4') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine, ~5% fines, non plastic; max. size 0.5, wet, brown, loose.	
	25	S6	60/40	0.3						
									(27.4'- 30') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine, ~5% fines, non plastic; max. size 0.5, wet, brown, dense.	
-20	30	S7	60/NM	0.2					(30'- 35') WIDELY GRADED SAND WITH GRAVEL (SW); ~80% sand, fine to coarse, ~15% gravel, fine to coarse, ~5% fines, non plastic; max. size 2.5, moist, brown.	
-25										
	35	S8	60/13	0.1				WWMW-11 (39-40)	(35'- 40') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine, ~5% fines, non plastic; max. size 0.5, wet, brown, dense.	
-30										
	40	S9	60/59	0.3			NLO		(40'- 45') LEAN CLAY (CL); ~90% fines, medium plasticity, ~10% sand, fine; slight naphthalene-like odor, reddish gray.	
-35										

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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BORING LOG
PAGE 3 of 3
WW-MW-11

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
	45						NLO		End of Boring at 45 feet. Grouted	

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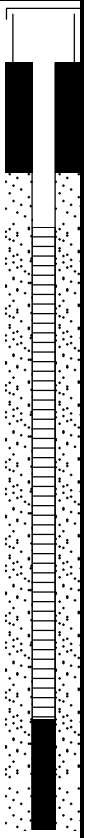
BORING LOG
PAGE 1 of 3
WW-MW-13

GROUND SURFACE ELEVATION (FT): 7.07 **LOCATION:** North 12th Street
NORTHING (FT): 689224 **EASTING (FT):** 641557 **TOTAL DEPTH (FT):** 58.0
DRILLED BY: Zebra Environmental / Quincy Brandt **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Maura MacLeod **DATE START / END:** 9/15/2009 - 9/15/2009
DRILLING DETAILS: Geoprobe
WATER LEVEL DEPTHS (FT): ▽ 5.00 9/15/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	0	S1	60/24						(0'- 0.5') CONCRETE. (0.5'- 2.7') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine to coarse, ~5% fines, non plastic; max. size 1, dry, brown, hand cleared. FILL.
5	5			21.9			NLO	WWMW-13 (2-5)	(2.7'- 5') WIDELY GRADED GRAVEL WITH SAND (GW); ~60% gravel, fine to coarse, ~35% sand, fine to coarse, ~5% fines, non plastic; max. size 1.5, slight naphthalene-like odor, moist, black, coal fragments, petroleum-like staining, moderate petroleum-like odor, hand cleared. FILL.
▽	5	S2	60/19						(5'- 10') WIDELY GRADED GRAVEL WITH SAND (GW); ~70% gravel, fine to coarse, ~25% sand, fine to coarse, ~5% fines, non plastic; max. size 2, strong naphthalene-like odor, wet, black, brick, coal, organic fragments, tar-like staining, pockets of coating. FILL.
0				3008			NLO	WWMW-13 (5-10)	
	10	S3	60/29						(10'- 12.9') WIDELY GRADED GRAVEL WITH SAND (GW); ~80% gravel, fine to coarse, ~15% sand, fine to coarse, ~5% fines, non plastic; max. size 2, moderate naphthalene-like odor, wet, black, coal and brick fragments, tar-like staining and blebs. FILL.
-5				2463			NLO		
							NLO		(12.9'- 15') SILT WITH SAND (ML); ~80% fines, medium plasticity, ~20% sand, fine; slight naphthalene-like odor, moist, black, lens of organics, moderate petroleum-like odor.
	15	S4	60/22						(15'- 16.8') WIDELY GRADED SAND (SW); ~85% sand, fine to coarse, ~10% gravel, fine to coarse, ~5% fines, non plastic; max. size 1, moderate naphthalene-like odor, brown, pockets of petroleum-like staining, moderate petroleum-like odor.
-10				377			NLO		
							NLO		(16.8'- 17.5') WIDELY GRADED SAND (SW); ~85% sand, fine to coarse, ~10% gravel, fine to coarse, ~5% fines, non plastic; max. size 1, moderate naphthalene-like odor, brown, pockets of tar-like coating, moderate petroleum-like odor.
							NLO		(17.5'- 20') SILTY SAND (ML); ~80% sand, fine to
	20								

WELL DETAILS



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BORING LOG
PAGE 2 of 3
WW-MW-13

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
	20	S5	60/37	518			NLO		coarse, ~15% fines, low plasticity, ~5% gravel, fine to coarse; max. size 1, slight naphthalene-like odor, moist, brown, slight petroleum-like odor.	
-15									(20'- 22.7') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine, ~5% fines, non plastic; max. size 0.5, moderate naphthalene-like odor, moist, brown, sheen and tar-like staining.	
							NLO		(22.7'- 25') SILTY SAND (ML); ~80% sand, fine to coarse, ~15% fines, low plasticity, ~5% gravel, fine to coarse; max. size 1, slight naphthalene-like odor, moist, brown, slight petroleum-like odor.	
	25	S6	60/35	52.9			NLO		(25'- 30') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight naphthalene-like odor, moist, reddish brown.	
-20										
	30	S7	60/43	114					(30'- 45') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight naphthalene-like odor, moist, brown.	
-25										
	35	S8	60/43	99.8			NLO			
-30										
	40	S9	60/35	24.2						
-35										

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

GEI Consultants

GEI Consultants, Inc.
455 Winding Brook Road
Glastonbury, CT 06033
(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 3 of 3
WW-MW-13

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
	45	S10	60/43	50.7			NLO		(45'- 58') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight naphthalene-like odor, moist, reddish brown.	
-40										
	50	S11	60/38	207			NLO			
-45										
	55	S12	36/NM							
-50										

End of Boring at 58 feet.
Refusal at 58 feet.
Grouted

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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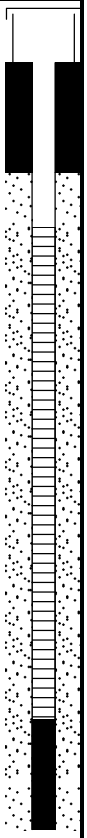
BORING LOG
PAGE 1 of 3
WW-MW-14

GROUND SURFACE ELEVATION (FT): 6.75 **LOCATION:** North 11th Street
NORTHING (FT): 689121 **EASTING (FT):** 641313 **TOTAL DEPTH (FT):** 60.0
DRILLED BY: Zebra Environmental / Quincy Brandt **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Maura MacLeod **DATE START / END:** 9/1/2009 - 9/2/2009
DRILLING DETAILS: Geoprobe
WATER LEVEL DEPTHS (FT): ▽ 5.00 9/1/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	0								(0'- 0.5') ASPHALT.
		S1	54/12						(0.5'- 1.7') wood fragments, hand cleared. FILL.
5									(1.7'- 5') WIDELY GRADED SAND WITH GRAVEL (SW); ~75% sand, fine to coarse, ~20% gravel, fine to coarse, ~5% fines, non plastic; max. size 1.5, dry, blackish brown, wood fragments, hand cleared. FILL.
				5.0				WWMW-14 (3-5)	
▽	5	S2	60/20						(5'- 10') WIDELY GRADED SAND WITH GRAVEL (SW); ~65% sand, fine to coarse, ~30% gravel, fine to coarse, ~5% fines, non plastic; max. size 1.5, wet to moist, brown, brick fragments. FILL.
0				15.8					
	10	S3	60/25	4.4			NLO		(10'- 15') WIDELY GRADED SAND WITH GRAVEL (SW); ~65% sand, fine to coarse, ~30% gravel, fine to coarse, ~5% fines, non plastic; max. size 1.5, slight naphthalene-like odor, wet, brown, brick fragments. FILL.
-5									
	15	S4	60/33				NLO		(15'- 16.7') WIDELY GRADED SAND WITH GRAVEL (SW); ~65% sand, fine to coarse, ~30% gravel, fine to coarse, ~5% fines, non plastic; max. size 1.5, slight naphthalene-like odor, wet, brown, brick fragments, sheen, slight petroleum-like odor. FILL.
-10							NLO		(16.7'- 17.3') WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); ~50% sand, fine to coarse, ~40% gravel, fine to coarse, ~10% fines, non plastic; max. size 1.5, slight naphthalene-like odor, wet, black, organics, wood, and root fragments, sheen, slight petroleum-like odor.
				578			NLO		
	20								

WELL DETAILS



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CLIENT: National Grid
PROJECT: Williamsburg MGP RI
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BORING LOG
PAGE 2 of 3
WW-MW-14

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
-15	20	S5	60/46	973			NLO		(17.3'- 20') WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); ~50% sand, fine to coarse, ~40% gravel, fine to coarse, ~10% fines, non plastic; max. size 1.5, moderate naphthalene-like odor, wet, black, organics, wood, and root fragments, sheen, slight petroleum-like odor.	
							NLO		(20'- 22.2') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, wet, black, tar-like coating, slight petroleum-like odor.	
	25	S6	60/55	1345			NLO		(22.2'- 25') SANDY ORGANIC SOIL (OL); ~60% fines, low plasticity, ~40% sand, fine; moderate naphthalene-like odor, moist, black, organics, roots, wood fragments, tar-like staining, slight petroleum-like odor.	
-20							NLO		(25'- 26.6') WIDELY GRADED SAND WITH GRAVEL (SW); ~65% sand, fine to coarse, ~30% gravel, fine to coarse, ~5% fines, non plastic; max. size 1.5, slight naphthalene-like odor, wet, brown, brick fragments, slight petroleum-like odor.	
							NLO		(26.6'- 28.6') SANDY ORGANIC SOIL (OL); ~60% fines, low plasticity, ~40% sand, fine; moderate naphthalene-like odor, moist, black, organics, roots, wood fragments, tar-like staining, slight petroleum-like odor.	
	30	S7	60/33				NLO		(28.6'- 28.8') WIDELY GRADED SAND (SW); tar-like coating.	
-25				348			NLO		(28.8'- 29.1') SANDY ORGANIC SOIL (OL); ~60% fines, low plasticity, ~40% sand, fine; moderate naphthalene-like odor, moist, black, organics, roots, wood fragments, tar-like staining, slight petroleum-like odor.	
							NLO		(29.1'- 30') ORGANIC SOIL WITH SAND (OL); ~80% fines, low plasticity, ~20% sand, fine; moderate naphthalene-like odor, moist, black, organics, roots, wood fragments, tar-like staining, slight petroleum-like odor.	
	35	S8	60/35				NLO		(30'- 32.1') NARROWLY GRADED SAND (SP); ~95% sand, fine, ~5% fines, non plastic; slight naphthalene-like odor, wet, brown, slight petroleum-like odor.	
-30				1313			NLO	WWMW-14 (36-37)	(32.1'- 33.9') SILTY SAND (SM); ~75% sand, fine to medium, ~20% fines, non plastic, ~5% gravel, fine; max. size 0.25, slight naphthalene-like odor, brown, lenses of silt and white burnt-like material, slight petroleum-like odor.	
							NLO		(33.9'- 35') SILT (ML); ~90% fines, low plasticity, slow dilatancy, ~10% sand, fine; slight naphthalene-like odor, wet, gray, slight petroleum-like odor.	
	40	S9	60/56	1044			NLO		(35'- 36.6') WIDELY GRADED SAND (SW); ~85% sand, fine to coarse, ~10% gravel, fine, ~5% fines, non plastic; max. size 0.5, strong naphthalene-like odor, black, tar-like coating, slight petroleum-like odor.	
-35							NLO		(36.6'- 36.9') SLIT (ML); gray.	
							NLO		(36.9'- 40') WIDELY GRADED SAND WITH GRAVEL (SW); ~80% sand, fine to medium, ~15% gravel, fine to coarse, ~5% fines, non plastic; max. size 1, slight naphthalene-like odor, wet, gray, slight petroleum-like odor.	
							NLO		(40'- 42.1') WIDELY GRADED SAND WITH GRAVEL (SW); ~80% sand, fine to medium, ~15% gravel, fine to coarse, ~5% fines, non plastic; max. size 1, slight naphthalene-like odor, wet, gray, silty lenses, tar-like	

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 3 of 3
WW-MW-14

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
	45	S10	60/54	100			NLO		coating, slight petroleum-like odor. (42.1'- 43.9') WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); ~75% sand, fine to coarse, ~15% gravel, fine to coarse, ~10% fines, non plastic; max. size 1.25, moderate naphthalene-like odor, wet, brown, sheen, tar-like blebs, slight petroleum-like odor. (43.9'- 47.9') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine, ~5% fines, non plastic; max. size 0.5, slight naphthalene-like odor, moist, brown. (47.9'- 50') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine, ~5% fines, non plastic; max. size 0.5, moist, brown.	
-40	50	S11	60/43	109			NLO		(50'- 54.8') WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); ~85% sand, fine to coarse, ~10% fines, non plastic, ~5% gravel, fine to coarse; max. size 1, slight naphthalene-like odor, moist, brown, slight petroleum-like odor.	
-45	55	S12	60/53	55.3			NLO	WWMW-14 (55-57)	(54.8'- 55') SANDY LEAN CLAY (CL); ~70% fines, medium plasticity, ~30% sand, fine; moist, reddish brown. (55'- 57') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine, ~5% fines, non plastic; max. size 0.75, slight naphthalene-like odor, moist, brown, lenses of clay, slight petroleum-like odor.	
-50							NLO		(57'- 60') LEAN CLAY (CL); ~90% fines, medium plasticity, ~10% sand, fine; slight naphthalene-like odor, moist, reddish gray, lens of sand, slight petroleum-like odor.	
	60								End of Boring at 60 feet. Grouted	

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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BORING LOG
PAGE 1 of 2
WW-MW-15

GROUND SURFACE ELEVATION (FT): 6.35 **LOCATION:** North 12th Street
NORTHING (FT): 689377 **EASTING (FT):** 641365 **TOTAL DEPTH (FT):** 21.0
DRILLED BY: Zebra Environmental / Quincy Brandt **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Maura MacLeod **DATE START / END:** 9/24/2009 - 9/29/2009
DRILLING DETAILS: Geoprobe
WATER LEVEL DEPTHS (FT): ▽ 6.50 9/28/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
6.35	0								(0'- 0.5') CONCRETE.	
		S1	60/NM	323			NLO	WWMW-15 (1-4)	(0.5'- 1.5') WIDELY GRADED SAND WITH GRAVEL (SW); ~75% sand, fine to coarse, ~20% gravel, fine to coarse, ~5% fines, non plastic; max. size 2, dry, brown, hand cleared. FILL. (1.5'- 5') WIDELY GRADED SAND WITH GRAVEL (SW); ~75% sand, ~20% gravel, ~5% fines, non plastic; max. size 2, slight naphthalene-like odor, moist, brown, pockets of petroleum-like staining, moderate petroleum-like odor, hand cleared. FILL.	
5	5	S2	60/27	1927			PLO		(5'- 6.5') slight petroleum-like odor, wood fragments. FILL.	
▽ 0							NLO		(6.5'- 10') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine, ~5% fines, non plastic; max. size 0.5, moderate naphthalene-like odor, wet, black, wood fragments, moderate petroleum-like odor, strong organic-like odor. FILL.	
-5	10	S3	60/54	3102			NLO	WWMW-15 (12-13)	(10'- 13.1') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine, ~5% fines, non plastic; max. size 0.5, moderate naphthalene-like odor, wet, brown black, wood fragments, moderate petroleum and organic-like odor. FILL.	
							NLO		(13.1'- 13.9') WIDELY GRADED SAND WITH GRAVEL (SW); ~80% sand, fine to coarse, ~15% gravel, fine to coarse, ~5% fines; max. size 1, slight naphthalene-like odor, wet, gray, slight petroleum-like odor, moderate organic-like odor. FILL.	
-10	15	S4	60/53	1437			NLO		(13.9'- 15') SILTY SAND (SM); ~70% sand, fine to coarse, ~30% fines, low plasticity; moderate naphthalene-like odor, moist, black, organics, moderate tar-like staining, moderate petroleum-like staining and odor. FILL.	
							NLO		(15'- 17.2') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine, ~5% fines, non plastic; max. size 0.5, moderate naphthalene-like odor, wet, gray, wood fragments, moderate petroleum-like odor, strong organic-like odor. FILL.	
	20						NLO		(17.2'- 18.3') SILTY SAND (SM); ~70% sand, fine to	

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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BORING LOG
PAGE 2 of 2
WW-MW-15

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
	20	S5	12/54	1015			NLO NLO		coarse, ~30% fines, low plasticity; moderate naphthalene-like odor, moist, black, organics, moderate tar-like staining, moderate petroleum-like odor. FILL. (18.3'- 20') SANDY SILT (ML); ~70% fines, medium plasticity, ~30% sand, fine; moderate naphthalene-like odor, moist, black, moderate petroleum-like odor. FILL. (20'- 20.4') WIDELY GRADED GRAVEL WITH SAND (GW); ~60% gravel, fine to coarse, ~35% sand, fine to coarse, ~5% fines, non plastic; max. size 1, moderate naphthalene-like odor, moist, black, moderate petroleum-like odor. FILL. (20.4'- 20.8') SILTY SAND (SM); ~70% sand, fine to coarse, ~30% fines, low plasticity; moderate naphthalene-like odor, moist, black, organics, moderate tar-like staining, moderate petroleum-like staining and odor. FILL. (20.8'- 21') wood fragments. FILL. End of Boring at 21 feet. Refusal at 21 feet. Grouted	

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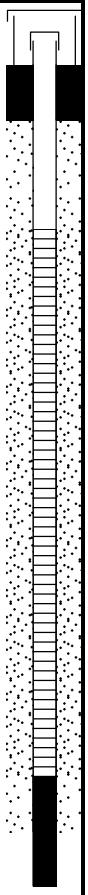
BORING LOG
PAGE 1 of 3
WW-MW-17

GROUND SURFACE ELEVATION (FT): 11.62 **LOCATION:** 50 Kent Ave
NORTHING (FT): 688917 **EASTING (FT):** 641758 **TOTAL DEPTH (FT):** 60.0
DRILLED BY: Zebra Environmental / Luke Caballero **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Maura MacLeod **DATE START / END:** 6/8/2009 - 6/9/2009
DRILLING DETAILS: Geoprobe
WATER LEVEL DEPTHS (FT):
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
10	0	S1	60/NM	2.1				WWMW-17 (1-2)	(0'- 0.33') CONCRETE. (0.3'- 5') SILTY SAND (SM); ~80% sand, fine to coarse, ~15% fines, non plastic, ~5% gravel, fine; brown, hand cleared.
5	5	S2	60/24				NLO	WWMW-17 (7-8)	(5'- 8.3') SILTY SAND (SM); ~80% sand, fine to coarse, ~15% fines, non plastic, ~5% gravel, fine to coarse; max. size 2, slight naphthalene-like odor, brown.
				868			NLO		(8.3'- 10') SILTY SAND (SM); ~80% sand, fine to coarse, ~15% fines, non plastic, ~5% gravel, fine to coarse; max. size 2, moderate naphthalene-like odor, brown, sheen, tar-like staining.
0	10	S3	60/49	349			NLO		(10'- 12.9') SILTY SAND (SM); ~80% sand, fine to coarse, ~15% fines, non plastic, ~5% gravel, fine to coarse; max. size 2, slight naphthalene-like odor, brown, sand and gravel lenses.
									(12.9'- 15') SILTY SAND (SM); ~80% sand, fine to coarse, ~15% fines, non plastic, ~5% gravel, fine to coarse; max. size 2, brown, sand and gravel lenses.
-5	15	S4	60/45	1281			NLO NLO NLO		(15'- 15.2') SILTY SAND (SM); ~80% sand, fine to coarse, ~15% fines, non plastic, ~5% gravel, fine to coarse; max. size 2, slight naphthalene-like odor, black, organics. (15.2'- 15.3') SILTY SAND (SM); ~80% sand, fine to coarse, ~15% fines, non plastic, ~5% gravel, fine to coarse; max. size 2, slight naphthalene-like odor, black, organics, tar-like coating.
							NLO NLO		(15.3'- 17') SILTY SAND (SM); ~80% sand, ~15% fines, non plastic, ~5% gravel; max. size 2, slight naphthalene-like odor, black, organics, sandy silt lens
	20								

WELL DETAILS



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SLO = SULFUR LIKE ODOR
MLO = MUSTY LIKE ODOR

ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

GEI Consultants

GEI Consultants, Inc.
455 Winding Brook Road
Glastonbury, CT 06033
(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 2 of 3
WW-MW-17

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
	20	S5	60/35	71.3			NLO		from 16.3 to 16.7 ft. (17'- 17.6') SILTY SAND (SM); ~80% sand, fine to coarse, ~15% fines, non plastic, ~5% gravel, fine to coarse; max. size 2, slight naphthalene-like odor, black, organics, sheen. (17.6'- 18.2') SILTY SAND (SM); ~55% sand, fine, ~45% fines, low plasticity; slight naphthalene-like odor, black. (18.2'- 20') SANDY SILT (ML); ~70% fines, low plasticity, ~30% sand, fine; gray, shells from 19.2 to 20 ft.	
-10									(20'- 23.3') SILTY SAND (SM); ~80% sand, fine to coarse, ~15% fines, non plastic, ~5% gravel, fine to coarse; max. size 2, slight naphthalene-like odor, brown.	
	25	S6	60/19	0					(23.3'- 25') SANDY SILT (ML); ~70% fines, low plasticity, ~30% sand, fine; brown gray. (25'- 30') SILTY SAND (SM); ~60% sand, fine to coarse, ~30% fines, non plastic, ~10% gravel, fine to coarse; max. size 2, brown.	
-15										
	30	S7	60/44	0					(30'- 35.3') SILTY SAND (SM); ~70% sand, fine to coarse, ~20% fines, non plastic, ~10% gravel, fine to coarse; max. size 2, brown, gravel layer from 43.9 to 44.4 ft.	
-20										
	35	S8	60/47	0					(35.3'- 36.1') WIDELY GRADED GRAVEL WITH SAND (GW); ~50% gravel, fine to coarse, ~45% sand, fine to coarse, ~5% fines, non plastic; max. size 2, gray. (36.1'- 38') SILTY SAND (SM); ~70% sand, fine to coarse, ~20% fines, non plastic, ~10% gravel, fine to coarse; brown, 1" lens of fine to coarse gravel at 37.9 ft.	
-25									(38'- 40') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; brown.	
	40	S9	60/41	6.2			OLO		(40'- 41.6') SILTY SAND (SM); ~80% sand, fine to medium, ~20% fines, non plastic; moderate organic-like odor, brown.	
-30							NLO		(41.6'- 46.8') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, black, lens of brown silty sand from 43.9 to 44.4 ft, organic odor.	

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BORING LOG
PAGE 3 of 3
WW-MW-17

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION	WELL DETAILS
	45	S10	60/39	11.6			NLO			
-35									(46.8'- 49.2') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; brown, silty sand lenses.	
	50	S11	60/38	55			NLO		(49.2'- 50') SILT (ML); ~80% fines, non plastic, ~20% sand, fine; brown.	
							NLO		(50'- 50.3') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight naphthalene-like odor, brown.	
-40							NLO		(50.3'- 50.7') SILTY SAND (SM); ~70% sand, fine, ~30% fines, non plastic; slight naphthalene-like odor, gray.	
							NLO		(50.7'- 51.8') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight naphthalene-like odor, brown.	
							NLO	WWMW-17 (54-55)	(51.8'- 52.4') SANDY SILT (ML); ~60% fines, non plastic, ~40% sand, fine; slight naphthalene-like odor, gray.	
	55	S12	60/20	1.4			NLO		(52.4'- 54.7') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight naphthalene-like odor, brown.	
-45									(54.7'- 55') LEAN CLAY (CL); ~95% fines, medium plasticity, ~5% sand, fine; slight naphthalene-like odor, reddish brown.	
									(55'- 60') LEAN CLAY (CL); ~95% fines, medium plasticity, ~5% sand, fine; brown, reddish brown varves.	
	60								End of Boring at 60 feet. Grouted	

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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CITY/STATE: Brooklyn, New York
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BORING LOG
PAGE 1 of 2
WW-SB-01

GROUND SURFACE ELEVATION (FT): 16.19 **LOCATION:** North 11th Street
NORTHING (FT): 688566 **EASTING (FT):** 642027 **TOTAL DEPTH (FT):** 26.0
DRILLED BY: Zebra Environmental / Luke Caballero **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Melissa Felter **DATE START / END:** 7/10/2009 - 7/10/2009
DRILLING DETAILS: Geoprobe
WATER LEVEL DEPTHS (FT): ▽ 10.00 7/10/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
15	0	S1	60/38	0.2				WWSB-01 (1-5)	(0'- 0.5') CONCRETE. (0.5'- 5') SILTY SAND (SM); ~80% sand, fine, ~20% fines; ~5% brick, moist, brown, soft, hand cleared. FILL.
10	5	S2	60/45						(5'- 8') SILTY SAND (SM); ~85% sand, fine to medium, ~15% fines; ~5% brick, moist, brown, loose. FILL.
				256			PLO		(8'- 8.2') WIDELY GRADED SAND (SW); ~95% sand, medium to coarse, ~5% fines; dry, light brown, loose. (8.2'- 9') SANDY SILT (ML); ~60% fines, ~40% sand, fine; moist, brown, soft.
5	10 ▽	S3	60/43						(9'- 10') SANDY SILT (ML); ~60% fines, ~40% sand, fine; moderate petroleum-like odor, moist, black, soft, black stained. (10'- 14.5') SANDY SILT (ML); ~50% fines, ~45% sand, fine to medium, ~5% gravel, fine to coarse; moderate petroleum-like odor, wet, black and brown, black stained lenses.
				524			PLO	WWSB-01 (14-15)	
0	15	S4	60/60	582			PLO		(14.5'- 16.5') WIDELY GRADED SAND WITH SILT (SW-SM); ~85% sand, fine to medium, ~10% fines, ~5% gravel, fine; moderate petroleum-like odor, wet, gray, loose, gray stained.
									(16.5'- 18.5') SANDY SILT (ML); ~60% fines, ~35% sand, fine, ~5% gravel, fine to coarse; moist, gray and reddish brown, dense.
	20								(18.5'- 19.5') NARROWLY GRADED SAND WITH SILT (SP-SM); ~85% sand, fine to medium, ~10% fines, ~5% gravel, fine; moist, reddish brown, dense.

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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BORING LOG

WW-SB-01

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	20	S5	60/52						(19.5'- 20') SILTY SAND (SM); ~80% sand, fine, ~15% fines, ~5% gravel, fine to coarse; moist, brown, dense. (20'- 23') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine, ~5% fines; wet, brown, loose.
-5									
				64					(23'- 25') SILTY SAND (SM); ~60% sand, fine, ~25% gravel, fine to coarse, ~15% fines; wet, brown and grayish brown, dense, lens of crushed rock 24-24.5 ft.
	25	S6	12/12	21					(25'- 26') SANDY SILT (ML); ~60% fines, ~30% sand, fine, ~10% gravel, fine; moist, gray, very dense.
									End of Boring at 26 feet. Refusal at 26 feet. Grouted

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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BORING LOG
PAGE 1 of 3
WW-SB-02

GROUND SURFACE ELEVATION (FT): 13.19 **LOCATION:** N 12th Street
NORTHING (FT): 688735 **EASTING (FT):** 642160 **TOTAL DEPTH (FT):** 55.0
DRILLED BY: Zebra Environmental / Luke Caballero **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Maura MacLeod **DATE START / END:** 7/8/2009 - 7/9/2009
DRILLING DETAILS: Geoprobe
WATER LEVEL DEPTHS (FT): ▽ 8.00 7/8/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	0	S1	60/18	5.5		OLO	WWSB-02 (2-5)	(0'- 0.5') CONCRETE. (0.5'- 2.2') WIDELY GRADED SAND WITH GRAVEL (SW); ~80% sand, fine to coarse, ~15% gravel, fine to coarse, ~5% fines, non plastic; max. size 2, gray, hand cleared. (2.2'- 5') WIDELY GRADED SAND WITH GRAVEL (SW); ~80% sand, fine to coarse, ~15% gravel, fine to coarse, ~5% fines, non plastic; max. size 2, moderate organic-like odor, brown, coal fragments and organics from 2.8 to 3.3 ft, hand cleared.
10	5	S2	60/33	1322		PLO PLO		(5'- 6.1') WIDELY GRADED SAND WITH GRAVEL (SW); ~80% sand, fine to coarse, ~15% gravel, fine to coarse, ~5% fines, non plastic; max. size 2, brown. (6.1'- 6.5') LEAN CLAY (CL); ~90% fines, medium plasticity, ~10% sand, fine; red. (6.5'- 8') SILTY SAND (SM); ~80% sand, fine to coarse, ~15% fines, non plastic, ~5% gravel, fine; max. size 0.5, organics. (8'- 9.1') SILTY SAND (SM); ~80% sand, fine to coarse, ~15% fines, non plastic, ~5% gravel, fine; max. size 0.5, slight petroleum-like odor, moist, organics, black layers.
5 ▽	10	S3	60/60	1574		NLO NLO PLO PLO PLO	WWSB-02 (10.5-11.5)	(9.1'- 10') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moderate petroleum-like odor, gray. (10'- 10.6') WIDELY GRADED GRAVEL WITH SAND (GW); ~70% gravel, fine to coarse, ~25% sand, fine to coarse, ~5% fines, non plastic; max. size 2, moist, brown. (10.6'- 11.1') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moderate naphthalene-like odor, wet, gray, moderate petroleum-like odor. (11.1'- 11.7') SILTY SAND (SM); ~85% sand, fine to coarse, ~15% fines, non plastic; moderate naphthalene-like odor, wet, brown, moderate petroleum-like odor. (11.7'- 12.3') SILT (ML); ~70% fines, medium plasticity, ~30% sand, fine; slight petroleum-like odor, brown. (12.3'- 13.9') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to coarse, ~10% fines, non plastic; slight petroleum-like odor, brown and black.
0	15	S4	60/58	15.9		PLO		(13.9'- 15') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight petroleum-like odor, brown. (15'- 16.2') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to medium, ~10% fines, non plastic; slight petroleum-like odor, black. (16.2'- 20') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; brown.
-5	20							

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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BORING LOG
PAGE 2 of 3
WW-SB-02

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	20	S5	60/44	317		NLO		(20'- 22.2') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, moist, brown, slight petroleum-like odor.
						PLO		(22.2'- 23.4') SILTY SAND (SM); ~80% sand, fine, ~20% fines, low plasticity; slight petroleum-like odor, brown.
-10						PLO		(23.4'- 25') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight petroleum-like odor, moist, brown.
	25	S6	60/49	356		NLO		(25'- 25.3') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, moist, brown, slight petroleum-like odor.
						NLO		(25.3'- 26.2') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; moderate naphthalene-like odor, brown and black, moderate petroleum-like odor.
-15						NLO		(26.2'- 30') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, moist, brown, lens of gravel from 28.8 to 29 ft, slight petroleum-like odor.
	30	S7	60/55			PLO		(30'- 32') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight petroleum-like odor, moist, brown.
-20				761		NLO		(32'- 35') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; moderate naphthalene-like odor, brown, moderate petroleum-like odor.
	35	S8	60/40			NLO		(35'- 38.6') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, brown.
-25				1014		NLO		(38.6'- 40') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moderate naphthalene-like odor, brown.
	40	S9	60/40	387		NLO		(40'- 44.3') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, brown, slight petroleum-like odor.
-30								

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BORING LOG

PAGE 3 of 3

WW-SB-02

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	45	S10	60/56	7.0		NLO NLO		(44.3'- 45') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, brown, silty seams, slight petroleum-like odor. (45'- 50') SILTY SAND (SM); ~80% sand, fine to coarse, ~20% fines, low plasticity; slight petroleum-like odor, gray.
-35						PLO		
	50	S11	60/55	185				(50'- 52.6') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; wet, brown, loose.
-40						PLO		(52.6'- 55') SILTY SAND (SM); ~85% sand, fine to medium, ~15% fines, non plastic; slight petroleum-like odor, brown.
	55							End of Boring at 55 feet. Refusal at 55 feet. Grouted

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BORING LOG
PAGE 1 of 2
WW-SB-03

GROUND SURFACE ELEVATION (FT): 14.12 **LOCATION:** 50 Kent Ave
NORTHING (FT): 688656 **EASTING (FT):** 641953 **TOTAL DEPTH (FT):** 22.0
DRILLED BY: Zebra Environmental / Luke Caballero **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Sarah Hay **DATE START / END:** 7/14/2009 - 7/14/2009
DRILLING DETAILS: Geoprobe
WATER LEVEL DEPTHS (FT): ▼ 7.50 7/14/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	0								(0'- 3') hand cleared.
10		S1	24/15	7.3				WWSB-03 (3-5)	(3'- 4.1') WIDELY GRADED SAND WITH SILT (SW-SM); ~89% sand, fine to medium, ~10% fines, low plasticity fines, ~1% gravel, fine; max. size 0.5, dry, brown, brick fragments, hand cleared. FILL. (4.1'- 4.3') CONCRETE; crushed concrete, hand cleared. FILL.
	5	S2	60/18				NLO		(4.3'- 5') WIDELY GRADED SAND WITH SILT (SW-SM); ~89% sand, fine to medium, ~10% fines, low plasticity fines, ~1% gravel, fine; max. size 0.5, dry, brown, brick fragments, hand cleared. FILL.
▼									(5'- 7.5') WIDELY GRADED SAND WITH SILT (SW-SM); ~89% sand, fine to medium, ~10% fines, low plasticity fines, ~1% gravel, fine; max. size 0.5, slight naphthalene-like odor, dry, brown, brick fragments. FILL.
5				769			NLO		(7.5'- 10') BRICK; moderate naphthalene-like odor, wet, crushed brick with sand. FILL.
	10	S3	60/22						(10'- 15') WIDELY GRADED GRAVEL WITH SAND (GW); ~70% gravel, ~25% sand, ~5% fines; ~20% brick fragments, max. size 2, strong naphthalene-like odor, wet, brown to black, FILL.
0				1089			NLO		
	15	S4	60/40						(15'- 20') WIDELY GRADED SAND WITH GRAVEL (SW); ~80% sand, fine to coarse, ~15% gravel, ~5% fines; max. size 1.5, strong naphthalene-like odor, wet, brown to black, brick fragments, sheen, tar-like staining, trace tar-like blebs. FILL.
-5				1777			NLO		
	20								

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S_V = TORVANE PEAK

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IN. = INCHES
FT. = FEET

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

GEI Consultants

GEI Consultants, Inc.
455 Winding Brook Road
Glastonbury, CT 06033
(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG

WW-SB-03

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	20	S5	24/21	3949			NLO	WWSB-03 (20-22)	(20'- 21') WIDELY GRADED SAND WITH GRAVEL (SW); ~80% sand, fine to coarse, ~15% gravel, fine to medium, ~5% fines; max. size 1.5, strong naphthalene-like odor, wet, brown to black, heavy tar-like staining, glass, coal ash, and brick fragments. FILL.
							NLO		(21'- 21.8') WIDELY GRADED GRAVEL WITH SILT (GW-GM); ~80% gravel, angular, ~10% sand, ~10% fines; max. size 2, strong naphthalene-like odor, wet, brick and concrete fragments, tar-like staining. FILL.
							NLO		(21.8'- 22') WIDELY GRADED GRAVEL WITH SILT (GW-GM); ~80% gravel, angular, ~10% sand, ~10% fines; max. size 2, strong naphthalene-like odor, wet, tar-like saturation. FILL.
									End of Boring at 22 feet.
									Refusal at 22 feet.
									Grouted

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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455 Winding Brook Road
Glastonbury, CT 06033
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CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 1 of 2
WW-SB-04

GROUND SURFACE ELEVATION (FT): 13.80 **LOCATION:** 50 Kent Ave
NORTHING (FT): 688696 **EASTING (FT):** 641988 **TOTAL DEPTH (FT):** 20.0
DRILLED BY: Zebra Environmental / Quincy Brandt **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Maura MacLeod **DATE START / END:** 10/5/2009 - 10/5/2009
DRILLING DETAILS: Geoprobe
WATER LEVEL DEPTHS (FT): ▽ 5.00 10/5/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	0	S1	60/NM	2.9				WWSB-04 (2-4)	(0'- 0.5') ASPHALT. (0.5'- 5') WIDELY GRADED SAND WITH GRAVEL (SW); ~70% sand, fine to coarse, ~25% gravel, fine to coarse, ~5% fines, non plastic; max. size 1.5, dry, brown, hand cleared. FILL.
10	5	S2	60/16	299			NLO		(5'- 10') WIDELY GRADED GRAVEL WITH SAND (GW); ~60% gravel, fine to coarse, ~35% sand, fine to coarse, ~5% fines, non plastic; max. size 1.5, moderate naphthalene-like odor, wet, brown, FILL.
5	10	S3	60/26	1245			NLO		(10'- 15') WIDELY GRADED GRAVEL WITH SAND (GW); ~75% gravel, fine to coarse, ~20% sand, fine to coarse, ~5% fines, non plastic; max. size 2.5, moderate naphthalene-like odor, wet, brown, sheen. FILL.
0	15	S4	60/34	1601			NLO	WWSB-04 (18-20)	(15'- 20') WIDELY GRADED SAND WITH GRAVEL (SW); ~75% sand, fine to coarse, ~20% gravel, fine to coarse, ~5% fines, non plastic; max. size 1, strong naphthalene-like odor, wet, brown, tar-like staining. FILL.
-5	20								

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 9/11/14

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CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 2 of 2
WW-SB-04

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
									End of Boring at 20 feet. Refusal at 20 feet. Grouted

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CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 1 of 2
WW-SB-05

GROUND SURFACE ELEVATION (FT): 13.38 **LOCATION:** 50 Kent Ave
NORTHING (FT): 688735 **EASTING (FT):** 641857 **TOTAL DEPTH (FT):** 24.0
DRILLED BY: Zebra Environmental / Luke Caballero **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Sarah Hay **DATE START / END:** 7/14/2009 - 7/14/2009
DRILLING DETAILS: Geoprobe
WATER LEVEL DEPTHS (FT): ▽ 4.50 7/14/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	0							WWSB-05 (3-5)	(0'- 3') CONCRETE; hand cleared.
10		S1	24/11	283			NLO		(3'- 4.5') CONCRETE; crushed concrete, hand cleared. FILL.
▽	5	S2	60/19	2324			NLO		(4.5'- 5') WIDELY GRADED SAND WITH GRAVEL (SW); ~80% sand, fine to coarse, ~15% gravel, ~5% fines; max. size 0.75, slight naphthalene-like odor, wet, brick/coal fragments, hand cleared. FILL. (5'- 10') WIDELY GRADED GRAVEL WITH SAND (GW); ~70% gravel, fine to coarse, angular, ~25% sand, fine to coarse, ~5% fines; strong naphthalene-like odor, wet, black staining. FILL.
5	10	S3	60/14	3486			NLO		(10'- 15') WIDELY GRADED GRAVEL WITH SAND (GW); ~70% gravel, fine to coarse, angular, ~25% sand, fine to coarse, ~5% fines; strong naphthalene-like odor, wet, tar saturated. FILL.
0	15	S4	60/23	3051			NLO		(15'- 24') WIDELY GRADED SAND WITH SILT AND GRAVEL (SW); ~75% sand, fine to coarse, ~15% gravel, fine to coarse, angular, ~10% fines; max. size 1, strong naphthalene-like odor, black, tar saturated. FILL.
-5	20								

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

GEI Consultants

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455 Winding Brook Road
Glastonbury, CT 06033
(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG

WW-SB-05

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	20	S5	48/46	4567			NLO	WWSB-05 (20-24)	
-10									

End of Boring at 24 feet.
Refusal at 24 feet.
Grouted

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BORING LOG
PAGE 1 of 2
WW-SB-06

GROUND SURFACE ELEVATION (FT): 9.40 **LOCATION:** 50 Kent Ave
NORTHING (FT): 688765 **EASTING (FT):** 641905 **TOTAL DEPTH (FT):** 25.5
DRILLED BY: Zebra Environmental / Luke Caballero **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Sarah Hay **DATE START / END:** 7/16/2009 - 7/16/2006
DRILLING DETAILS: Geoprobe
WATER LEVEL DEPTHS (FT): ▽ 5.00 7/16/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	SOIL / BEDROCK DESCRIPTION
5	0	S1	60/NM	11.9				(0'- 0.7') CONCRETE. (0.7'- 5') WIDELY GRADED SAND WITH GRAVEL (SW); ~65% sand, fine to coarse, ~30% gravel, subangular to angular, ~5% fines; max. size 1.5, brown, hand cleared. FILL.
▽	5	S2	60/19	852			NLO	(5'- 12.2') WIDELY GRADED GRAVEL WITH SILT AND SAND (GW-GM); ~70% gravel, subrounded to angular, ~20% sand, medium to coarse, ~10% fines; ~5% brick and wood fragments, max. size 1.5, moderate naphthalene-like odor, wet, black, heavy sheen, petroleum-like odor. FILL.
0	10	S3	60/34	5558			NLO	(12.2'- 13.5') BRICK; ~95% sand, medium to coarse, ~5% gravel; ~80% brick fragments, strong naphthalene-like odor, wet, black, tar-like staining. FILL.
-5	15	S4	60/15	> 9999			NLO	(13.5'- 15') WIDELY GRADED GRAVEL WITH SAND (GW); ~80% gravel, subrounded to subangular, ~20% sand, medium to coarse; ~5% wood and paper-like debris, max. size 1.5, strong naphthalene-like odor, black, tar-like coating. FILL. (15'- 23.5') WIDELY GRADED GRAVEL WITH SAND (GW); ~80% gravel, ~20% sand, fine to coarse; ~15% brick fragments, max. size 1, strong naphthalene-like odor, heavy tar-like coating. FILL.
-10	20						NLO	

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG

WW-SB-06

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	SOIL / BEDROCK DESCRIPTION
	20	S5	60/24	> 9999			NLO	
-15							NLO	(23.5'- 25.5') WIDELY GRADED GRAVEL WITH SAND (GW); ~80% gravel, ~20% sand, fine to coarse; ~15% brick fragments, max. size 1, strong naphthalene-like odor, tar saturated. FILL.
	25	S6	6/5	> 9999				

End of Boring at 25.5 feet.
Refusal at 25.5 feet.
Grouted

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 1 of 2
WW-SB-07

GROUND SURFACE ELEVATION (FT): 12.24 **LOCATION:** 50 Kent Ave
NORTHING (FT): 688810 **EASTING (FT):** 641918 **TOTAL DEPTH (FT):** 22.0
DRILLED BY: Zebra Environmental / Luke Caballero **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Sarah Hay **DATE START / END:** 7/15/2009 - 7/15/2009
DRILLING DETAILS: Geoprobe
WATER LEVEL DEPTHS (FT): ▽ 3.00 7/15/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	0								(0'- 3') hand cleared.
10		S1	24/NM	5.6			PLO	WWSB-07 (3-5)	(3'- 5') WIDELY GRADED SAND WITH GRAVEL (SW); ~80% sand, fine to coarse, ~15% gravel, ~5% fines; max. size 0.75, slight petroleum-like odor, wet, asphalt and brick fragments, hand cleared. FILL.
▽	5	S2	60/36				OLO		(5'- 7.4') WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); ~80% sand, fine to coarse, ~10% gravel, fine, ~10% fines, non plastic; slight organic-like odor, brown, FILL.
5				8056			NLO		(7.4'- 10') WIDELY GRADED SAND WITH GRAVEL (SW); ~80% sand, fine to coarse, ~15% gravel, angular, ~5% fines; max. size 0.75, moderate naphthalene-like odor, wet, wood fragments, tar-like staining, slight petroleum-like odor. FILL.
	10	S3	60/36						(10'- 15') BRICK AND CONCRETE; ~70% sand, fine to coarse, ~30% gravel; ~60% brick and concrete fragments, max. size 0.25, wet, sheen, tar-like staining and blebs. FILL.
0				> 9999					
	15	S4	60/27						(15'- 20') BRICK AND CONCRETE; ~70% sand, fine to coarse, ~30% gravel; ~60% brick and concrete fragments, max. size 0.25, wet, wood fragments, heavy tar-like staining, tar-like blebs and partial coating. FILL.
-5				> 9999				WWSB-07 (19-22)	
	20								

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

GEI Consultants, Inc.
455 Winding Brook Road
Glastonbury, CT 06033
(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 2 of 2
WW-SB-07

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	20	S5	24/24	> 9999					(20'- 22') BRICK AND CONCRETE; ~70% sand, fine to coarse, ~30% gravel; ~60% brick and concrete fragments, max. size 0.25, wet, tar-like coating with partial tar saturation. FILL.
									End of Boring at 22 feet. Refusal at 22 feet. Grouted

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GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 1 of 2
WW-SB-08

GROUND SURFACE ELEVATION (FT): 11.80 **LOCATION:** 50 Kent Ave
NORTHING (FT): 688829 **EASTING (FT):** 641958 **TOTAL DEPTH (FT):** 24.0
DRILLED BY: Zebra Environmental / Luke Caballero **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Sarah Hay **DATE START / END:** 7/15/2009 - 7/15/2009
DRILLING DETAILS: Geoprobe
WATER LEVEL DEPTHS (FT): ▽ 3.00 7/15/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	SOIL / BEDROCK DESCRIPTION
10	0	S1	60/NM	457				(0'- 3') CONCRETE; crushed concrete and asphalt, hand cleared.
▽							PLO	(3'- 5') WIDELY GRADED SAND WITH GRAVEL (SW); ~80% sand, fine to coarse, ~15% gravel, ~5% fines; max. size 1.5, slight petroleum-like odor, wet, dark gray, brick/rubber fragments, slight organic-like odor, hand cleared. FILL.
5	5	S2	60/31				NLO	(5'- 8') WIDELY GRADED SAND WITH GRAVEL (SW); ~80% sand, fine to coarse, ~15% gravel, ~5% fines; max. size 2, moderate naphthalene-like odor, wet, dark gray, brick fragments, tar-like coating. FILL.
0				3929			NLO	(8'- 10') BRICK AND CONCRETE; ~100% sand, fine to coarse; ~90% brick and concrete fragments, strong naphthalene-like odor, wet, tar-like coating. FILL.
-5	10	S3	60/34	1904			NLO	(10'- 11') WIDELY GRADED SAND WITH GRAVEL (SW); ~85% sand, fine to coarse, ~10% gravel, ~5% fines; strong naphthalene-like odor, wet, dark gray, tar-like coating. FILL.
								(11'- 13') WIDELY GRADED SAND WITH GRAVEL (SW); ~65% sand, ~30% gravel, ~5% fines; max. size 2, wet, dark gray, tar-like coating. FILL.
							NLO	(13'- 15') WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); ~70% sand, fine to coarse, ~15% gravel, ~15% fines; max. size 1, strong naphthalene-like odor, moist, light brown to gray, partial tar-like staining. FILL.
	15	S4	60/36				NLO	(15'- 17') WIDELY GRADED SAND (SW); ~85% sand, fine to coarse, ~10% gravel, ~5% fines; moderate naphthalene-like odor, dark gray to black, tar saturated. FILL.
				>9999			NLO	(17'- 20') WIDELY GRADED GRAVEL WITH SAND (GW); ~95% sand, fine to coarse, ~5% fines; ~60% gravel and concrete fragments, ~5% wood fragments, strong naphthalene-like odor, wet, tar saturated. FILL.
	20							

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

GEI Consultants, Inc.
455 Winding Brook Road
Glastonbury, CT 06033
(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG

WW-SB-08

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	SOIL / BEDROCK DESCRIPTION
-10	20	S5	48/36	9965			CrLO	(20'- 24') WIDELY GRADED SAND WITH GRAVEL (SW); ~75% sand, fine to coarse, ~20% gravel, ~5% fines; slight creosote-like odor, wet, dark gray to black, wood fragments and fuzzy paper-like material 22.5-23 feet, tar-like coating. FILL.
								End of Boring at 24 feet. Refusal at 24 feet. Grouted

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
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BORING LOG
PAGE 1 of 3
WW-SB-09

GROUND SURFACE ELEVATION (FT): 12.28 **LOCATION:** 50 Kent Ave
NORTHING (FT): 688913 **EASTING (FT):** 641906 **TOTAL DEPTH (FT):** 55.0
DRILLED BY: Boart Longyear / Fred Lavoie **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Maura MacLeod **DATE START / END:** 6/25/2009 - 7/13/2009
DRILLING DETAILS: Sonic Coring
WATER LEVEL DEPTHS (FT): ▽ 5.00 7/13/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
10	0	S1	60/NM	2.1				WWSB-09 (2-4)	(0'- 1') WIDELY GRADED SAND WITH GRAVEL (SW); ~55% sand, fine to coarse, ~40% gravel, fine to coarse, subangular, ~5% fines, non plastic; max. size 3, brown, fragments of coal, brick, and glass, hand cleared. FILL. (1'- 2') CONCRETE; FILL. (2'- 5') WIDELY GRADED SAND (SW); ~85% sand, fine to coarse, ~10% gravel, fine to coarse, subangular, ~5% fines, non plastic; max. size 1, brown, fragments of brick and coal, hand cleared. FILL.
▽ 5	5	S2	120/87	2.2			PLO		(5'- 7.3') WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); ~70% sand, fine to coarse, ~15% gravel, fine to coarse, ~10% fines, non plastic; max. size 2, slight petroleum-like odor, brown, fragments of coal and brick. FILL.
5							PLO		(7.3'- 8.4') WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); ~65% sand, fine to medium, ~20% gravel, fine to coarse, ~10% fines, non plastic; max. size 3, moderate petroleum-like odor, gray brown.
	10			1805			NLO		(8.4'- 10.5') WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); ~65% sand, fine to coarse, ~20% gravel, fine to coarse, ~10% fines, non plastic; max. size 3, strong naphthalene-like odor, gray brown, tar-like staining.
0							NLO	WWSB-09 (11-12)	(10.5'- 11.8') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; moderate naphthalene-like odor, brown gray, sheen.
							NLO		(11.8'- 15') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight naphthalene-like odor, brown gray.
	15	S3	120/87	644			NLO		(15'- 17.4') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, low plasticity; moderate naphthalene-like odor, gray.
-5							NLO		(17.4'- 18.1') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, low plasticity; moderate naphthalene-like odor, gray, sheen, tar-like staining.
							NLO		(18.1'- 19.3') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine to coarse, ~5% fines, non plastic; max. size 1.5, moderate naphthalene-like odor, gray brown, sheen,
	20								

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

GEI Consultants

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455 Winding Brook Road
Glastonbury, CT 06033
(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 2 of 3
WW-SB-09

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	20			1297			NLO		tar-like staining. (19.3'- 20.6') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine to coarse, ~5% fines, non plastic; max. size 2, slight naphthalene-like odor, brown, sheen. (20.6'- 25') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine to coarse, ~5% fines, non plastic; max. size 2, brown.
-10									
	25	S4	60/46	6.8					(25'- 30') WIDELY GRADED SAND WITH CLAY AND GRAVEL (SW-SC); ~80% sand, fine to medium, ~15% gravel, fine to coarse; max. size 1.5, gray.
-15									
	30	S5	60/12	0.1					(30'- 32.5') Bolder.
-20									(32.5'- 37.8') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to medium, ~10% fines, low plasticity; gray.
	35	S6	60/50	104					
-25									(37.8'- 40') WIDELY GRADED SAND WITH GRAVEL (SW); ~75% sand, fine to coarse, ~20% gravel, fine to coarse, ~5% fines, non plastic; max. size 2.5, brown, dense, iron oxide bands.
	40	S7	60/60	642					(40'- 45') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight naphthalene-like odor, brown.
-30				592			NLO		

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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BORING LOG

WW-SB-09

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	45	S8	120/78	3159			NLO		(45'- 47.3') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moderate naphthalene-like odor, brown.
							NLO		
-35									(47.3'- 51.4') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, brown, sheen, tar-like staining, lenses of tar-like coating.
	50			2435			NLO		
-40							NLO	WWSB-09 (53-54)	(51.4'- 54') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to medium, ~10% fines, non plastic; strong naphthalene-like odor, gray brown, sheen, tar-like staining and blebs.
									(54'- 55') SILT (ML); ~80% fines, medium plasticity, ~20% sand, fine; gray.
	55								End of Boring at 55 feet. Grouted

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BORING LOG
PAGE 1 of 3
WW-SB-10

GROUND SURFACE ELEVATION (FT): 12.02 **LOCATION:** 50 Kent Ave
NORTHING (FT): 688818 **EASTING (FT):** 641756 **TOTAL DEPTH (FT):** 55.0
DRILLED BY: Zebra Environmental / Luke Caballero **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Sarah Hay **DATE START / END:** 6/25/2009 - 7/14/2009
DRILLING DETAILS: Geoprobe
WATER LEVEL DEPTHS (FT): ▽ 6.10 7/13/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
10	0	S1	60/NM	5.6					(0'- 0.3') CONCRETE. (0.3'- 0.7') ASPHALT. (0.7'- 5') WIDELY GRADED SAND WITH GRAVEL (SW); ~70% sand, fine to coarse, ~25% gravel, fine to coarse, subangular, ~5% fines, non plastic; max. size 2, brown, coal and brick fragments, hand cleared. FILL.
5	5	S2	60/24					WWSB-10 (2-3)	(5'- 7.7') WIDELY GRADED SAND WITH GRAVEL (SW); ~80% sand, fine to coarse, ~15% gravel, ~5% fines; max. size 0.5, dry, tan, brick and shale fragments. FILL.
▽ 5				8623			NLO		(7.7'- 10') WIDELY GRADED SAND WITH GRAVEL (SW); ~80% sand, fine to coarse, ~15% gravel, ~5% fines; max. size 0.5, moderate naphthalene-like odor, wet, tan, wood fragments, tar-like staining and blebs, petroleum-like odor.
0	10	S3	60/50	3350			NLO		(10'- 11.8') WIDELY GRADED SAND WITH GRAVEL (SW); ~80% sand, fine to coarse, ~15% gravel, ~5% fines; max. size 0.5, moderate naphthalene-like odor, tan, sheen, tar-like blebs, petroleum-like odors.
							NLO		(11.8'- 15') SILTY SAND (SM); ~70% sand, fine to medium, ~30% fines, non plastic fines; moderate naphthalene-like odor, wet, brown.
-5	15	S4	60/30	426			NLO		(15'- 20') SILTY SAND (SM); ~70% sand, ~30% fines, non plastic fines; moderate naphthalene-like odor, wet, brown to gray.
	20								

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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BORING LOG
PAGE 2 of 3
WW-SB-10

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	20	S5	60/53	455			NLO		(20'- 23.5') WIDELY GRADED SAND (SW); ~94% sand, fine to medium, ~5% fines, ~1% gravel; slight naphthalene-like odor, wet, brown.
-10							NLO		(23.5'- 25') SANDY SILT (ML); ~60% fines, ~40% sand, fine to medium; slight naphthalene-like odor, dry, brown.
	25	S6	36/16	0.0			PLO		(25'- 27.4') SILTY SAND (SM); ~70% sand, fine to medium, ~30% fines, non plastic; slight petroleum-like odor, gray.
-15									(27.4'- 28') possible bolder.
		S7	24/24	0.0					(28'- 28.9') possible bolder.
									(28.9'- 29.8') SILTY SAND (SM); ~80% sand, fine to coarse, ~15% fines, non plastic, ~5% gravel, fine; max. size 0.5, brown.
	30	S8	60/0						(29.8'- 30') possible bolder. (30'- 35') no recovery, bolder plugged sampler.
-20									
	35	S9	120/120	435					(35'- 40') SILTY SAND (SM); ~80% sand, fine to coarse, ~15% fines, non plastic, ~5% gravel, fine; max. size 0.5, brown.
-25									
	40			173					(40'- 45') WIDELY GRADED SAND WITH SILT (SW-SM); ~80% sand, fine to coarse, ~10% gravel, fine, ~10% fines, non plastic; max. size 0.5, brown.
-30									

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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BORING LOG
PAGE 3 of 3
WW-SB-10

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	45	S10	120/94				NLO		(45'- 47.7') WIDELY GRADED SAND WITH SILT (SW-SM); ~80% sand, fine to coarse, ~10% gravel, fine, ~10% fines, non plastic; max. size 0.5, moderate naphthalene-like odor, brown.
-35							NLO		(47.7'- 49') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, brown, tar-like staining and coating.
				9999			NLO	WWSB-10 (49-50)	(49'- 51') SANDY SILT (ML); ~60% fines, low plasticity, ~40% sand, fine; moderate naphthalene-like odor, gray.
	50			2553			NLO	WWSB-10 (51-52)	(51'- 51.6') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; moderate naphthalene-like odor, brown.
-40							NLO		(51.6'- 55') LEAN CLAY (CL); ~90% fines, medium plasticity, ~10% sand, fine; slight naphthalene-like odor, reddish gray.
	55								End of Boring at 55 feet. Geoprobe refusal at 26' with Zebra Environmental, boring completed by Boart Longyear using sonic drilling methods. Grouted

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 1 of 3
WW-SB-11

GROUND SURFACE ELEVATION (FT): 11.12 **LOCATION:** 50 Kent Ave
NORTHING (FT): 688995 **EASTING (FT):** 641799 **TOTAL DEPTH (FT):** 65.0
DRILLED BY: Boart Longyear / Fred Lavoie **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Maura MacLeod **DATE START / END:** 6/25/2009 - 7/14/2009
DRILLING DETAILS: Sonic Coring
WATER LEVEL DEPTHS (FT): ▽ 14.00 7/14/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
10	0	S1	60/NM	1.0			WWSB-11 (1-2)	(0'- 0.3') WIDELY GRADED SAND WITH GRAVEL (SW); ~55% sand, fine to coarse, ~40% gravel, fine to coarse, ~5% fines, non plastic; max. size 3, brown, coal, brick, and glass fragments, hand cleared. FILL. (0.3'- 1') CONCRETE; FILL. (1'- 5') WIDELY GRADED SAND (SW); ~85% sand, fine to coarse, ~10% gravel, fine to coarse, subangular, ~5% fines, non plastic; max. size 1, brown, coal fragments, hand cleared. FILL.
5	5	S2	120/48	1.8				(5'- 7.9') WIDELY GRADED GRAVEL WITH SAND (GW); ~70% gravel, fine to coarse, ~25% sand, fine to coarse, ~5% fines, non plastic; max. size 3, reddish brown, FILL.
0	10			114				(7.9'- 9.4') layer of brick. FILL. (9.4'- 11') WIDELY GRADED SAND WITH SILT AND GRAVEL (SW); ~65% sand, fine to coarse, ~25% gravel, fine to coarse, ~10% fines, non plastic; max. size 2, black, wood pieces, odor possibly related to wood preservative. FILL. (11'- 13.3') CONCRETE.
▽						PLO		(13.3'- 15') WIDELY GRADED GRAVEL WITH SAND (GW); ~70% gravel, fine to coarse, ~25% sand, fine to coarse, ~5% fines, non plastic; max. size 2.5, slight petroleum-like odor, wet, gray brown.
-5	15	S3	120/83	150		NLO		(15'- 16.2') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, brown. (16.2'- 17.4') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; brown. (16.8'- 20.1') WIDELY GRADED SAND WITH SILT (SW-SM); ~80% sand, fine to medium, ~10% gravel, fine to coarse, ~10% fines, non plastic; max. size 1, gray, layer of wood fragments.
	20							

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

GEI Consultants

GEI Consultants, Inc.
455 Winding Brook Road
Glastonbury, CT 06033
(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 2 of 3
WW-SB-11

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	20			34.9				(20.1'- 21.4') WIDELY GRADED SAND WITH GRAVEL (SW); ~75% sand, fine to medium, ~20% gravel, fine to coarse, ~5% fines, non plastic; max. size 1, gray brown. (21.4'- 25') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; light brown.
-10								
	25	S4	120/101	0.9		PLO		(25'- 27.3') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight petroleum-like odor, light brown.
-15								
						PLO		(27.3'- 30.3') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight petroleum-like odor, light brown.
	30							
-20						PLO		(30.3'- 35') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine, ~5% fines, non plastic; max. size 0.5, slight petroleum-like odor.
	35	S5	120/103	2.5		PLO		(35'- 36.5') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, ~5% fines; slight petroleum-like odor, wet, orange brown.
-25								(36.5'- 39.4') WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); ~75% sand, fine to coarse, ~15% gravel, fine to medium, ~10% fines; max. size 2, gray with red, dense.
	40							(39.4'- 40.1') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, ~5% fines; wet, orange brown. (40.1'- 42.3') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines; slight naphthalene-like odor, gray brown.
-30						NLO		
				125				(42.3'- 52.2') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines; moderate naphthalene-like odor, gray brown.
						NLO		

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BORING LOG

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ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	45	S6	120/107					
-35						NLO		
	50			546			WWSB-11 (50-51)	
-40								(52.2'- 55') SANDY SILT (ML); ~70% fines, low plasticity, ~30% sand, fine; slight naphthalene-like odor, brown.
						NLO		
	55	S7	120/104	0.2				(55'- 60') SILTY SAND (SM); ~85% sand, fine to medium, ~15% fines, non plastic; gray.
-45								
	60			0.3				(60'- 63.7') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; brown.
-50							WWSB-11 (63-64)	
	65							(63.7'- 65') LEAN CLAY (CL); ~90% fines, medium plasticity, ~10% sand, fine; reddish gray.
								End of Boring at 65 feet. Grouted

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BORING LOG
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WW-SB-13

GROUND SURFACE ELEVATION (FT): 9.70 **LOCATION:** North 11th Street
NORTHING (FT): 688891 **EASTING (FT):** 641611 **TOTAL DEPTH (FT):** 45.0
DRILLED BY: Zebra Environmental / Quincy Brandt **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Maura MacLeod **DATE START / END:** 8/21/2009 - 8/24/2009
DRILLING DETAILS: Geoprobe
WATER LEVEL DEPTHS (FT): ▽ 9.10 8/24/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	0	S1	60/NM	4.2				WWSB-13 (4-5)	(0'- 0.2') ASPHALT. (0.2'- 0.8') NARROWLY GRADED SAND WITH SILT (SP-SM); ~75% sand, fine, ~15% gravel, fine, ~10% fines, non plastic; max. size 0.5, dry, olive brown, FILL. (0.8'- 5') WIDELY GRADED GRAVEL WITH SAND (GW); ~55% gravel, fine to coarse, ~40% sand, fine to coarse, ~5% fines, non plastic; max. size 1.5, moist, gray to black, asphalt, coal, brick fragments, hand cleared. FILL.
5	5	S2	60/39	765			NLO		(5'- 8.8') WIDELY GRADED SAND WITH GRAVEL (SW); ~80% sand, fine to coarse, ~15% gravel, fine, ~5% fines, non plastic; max. size 0.75, dry, brown black, coal, brick, metal-like fragments. FILL.
▽ 0							NLO		(8.8'- 9.1') WIDELY GRADED SAND WITH GRAVEL (SW); ~80% sand, fine to coarse, ~15% gravel, fine, ~5% fines, non plastic; max. size 0.75, moderate naphthalene-like odor, dry, brown black, coal, brick, metal-like fragments, slight petroleum-like odor. FILL.
	10	S3	60/45	1305				WWSB-13 (12-15)	(9.1'- 10') WIDELY GRADED SAND WITH GRAVEL (SW); ~80% sand, fine to coarse, ~15% gravel, fine, ~5% fines, non plastic; max. size 0.75, moderate naphthalene-like odor, moist, brown black, coal, brick, metal-like fragments, slight petroleum-like odor. FILL. (10'- 17.5') WIDELY GRADED GRAVEL WITH SAND (GW); ~60% gravel, fine to coarse, ~35% sand, fine to coarse, ~5% fines, non plastic; max. size 2.5, strong naphthalene-like odor, black, brick, coal, wood fragments, sheen, tar-like coating. FILL.
-5	15	S4	60/34	1021			NLO		
							NLO		(17.5'- 19.3') WIDELY GRADED SAND WITH GRAVEL (SW); ~70% sand, fine to coarse, ~25% gravel, fine, ~5% fines, non plastic; max. size 0.75, moderate naphthalene-like odor, black, coal and wood fragments, sheen, tar-like coating. FILL.
-10	20						NLO		(19.3'- 20') SANDY SILT (ML); ~60% fines, medium plasticity,

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BORING LOG
PAGE 2 of 3
WW-SB-13

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	20	S5	60/57	123			NLO		~40% sand, fine; slight naphthalene-like odor, moist, black, wood fragments. FILL.
									(20'- 21.2') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight naphthalene-like odor, wet, brown.
							NLO		(21.2'- 25') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, brown.
-15	25	S6	60/47	84.1			NLO		(25'- 28') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight naphthalene-like odor, wet, brown.
									(28'- 30') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; dry, brown, silty seams.
-20	30	S7	60/51	27.2					(30'- 30.5') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; wet, light brown, loose.
									(30.5'- 31.4') SILTY SAND (SM); ~70% sand, fine to medium, ~30% fines, low plasticity; moist, brown, dense.
									(31.4'- 35') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; wet, light brown, loose.
-25	35	S8	60/46	53.7			NLO	WWSB-13 (37-38)	(35'- 38.8') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight naphthalene-like odor, moist, light brown.
									(38.8'- 40') LEAN CLAY (CL); ~90% fines, medium plasticity, ~10% sand, fine; reddish gray.
-30	40	S9	60/60	129			NLO		(40'- 45') LEAN CLAY (CL); ~90% fines, medium plasticity, ~10% sand, fine; slight naphthalene-like odor, reddish gray.

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BORING LOG

WW-SB-13

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
-35	45						NLO		End of Boring at 45 feet. Grouted

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BORING LOG
PAGE 1 of 3
WW-SB-14

GROUND SURFACE ELEVATION (FT): 7.45 **LOCATION:** North 12th Street
NORTHING (FT): 689182 **EASTING (FT):** 641609 **TOTAL DEPTH (FT):** 45.0
DRILLED BY: Zebra Environmental / Quincy Brandt **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Maura MacLeod **DATE START / END:** 9/11/2009 - 9/14/2009
DRILLING DETAILS: Geoprobe
WATER LEVEL DEPTHS (FT): ▽ 5.00 9/11/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	0	S1	60/29					WWSB-14 (1-5)	(0'- 0.5') ASPHALT. (0.5'- 1.3') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine, ~5% fines, non plastic; max. size 0.5, dry, brown, hand cleared.
5							PLO		(1.3'- 2.5') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine, ~5% fines, non plastic; max. size 0.5, slight petroleum-like odor, moist, brown, petroleum-like staining, hand cleared.
							PLO		(2.5'- 4.2') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine, ~5% fines, non plastic; max. size 0.5, moderate petroleum-like odor, moist, brown, petroleum-like staining, hand cleared.
				213			NLO		(4.2'- 5') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine, ~5% fines, non plastic; max. size 0.5, slight naphthalene-like odor, moist, brown, petroleum-like staining, moderate petroleum-like odor, hand cleared.
▽	5	S2	60/NM						(5'- 10') no recovery.
0									
	10	S3	60/57	373			NLO	WWSB-14 (10-11)	(10'- 11.1') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, wet, brown, sheen, tar-like staining, pockets of tar-like coating.
							NLO		(11.1'- 12.1') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to medium, ~10% fines, non plastic; slight naphthalene-like odor, wet, brown, sheen.
-5							NLO		(12.1'- 13.6') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to medium, ~10% fines, non plastic; slight naphthalene-like odor, wet, brown.
							NLO		(13.6'- 14.6') SILTY SAND (SM); ~70% sand, fine to medium, ~30% fines, non plastic; slight naphthalene-like odor, moist, brown, slight burnt-like odor.
	15	S4	60/52	58.6			NLO		(14.6'- 15') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, ~5% fines, non plastic; max. size 0.5, slight naphthalene-like odor, moist, brown, slight burnt-like odor.
							PLO		(15'- 15.8') SILTY SAND (SM); ~70% sand, fine to medium, ~30% fines, non plastic; slight petroleum-like odor, moist, brown.
-10							PLO		(15.8'- 16.8') SANDY SILT (ML); ~70% fines, low plasticity, ~30% sand, fine; slight petroleum-like odor, moist, black, possible petroleum-like staining.
							NLO		(16.8'- 20') WIDELY GRADED SAND (SW); ~85% sand, fine to coarse, ~20% gravel, fine to coarse, ~5% fines, low plasticity; max. size 2.5, slight naphthalene-like odor, wet, brown.
	20								

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BORING LOG
PAGE 2 of 3
WW-SB-14

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	20	S5	60/56	40.1			PLO		(20'- 21.5') WIDELY GRADED SAND WITH SILT (SW-SM); ~85% sand, fine to coarse, ~10% fines, low plasticity, ~5% gravel, fine to coarse; max. size 1.5, slight petroleum-like odor, moist, brown, seams of gray petroleum-like staining. (21.5'- 30') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight naphthalene-like odor, reddish brown, slight burnt-like odor, color change to brown at 24.2 ft.
-15									
	25	S6	60/46	32.0			NLO		
-20									
	30	S7	60/42	8.8			NLO		(30'- 35') WIDELY GRADED SAND (SW); ~90% sand, fine to medium, ~5% gravel, fine, subrounded, ~5% fines, non plastic; max. size 0.75, slight naphthalene-like odor, wet, brown.
-25									
	35	S8	60/56	3.1			NLO		(35'- 40') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight naphthalene-like odor, wet, brown, lenses of silty sand from 36.6 to 36.7 and 27.2 to 27.3 ft.
-30									
	40	S9	60/32	1.2			NLO		(40'- 45') WIDELY GRADED SAND (SW); ~90% sand, fine to medium, ~5% gravel, fine, subangular, ~5% fines, non plastic; slight naphthalene-like odor, wet, brown, sight sweet/fruit-like odor.
-35									

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BORING LOG
PAGE 3 of 3
WW-SB-14

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	45						NLO		End of Boring at 45 feet. Refusal at 45 feet. Grouted

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GEI Consultants, Inc.
455 Winding Brook Road
Glastonbury, CT 06033
(860) 368-5300

CLIENT:	National Grid
PROJECT:	Williamsburg MGP RI
CITY/STATE:	Brooklyn, New York
GEI PROJECT NUMBER:	093060

BORING LOG

PAGE 1 of 3

WW-SB-15

GROUND SURFACE ELEVATION (FT):	7.11	LOCATION:	North 12th Street
NORTHING (FT):	689278	EASTING (FT):	641493
TOTAL DEPTH (FT):	53.0		
DRILLED BY:	Zebra Environmental / Quincy Brandt	DATUM VERT. / HORZ.:	NAVD 88 / NAD83 NY East Zone
LOGGED BY:	Amy Malsbary	DATE START / END:	9/17/2009 - 9/18/2009
DRILLING DETAILS:	Geoprobe		
WATER LEVEL DEPTHS (FT):	▽ 4.50 9/17/2009		
GENERAL NOTE:			

ELEV. FT.	DEPTH FT.	SAMPLE INFO TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
5	0	S1	60/38	1445			NLO	WWSB-15 (3-5)	(0'- 0.5') CONCRETE. (0.5'- 2.9') WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); ~45% sand, fine to coarse, ~40% gravel, fine to coarse, subangular, ~15% fines; max. size 1.5, gray brown, brick fragments, hand cleared. FILL. (2.9'- 4.6') SILTY SAND (SM); ~80% sand, fine to medium, ~15% fines, non plastic, ~5% gravel, fine, subrounded; max. size 0.5, slight naphthalene-like odor, moist, dark gray to black, hand cleared.
0	5	S2	60/18	2637			NLO	WWSB-15 (7-9)	(4.6'- 6.4') WIDELY GRADED GRAVEL WITH SAND (GW); ~70% gravel, fine to coarse, angular to subangular, ~25% sand, fine to coarse, ~5% fines, non plastic; max. size 1, moderate naphthalene-like odor, wet, dark gray, sheen, hand cleared to 5 ft. (6.4'- 8.3') WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); ~70% sand, fine to medium, ~20% gravel, fine to coarse, subangular, ~10% fines, medium plasticity; max. size 1.5, moderate naphthalene-like odor, wet, dark gray to black, sheen, tar-like staining.
-5	10	S3	60/40	2283			NLO		(8.3'- 9.4') SILTY SAND (SM); ~70% sand, fine to medium, ~30% fines, non plastic; moderate naphthalene-like odor, moist, dark gray to black, slight petroleum-like odor. (9.4'- 11.5') WIDELY GRADED GRAVEL WITH SAND (GW); ~70% gravel, angular to subangular, ~25% sand, fine to coarse, ~5% fines, non plastic; max. size 1, moderate naphthalene-like odor, wet, dark gray to black, sheen, slight tar-like staining. (11.5'- 15') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moderate naphthalene-like odor, wet, dark gray to black, lenses of silt and gravel, sheen.
-10	15	S4	60/57	837			NLO		(15'- 17.9') WIDELY GRADED SAND (SW); ~85% sand, fine to coarse, ~10% gravel, fine to coarse, rounded to subrounded, ~5% fines; max. size 0.5, moderate naphthalene-like odor, wet, gray to black, seams of silt starting at 16.6 ft.
							NLO		(17.9'- 18.4') SILT (ML); ~95% fines, non plastic, ~5% sand, fine to medium; moderate naphthalene-like odor, moist, gray.
	20						NLO		(18.4'- 20') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines; slight naphthalene-like odor, wet, gray, color change to light brown at 19.6 ft.

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

GEI Consultants

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CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
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BORING LOG
PAGE 2 of 3
WW-SB-15

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	20	S5	60/57	156					(20'- 21') WIDELY GRADED SAND (SW); ~95% sand, medium to coarse, ~5% fines, non plastic; moist, light brown, loose. (21'- 22.4') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moist, light brown, loose.
-15							NLO		(22.4'- 23.3') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to coarse, ~10% fines, non plastic; slight naphthalene-like odor, moist, light brown.
							NLO		(23.3'- 24.4') WIDELY GRADED SAND WITH SILT (SW-SM); ~80% sand, fine to coarse, ~20% fines, non plastic; slight naphthalene-like odor, moist, light brown.
	25	S6	60/36	34.0			NLO		(24.4'- 25') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, moist, light brown. (25'- 30') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, moist, light brown to gray.
-20									
	30	S7	60/42	152			NLO		(30'- 33.5') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, wet, light brown.
-25									
							NLO		(33.5'- 35') WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); ~65% sand, fine to coarse, ~25% gravel, fine to coarse, subangular to subrounded, ~10% fines; max. size 1.5, slight naphthalene-like odor, moist, light brown.
	35	S8	60/33	759			NLO		(35'- 38.3') WIDELY GRADED SAND WITH SILT (SW-SM); ~80% sand, fine to coarse, ~20% fines, non plastic; slight naphthalene-like odor, brown, dense.
-30									
									(38.3'- 40') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% gravel, fine to coarse, subangular; max. size 1, brown, loose.
	40	S9	60/39	65.5					(40'- 41.3') WIDELY GRADED SAND (SW); ~95% sand, medium to coarse, ~5% fines; moist, brown.
-35									(41.3'- 45') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines; moist, brown, lenses of silty sand.

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BORING LOG

WW-SB-15

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	45	S10	60/39	4.2					(45'- 53') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines; moist, brown.
-40									
	50	S11	36/45	11.5					
-45									
									End of Boring at 53 feet. Refusal at 53 feet. Grouted

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BORING LOG

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WW-SB-16

GROUND SURFACE ELEVATION (FT):	6.54	LOCATION:	North 12th Street
NORTHING (FT):	689339	EASTING (FT):	641416
TOTAL DEPTH (FT):	54.0		
DRILLED BY:	Zebra Environmental / Quincy Brandt	DATUM VERT. / HORZ.:	NAVD 88 / NAD83 NY East Zone
LOGGED BY:	Maura MacLeod	DATE START / END:	9/22/2009 - 9/28/2009
DRILLING DETAILS:	Geoprobe		
WATER LEVEL DEPTHS (FT):	▽ 7.50 9/17/2009		
GENERAL NOTE:			

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
5	0	S1	60/NM	490			NLO	WWSB-16 (0.5-5)	(0'- 0.6') CONCRETE. (0.6'- 5') WIDELY GRADED SAND WITH GRAVEL (SW); ~70% sand, fine to coarse, ~25% gravel, fine to coarse, subangular, ~5% fines; max. size 1, moderate naphthalene-like odor, brown to dark gray, sheen, moderate petroleum-like odor, hand cleared.
0	5	S2	60/26				NLO		(5'- 7.5') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine to coarse, ~5% fines; max. size 1.5, slight naphthalene-like odor, moist, black, black petroleum-like staining, moderate petroleum-like odor.
▽				2835			NLO		(7.5'- 10') WIDELY GRADED SAND WITH SILT (SW-SM); ~85% sand, fine to coarse, ~10% fines, non plastic, ~5% gravel, fine to coarse; max. size 1, moderate naphthalene-like odor, wet, brown, organics, black petroleum-like staining, moderate petroleum-like odor.
-5	10	S3	60/49	1161			NLO		(10'- 11.9') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine, ~5% fines, non plastic; max. size 0.75, strong naphthalene-like odor, moist, black, petroleum-like staining, moderate petroleum-like odor.
							NLO	WWSB-16 (12-13)	(11.9'- 13') WIDELY GRADED SAND WITH GRAVEL (SW); ~65% sand, fine to coarse, ~30% gravel, fine to coarse, ~5% fines, non plastic; max. size 2.5, strong naphthalene-like odor, wet, brown to gray, tar-like blebs, strong organic-like odor.
							NLO		(13'- 13.4') SILTY SAND (SM); ~70% sand, fine to medium, ~30% fines, low plasticity; slight naphthalene-like odor, moist, black, organics, tar-like staining, petroleum-like staining and moderate odor, strong spicy-like odor.
							PLO		(13.4'- 15') SILTY SAND (SM); ~70% sand, fine to medium, ~30% fines, low plasticity; moderate petroleum-like odor, moist, black, organics, petroleum-like staining, strong spicy odor.
-10	15	S4	60/60	2607			NLO		(15'- 16.4') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moderate naphthalene-like odor, wet, black.
							NLO		(16.4'- 17.4') WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); ~70% sand, fine to coarse, ~20% gravel, fine to coarse, ~10% fines, non plastic; max. size 1, moderate naphthalene-like odor, wet, black, organics, strong spicy odor.
	20						NLO		(17.4'- 21.6') SILTY SAND (SM); ~70% sand, fine to medium,

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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CLIENT: National Grid
PROJECT: Williamsburg MGP RI
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BORING LOG
PAGE 2 of 3
WW-SB-16

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
-15	20	S5	60/61	2286			NLO		~30% fines, low plasticity; moderate naphthalene-like odor, moist, black, organics, tar-like staining, moderate petroleum-like staining and odor.
							NLO		(21.6'- 21.8') SILT (ML). (21.8'- 24') WIDELY GRADED SAND WITH SILT (SW-SM); ~85% sand, fine to coarse, ~10% fines, low plasticity, ~5% gravel, fine; max. size 0.5, slight naphthalene-like odor, reddish brown, gray varves of silty sand, petroleum-like staining, slight petroleum-like odor, spicy-like odor. (24'- 24.8') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; moist, brown, slight spicy odor.
-20	25	S6	60/42	28.5			NLO		(24.8'- 25') WIDELY GRADED SAND WITH SILT (SW-SM); ~85% sand, fine to coarse, ~10% fines, ~5% gravel, fine; max. size 0.5, slight naphthalene-like odor, reddish brown, gray varves of silty sand, petroleum-like staining, slight petroleum-like odor, spicy-like odor. (25'- 27.7') WIDELY GRADED SAND (SW); ~85% sand, fine to coarse, ~10% gravel, fine to coarse, ~5% fines, non plastic; max. size 2, brown, moderate spicy odor. (27.7'- 30') SILTY SAND (SW-SM); ~70% sand, fine to coarse, ~30% fines, low plasticity; moist, light brown, dense, moderate spicy odor.
-25	30	S7	60/52	28.7					(30'- 35') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine to coarse, ~5% fines, low plasticity; max. size 1.5, moist, brown, lens of silty sand, slight spicy odor.
-30	35	S8	48/NM	7.0					(35'- 47') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine to coarse, ~5% fines, non plastic; max. size 1.5, slight naphthalene-like odor, wet, brown.
-35	40	S9	48/53				NLO		
		S10	48/56						

ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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BORING LOG

WW-SB-16

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	45			18.7			NLO		
-40		S11	48/45	545			NLO		(47'- 48.7') SILTY SAND (SM); ~70% sand, fine to coarse, ~30% fines, low plasticity; slight naphthalene-like odor, moist, brown, slight petroleum and spicy-like odor.
							NLO		(48.7'- 49.3') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to coarse, ~10% fines, non plastic; slight naphthalene-like odor, moist, brown, slight spicy-like odor.
							NLO		(49.3'- 49.8') SILTY SAND (SM); ~70% sand, fine to coarse, ~30% fines, low plasticity; slight naphthalene-like odor, moist, brown, slight spicy-like odor.
	50						NLO		(49.8'- 51') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to coarse, ~10% fines, non plastic; slight naphthalene-like odor, moist, brown, slight spicy-like odor.
-45		S12	36/48	29.3			NLO		(51'- 54') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, brown.
									End of Boring at 54 feet. Refusal at 54 feet. Grouted

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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BORING LOG
PAGE 1 of 3
WW-SB-19

GROUND SURFACE ELEVATION (FT): 16.10 **LOCATION:** 35 Kent Ave
NORTHING (FT): 688521 **EASTING (FT):** 642165 **TOTAL DEPTH (FT):** 55.0
DRILLED BY: Boart Longyear / Fred Lavoie **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Maura MacLeod **DATE START / END:** 7/28/2009 - 7/30/2009
DRILLING DETAILS: Sonic Coring
WATER LEVEL DEPTHS (FT): ▽ 15.00 7/13/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
15	0	S1	60/NM						(0'- 0.7') CONCRETE.
								WWSB-19 (2-3)	(0.7'- 5') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine, ~5% fines, non plastic; max. size 0.5, brown, brick and coal fragments, hand cleared. FILL.
				23.5				WWSB-19 (4-5)	
10	5	S2	120/50						(5'- 10') rock in sample casing, no recovery.
5	10								(10'- 13') CONCRETE; ~95% sand, fine to coarse, ~5% fines; ~70% concrete fragments, max. size 3, light gray, loose, concrete-like odor. FILL.
				119			PLO	WWSB-19 (14-15)	(13'- 15') SILTY SAND (SM); ~75% sand, fine to coarse, ~15% fines, ~10% gravel, fine to coarse, angular; max. size 1, slight petroleum-like odor, moist, brown to grayish brown, brick and concrete fragments, lenses of silt. FILL.
▽ 0	15	S3	120/106				PLO		(15'- 16.3') WIDELY GRADED GRAVEL WITH SAND (GW); ~60% gravel, fine to coarse, ~35% sand, fine to coarse, ~5% fines, non plastic; max. size 3, moderate petroleum-like odor, wet, brown, loose, slight sheen.
							PLO		(16.3'- 18') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moderate petroleum-like odor, wet, brown, slight sheen.
							PLO		(18'- 19.6') SILTY SAND WITH GRAVEL (SM); ~65% sand, fine to medium, ~20% fines, non plastic, ~15% gravel, fine to coarse; max. size 2.5, moderate petroleum-like odor, brown.
	20						PLO		(19.6'- 20.6') WIDELY GRADED SAND (SW); ~95% sand, fine to

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BORING LOG

WW-SB-19

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	20			457			PLO		coarse, ~5% fines, non plastic; moderate petroleum-like odor, wet, brown, slight sheen.
-5									(20.6'- 25') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moderate petroleum-like odor, wet, brown.
							PLO		
	25	S4	120/105	171				WWSB-19 (25-35)	(25'- 27') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines; moderate naphthalene-like odor, wet, grayish brown, moderate petroleum-like odor.
-10							NLO		
							NLO		(27'- 28.5') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines; moderate naphthalene-like odor, wet, grayish brown, petroleum-like staining, moderate petroleum-like odor.
									(28.5'- 30.7') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines; wet, brown.
	30								
-15									(30.7'- 33.7') NARROWLY GRADED SAND (SP); ~95% sand, fine to medium, ~5% fines; wet, brown to orange brown.
									(33.7'- 35') SILTY SAND (SM); ~70% sand, fine, ~30% fines; reddish brown.
	35	S5	120/116	2.3					(35'- 36.9') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines; slight petroleum-like odor, brown, loose.
-20							PLO		
							PLO		(36.9'- 37.8') SILTY SAND (SM); ~85% sand, fine to medium, ~15% fines; slight petroleum-like odor, reddish brown.
							PLO		(37.8'- 38.6') SILTY SAND (SM); ~70% sand, fine, ~30% fines; slight petroleum-like odor, reddish brown, dense.
	40								(38.6'- 45') SANDY SILT (ML); ~70% fines, ~30% sand, fine; gray brown, very dense.
-25									

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FT. = FEET

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

GEI Consultants

GEI Consultants, Inc.
455 Winding Brook Road
Glastonbury, CT 06033
(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG

WW-SB-19

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	45	S6	120/64						(45'- 48.8') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines; brown, loose.
-30								WWSB-19 (47-50)	
	50			6.0					(48.8'- 55') LEAN CLAY (CL); red, dense.
-35									
	55								End of Boring at 55 feet. Grouted

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BORING LOG
PAGE 1 of 3
WW-SB-20

GROUND SURFACE ELEVATION (FT): 15.94 **LOCATION:** 35 Kent Ave
NORTHING (FT): 688605 **EASTING (FT):** 642141 **TOTAL DEPTH (FT):** 65.0
DRILLED BY: Boart Longyear / Fred Lavoie **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Maura MacLeod **DATE START / END:** 6/29/2009 - 7/21/2009
DRILLING DETAILS: Sonic Coring
WATER LEVEL DEPTHS (FT): ▽ 10.00 7/15/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
15	0	S1	60/NM	0.4				WWSB-20 (3-5)	(0'- 0.5') CONCRETE. (0.5'- 10') WIDELY GRADED SAND (SW); ~85% sand, fine to coarse, ~10% gravel, fine, ~5% fines, non plastic; max. size 0.5, reddish brown, brick fragments, possible ground brick, hand cleared to 5 feet. FILL.
10	5	S2	60/26	0.3					
5	10	S3	60/20	32.8					(10'- 11.5') LEAN CLAY (CL); ~70% fines, medium plasticity, ~30% sand, fine to medium; gray, FILL. (11.5'- 15') BRICK; brick fragments. FILL.
0	15	S4	120/76	21.6			NLO		(15'- 18.7') WIDELY GRADED GRAVEL WITH SAND (GW); ~70% gravel, fine to coarse, ~25% sand, fine to coarse, ~5% fines, non plastic; max. size 3, slight naphthalene-like odor, gray, red portions from brick. FILL.
							NLO		(18.7'- 19.7') WIDELY GRADED SAND WITH GRAVEL (SW); ~75% sand, fine to coarse, ~20% gravel, fine to coarse, ~5% fines, non plastic; max. size 1, strong naphthalene-like odor,
	20								

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CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG

WW-SB-20

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	20			825			NLO		brown.
-5							NLO		(19.7'- 21.6') SILTY SAND (SM); ~75% sand, fine to coarse, ~15% fines, non plastic, ~10% gravel, fine; max. size 0.5, slight naphthalene-like odor, brown, very dense.
							NLO		(21.6'- 23.2') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moderate naphthalene-like odor, brown, moderate burnt-like odor.
				377			NLO		(23.2'- 25') WIDELY GRADED SAND WITH SILT (SW-SM); ~80% sand, fine to coarse, ~10% gravel, fine, ~10% fines, non plastic; max. size 0.75, slight naphthalene-like odor, gray brown, slight burnt-like odor.
	25	S5	120/112	347			PLO		(25'- 26.3') WIDELY GRADED GRAVEL WITH SAND (GW); ~60% gravel, fine to coarse, ~35% sand, fine to coarse, ~5% fines, non plastic; max. size 2, slight petroleum-like odor, gray brown.
-10									(26.3'- 26.9') SILTY SAND (SP); ~85% sand, fine to medium, ~15% fines, non plastic; gray, moderate burnt rubber-like odor.
									(26.9'- 28.1') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; gray, moderate burnt-like odor.
									(28.1'- 33.2') SILTY SAND (SP); ~85% sand, fine to medium, ~15% fines, non plastic; gray, moderate burnt-like odor.
	30			313					
-15									
									(33.2'- 33.8') Possible bolder.
									(33.8'- 35') SILTY SAND (SP); ~85% sand, fine to medium, ~15% fines, non plastic; gray, moderate burnt rubber-like odor.
	35	S6	120/56						(35'- 45') WIDELY GRADED SAND WITH SILT (SW-SM); ~85% sand, fine to coarse, ~10% fines, ~5% gravel; max. size 0.5, slight naphthalene-like odor, moist, brown, very dense.
-20				58			NLO		
	40								
-25									
				1805					

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BORING LOG
PAGE 3 of 3
WW-SB-20

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	45	S7	120/42				NLO		(45'- 52.6') WIDELY GRADED SAND (SW); ~100% sand, fine to medium; moderate naphthalene-like odor, wet, brown, loose.
-30							NLO		
	50								
-35									
							NLO		(52.6'- 55') WIDELY GRADED SAND WITH GRAVEL (SW); ~85% sand, fine to coarse, ~15% gravel; ~5% cobbles, max. size 1, strong naphthalene-like odor, wet, brown, loose.
	55	S8	120/89	2885				WWSB-20 (55-57)	
-40							NLO		(55'- 58') WIDELY GRADED SAND (SW); ~100% sand, medium to coarse; strong naphthalene-like odor, brown, very loose, tar-like staining and partial coating.
							NLO		(58'- 59.4') WIDELY GRADED SAND (SW); ~100% sand, medium to coarse; strong naphthalene-like odor, brown, very loose.
							NLO		(59.4'- 59.8') WIDELY GRADED SAND (SW); ~100% sand, fine to medium; moderate naphthalene-like odor, moist, brown.
	60							WWSB-20 (62-63)	(59.8'- 63.1') SANDY SILT (ML); ~75% fines, ~25% sand, fine; slight naphthalene-like odor, brown gray, occasional sandy pockets.
-45							NLO		
							SLO		(63.1'- 64') WIDELY GRADED SAND (SW); ~100% sand, fine to medium; slight sulfur-like odor.
	65								(64'- 65') LEAN CLAY (CL); ~100% fines; red, very dense.
									End of Boring at 65 feet. Geoprobe refusal at 10' with Zebra Environmental, boring completed by Boart Longyear using sonic drilling methods. Grouted

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BORING LOG
PAGE 1 of 4
WW-SB-21

GROUND SURFACE ELEVATION (FT): 12.24 **LOCATION:** 35 Kent Ave
NORTHING (FT): 688662 **EASTING (FT):** 642188 **TOTAL DEPTH (FT):** 78.0
DRILLED BY: Boart Longyear / Fred Lavoie **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Sarah Hay **DATE START / END:** 7/1/2009 - 7/23/2009
DRILLING DETAILS: Sonic Coring
WATER LEVEL DEPTHS (FT): ▽ 9.00 7/1/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	0	S1	60/NM	0.4			OLO	WWSB-21 (1-2)	(0'- 0.67') CONCRETE. (0.67'- 5') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moderate organic-like odor, reddish brown, brick fragments, hand cleared. FILL.
10									
	5	S2	60/28	5.2			PLO		(5'- 7') WIDELY GRADED SAND (SW); ~85% sand, fine to coarse, ~10% gravel, fine to coarse, ~5% fines, non plastic; max. size 2, light brown and dark brown, brick fragments. FILL. (7'- 7.8') layer of brick from 7 to 7.3 ft, layer of organics with roots from 7.3 to 7.8 ft. FILL. (7.8'- 9.2') WIDELY GRADED SAND (SW); ~85% sand, fine to coarse, ~10% gravel, fine to coarse, ~5% fines, non plastic; max. size 2, light brown, brick fragments, layer of brick from 8.5 to 9 ft. FILL.
5									
▽									
	10	S3	120/72	21.0			NLO		(9.2'- 10') WIDELY GRADED SAND (SW); ~85% sand, fine to coarse, ~10% gravel, fine to coarse, ~5% fines, non plastic; max. size 2, slight petroleum-like odor, wet, light brown, brick fragments. FILL. (10'- 14.4') BRICK AND CONCRETE; ~95% sand, fine to coarse, ~5% fines; ~75% crushed brick and concrete, moderate naphthalene-like odor, wet, brown to brownish black, coal ash, and wood fragments. FILL.
0									
	15						NLO		(14.4'- 17.4') WIDELY GRADED SAND WITH GRAVEL (SW); ~55% sand, fine to coarse, ~40% gravel, ~5% fines; strong naphthalene-like odor, moist, light brown, wood fragments, sheen. FILL.
-5				2538					
	20						NLO		(17.4'- 20') WIDELY GRADED SAND (SW); ~80% sand, fine to medium, ~15% gravel, ~5% fines; ~15% brick and concrete fragments, strong naphthalene-like odor, moist, brown, orange lenses, sheen, 5 inch concrete fragment in sample tip. FILL.

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BORING LOG
PAGE 2 of 4
WW-SB-21

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	20	S4	60/24	228					(20'- 25') SILTY SAND (SM); ~80% sand, fine to medium, ~20% fines; moist, gray to grayish brown, dense.
-10									
	25	S5	60/60	149					(25'- 27.7') SANDY SILT (ML); ~70% fines, ~25% sand, fine to coarse, ~5% gravel, fine to coarse, angular to well rounded; max. size 2, moist, dark gray, dense, red sandstone particles from 27.3 to 27.7 ft.
-15									(27.7'- 30') WIDELY GRADED SAND WITH SILT (SW-SM); ~65% sand, fine to coarse, ~25% gravel, fine to coarse, angular to subrounded, ~10% fines; max. size 1.5, moist, dark gray, red sandstone.
	30	S6	120/104	2114			NLO	WWSB-21 (33-34)	(30'- 33.2') WIDELY GRADED SAND (SW); ~100% sand, fine to coarse; slight naphthalene-like odor, moist, brown, loose.
-20									(33.2'- 35.4') WIDELY GRADED SAND (SW); ~100% sand, fine to coarse; strong naphthalene-like odor, moist, brown, loose, tar-like staining and blebs.
	35						NLO		(35.4'- 40') WIDELY GRADED SAND (SW); ~100% sand, fine to coarse; moderate naphthalene-like odor, moist, brown, loose.
-25							NLO		
	40	S7	120/96	799			NLO		(40'- 43.3') WIDELY GRADED SAND (SW); ~100% sand, fine to coarse; strong naphthalene-like odor, moist, dark brown, loose, moderate tar-like staining.
-30							NLO		(43.3'- 44.8') WIDELY GRADED SAND (SW); ~100% sand, fine to coarse; slight naphthalene-like odor, moist, brown, loose.

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BORING LOG
PAGE 3 of 4
WW-SB-21

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	45								(44.8'- 46.1') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine, rounded, ~5% fines; brown, loose, silty pockets approximately 0.5 inch deposits. (46.1'- 50') WIDELY GRADED SAND (SW); ~100% sand, medium to coarse; brown.
-35									
	50	S8	60/48	14.6					(50'- 55') WIDELY GRADED SAND (SW); ~95% sand, medium to coarse, ~5% gravel, fine to coarse, subrounded; max. size 1, moist, brown, loose.
-40									
	55	S9	60/60	8.5					(55'- 60') WIDELY GRADED SAND (SW); ~99% sand, medium to coarse, ~1% gravel; brown, loose, trace gravel.
-45									
	60	S10	96/123	0.0			SLO		(60'- 63.7') SANDY SILT (ML); ~80% fines, ~20% sand, fine; slight sulfur-like odor, moist, gray.
-50									
	65								(63.7'- 68') WIDELY GRADED SAND (SW); ~99% sand, fine to coarse, ~1% fines; brown, loose, pockets of silt, trace red fines.
-55									
		S11	120/113				SLO	WWSB-21 (68-69)	(68'- 69.6') WIDELY GRADED SAND (SW); ~100% sand, fine to coarse; slight sulfur-like odor, brown, loose.

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BORING LOG

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WW-SB-21

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	70						SLO		(69.6'- 73.1') LEAN CLAY (CL); ~100% fines; red and brown gray, dense.
-60				1.5					(73.1'- 78') SANDY SILT (ML); ~80% fines, ~20% sand, fine; moist, gray.
	75								
-65									

End of Boring at 78 feet.
Geoprobe refusal at 10' with Zebra Environmental, boring completed by Boart Longyear using sonic drilling methods.
Grouted

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BORING LOG
PAGE 1 of 4
WW-SB-22

GROUND SURFACE ELEVATION (FT): 16.04 **LOCATION:** 35 Kent Ave
NORTHING (FT): 688642 **EASTING (FT):** 642078 **TOTAL DEPTH (FT):** 70.0
DRILLED BY: Boart Longyear / Fred Lavoie **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Maura MacLeod **DATE START / END:** 6/29/2009 - 7/27/2009
DRILLING DETAILS: Sonic Coring
WATER LEVEL DEPTHS (FT): ▽ 10.50 7/1/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
15	0	S1	60/NM	1.2			NLO	WWSB-22 (3-4)	(0'- 0.67') CONCRETE. (0.67'- 5') WIDELY GRADED SAND WITH GRAVEL (SW); ~75% sand, fine to coarse, ~20% gravel, fine to coarse, ~5% fines, non plastic; max. size 0.75, slight naphthalene-like odor, brown, coal fragments, hand cleared.
10	5	S2	60/46	1.0					(5'- 10') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine, subangular, ~5% fines, non plastic; max. size 0.5, brown.
5 ▽	10	S3	60/48	61.9					(10'- 12.8') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine, subangular, ~5% fines, non plastic; brown, moist from 10.5 to 15 ft, gravel layer from 12.6 to 12.8 ft.
							PLO	WWSB-22 (13-15)	(12.8'- 15') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine, subangular, ~5% fines, non plastic; slight petroleum-like odor, brown, black staining.
0	15	S4	60/60	6.0			PLO		(15'- 20') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine, subangular, ~5% fines, non plastic; slight petroleum-like odor, brown, wet from 15 to 16.7 ft, moist from 16.7 to 20 ft.
	20								

NOTES:

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S_V = TORVANE PEAK

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IN. = INCHES
FT. = FEET

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TLO = TAR LIKE ODOR
CLO = CHEMICAL LIKE ODOR
ALO = ASPHALT LIKE ODOR

CrLO= CREOSOTE LIKE ODOR
OLO = ORGANIC LIKE ODOR
SLO = SULFUR LIKE ODOR
MLO = MUSTY LIKE ODOR

ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

GEI Consultants

GEI Consultants, Inc.
455 Winding Brook Road
Glastonbury, CT 06033
(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 2 of 4
WW-SB-22

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
-5	20	S5	60/51	20.6			PLO		(20'- 25') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight petroleum-like odor, brown.
-10	25	S6	60/48	18.6			NLO		(25'- 30') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight naphthalene-like odor, brown, slight petroleum-like odor.
-15	30	S7	60/52	24.0			PLO		(30'- 31.3') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight petroleum-like odor, brown.
							NLO		(31.3'- 35') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, brown, slight petroleum-like odor.
-20	35	S8	120/114	>9999			NLO	WWSB-22 (37-38)	(35'- 36.4') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% gravel; max. size 3, strong naphthalene-like odor, brown, loose, tar-like staining.
							NLO		(36.4'- 38.1') SILT WITH SAND (ML); ~80% fines, ~20% sand, fine to coarse; moderate naphthalene-like odor, brown, dense.
-25	40						NLO		(38.1'- 42.2') WIDELY GRADED SAND (SW); ~100% sand, fine to coarse; strong naphthalene-like odor, brown, loose, lenses of tar-like staining.
							OLO		(42.2'- 45') SILT WITH SAND (ML); ~90% fines, ~10% sand, fine to medium; strong organic-like odor, dry, dark brown, very dense.

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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455 Winding Brook Road
Glastonbury, CT 06033
(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG

WW-SB-22

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	45						OLO		
		S9	120/97	15.5					(45'- 48.4') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, brown, moderate cement-like odor.
-30							NLO		
									(48.4'- 55') SILTY SAND (SM); ~80% sand, fine, ~20% fines, non plastic; slight organic-like odor, brown.
	50								
-35							OLO		
	55	S10	120/104						(55'- 56.9') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight naphthalene-like odor, brown.
-40							NLO		
				76.3					(56.9'- 60.6') SANDY SILT (ML); ~60% fines, low plasticity, ~40% sand, fine; slight naphthalene-like odor, brown.
							NLO		
	60								
-45									(60.6'- 65') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight petroleum-like odor, brown.
							PLO		
	65	S11	60/49	9.2				WWSB-22 (65-65.5)	(65'- 65.6') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; brown.
-50									(65.6'- 70') LEAN CLAY (CL); ~95% fines, medium plasticity, ~5% sand, fine; reddish gray.

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BORING LOG
PAGE 4 of 4
WW-SB-22

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	70								End of Boring at 70 feet. Geoprobe refusal at 35 ft with Zebra Environmental, boring completed by Boart Longyear using sonic drilling methods. Grouted

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CLIENT: National Grid
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BORING LOG
PAGE 1 of 3
WW-SB-23

GROUND SURFACE ELEVATION (FT): 12.10 **LOCATION:** 50 Kent Ave
NORTHING (FT): 688787 **EASTING (FT):** 641842 **TOTAL DEPTH (FT):** 65.0
DRILLED BY: Boart Longyear / Fred Lavoie **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Sarah Hay **DATE START / END:** 7/16/2009 - 7/17/2009
DRILLING DETAILS: Sonic Coring
WATER LEVEL DEPTHS (FT):
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
10	0	S1	54/48	188			PLO	WWSB-23 (1-4)	(0'- 0.7') CONCRETE. (0.7'- 4.5') WIDELY GRADED SAND WITH SILT (SW-SM); ~70% sand, fine to coarse, ~20% gravel, ~10% fines; ~5% brick and wood fragments, max. size 2, slight petroleum-like odor, light brown and brown, hand cleared. FILL.
5	5	S2	120/64	1081			PLO		(4.5'- 5') Rock. (5'- 7.5') WIDELY GRADED SAND WITH SILT (SW-SM); ~80% sand, fine to coarse, ~15% fines, ~5% gravel, subangular; max. size 0.5, strong petroleum-like odor, asphalt fragments. FILL.
0	10						NLO		(7.5'- 13.1') SILTY SAND (SM); ~75% sand, fine to medium, ~20% fines, ~5% gravel, subrounded; max. size 0.5, strong naphthalene-like odor, brown to dark gray, slight petroleum-like odor.
-5	15	S3	120/35	1076			NLO		(13.1'- 23.6') SILTY SAND (SM); ~75% sand, fine to medium, ~20% fines, ~5% gravel, subrounded; max. size 0.5, strong naphthalene-like odor, brown to dark gray, lenses of tar-like staining and blebs, slight petroleum-like odor.
	20								

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 2 of 3
WW-SB-23

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
-10	20						NLO		
	25	S4	120/103				NLO		(23.6'- 25') SANDY SILT (ML); ~60% fines, ~40% sand, medium to coarse; dark gray, burnt-like odor. (25'- 27.9') SILTY SAND (SM); ~65% sand, fine to medium, ~35% fines; strong naphthalene-like odor, moist, blue and gray, tar-like blebs.
-15							NLO		(27.9'- 29.3') SILTY SAND (SM); ~85% sand, fine to coarse, ~15% fines; strong naphthalene-like odor, moist, brown to gray, tar-like coating.
	30						NLO		(29.3'- 30.3') SILTY SAND (SM); ~80% sand, fine to medium, ~20% fines; strong naphthalene-like odor, tar-like staining, partial tar-like coating.
-20				452			NLO	WWSB-23 (31-33)	(30.3'- 33.6') WIDELY GRADED SAND (SW); ~100% sand, fine to coarse; strong naphthalene-like odor, brown, tar-like coating, partially tar saturated.
							NLO		(33.6'- 35') WIDELY GRADED SAND (SW); ~100% sand, fine to coarse; strong naphthalene-like odor, brown, tar-like stained.
-25	35	S5	180/150	9259			NLO		(35'- 38.8') SILTY SANDWELL GRADED GRAVEL WITH SANDSILTY SAND (SM); ~84% sand, fine, ~15% fines, ~1% gravel; strong naphthalene-like odor, moist, gray, dense, tar saturated seams.
									(38.8'- 39.5') WIDELY GRADED GRAVEL WITH SAND (GW); ~70% gravel, coarse, ~30% sand, fine to coarse; max. size 5, tar saturated.
	40								(39.5'- 44.5') SILTY SAND (SM); ~84% sand, fine, ~15% fines, ~1% gravel; strong naphthalene-like odor, moist, gray, dense, tar saturated seams.
-30							NLO		

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GEI Consultants

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Glastonbury, CT 06033
(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 3 of 3
WW-SB-23

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	45								(44.5'- 48.2') WIDELY GRADED SAND (SW); ~100% sand; gray, tar-like coating, lenses of tar-like saturation.
-35									
							NLO		(48.2'- 50') SILTY SANDWELL GRADED GRAVEL WITH SANDSILTY SAND (SM); ~84% sand, fine, ~15% fines, ~1% gravel; strong naphthalene-like odor, moist, gray, dense, tar saturated seams.
	50	S6	180/130						(50'- 54.8') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines; moderate naphthalene-like odor, brown, tar saturated lenses.
-40							NLO		
	55								(54.8'- 59.5') SILTY SAND (SW-SM); ~85% sand, fine to coarse, ~15% fines; strong naphthalene-like odor, lens of sand from 59.2 to 59.7 ft.
-45				>9999			NLO		
	60						NLO		(59.5'- 60.4') WIDELY GRADED SAND (SW); ~100% sand, medium to coarse; strong naphthalene-like odor, wet, brown, sheen.
-50							OLO	WWSB-23 (62-63)	(60.4'- 65') LEAN CLAY (CL); ~95% fines, ~5% sand; moderate organic-like odor, wet, red, dense, sand pocket at 61 ft.
	65								End of Boring at 65 feet. Grouted

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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Glastonbury, CT 06033
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CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 1 of 3
WW-SB-24

GROUND SURFACE ELEVATION (FT): 12.30 **LOCATION:** 50 Kent Ave
NORTHING (FT): 688884 **EASTING (FT):** 641934 **TOTAL DEPTH (FT):** 55.0
DRILLED BY: Boart Longyear / Fred Lavoie **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Sarah Hay **DATE START / END:** 7/16/2009 - 7/16/2009
DRILLING DETAILS: Sonic Coring
WATER LEVEL DEPTHS (FT): ▽ 5.00 7/16/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
10	0	S1	60/NM	5.5			PLO	WWSB-24 (4-5)	(0'- 0.5') CONCRETE. (0.5'- 5') WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); ~75% sand, fine to coarse, ~15% gravel, angular, ~10% fines, non plastic; max. size 2, slight petroleum-like odor, moist, brown, slight organic-like odor, hand cleared. FILL.
5 ▽	5	S2	120/78						(5'- 7.6') WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); ~75% sand, fine to coarse, ~15% gravel, angular to rounded, ~10% fines, non plastic; max. size 2, wet, dark gray, asphalt and brick fragments. FILL.
5	10						NLO		(7.6'- 12.1') SILTY SAND (SM); ~70% sand, fine to medium, ~25% fines, ~5% gravel, subangular; slight naphthalene-like odor, dark gray to brown, lenses of sand with petroleum-like odor.
0	15			8959			NLO		(12.1'- 15') SILTY SAND (SM); ~70% sand, fine to medium, ~25% fines, ~5% gravel, subangular; moderate naphthalene-like odor, brown, light tar-like staining, trace tar-like blebs.
-5	20	S3	120/96	6418			NLO		(15'- 16.7') WIDELY GRADED SAND (SW); ~90% sand, fine to medium, ~5% gravel, rounded, ~5% fines; max. size 0.25, strong naphthalene-like odor, dark gray, shells, tar-like staining, tar-like seam. (16.7'- 20.2') WIDELY GRADED SAND WITH SILT (SW-SM); ~80% sand, fine to coarse, ~10% gravel, angular to rounded, ~10% fines; max. size 2.5, light brown to dark brown, tar-like staining and blebs.

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

GEI Consultants, Inc.
455 Winding Brook Road
Glastonbury, CT 06033
(860) 368-5300

CLIENT:	National Grid
PROJECT:	Williamsburg MGP RI
CITY/STATE:	Brooklyn, New York
GEI PROJECT NUMBER:	093060

BORING LOG

WW-SB-24

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	20						NLO		(20.2'- 21.8') SILTY SAND (SM); ~85% sand, fine to medium, ~15% fines; moderate naphthalene-like odor, light brown, sheen.
-10				1326					(21.8'- 25') SANDY SILT (ML); ~60% fines, ~35% sand, fine to medium, ~5% gravel; moist, light brown to orange, dense.
	25	S4	120/60						(25'- 35') SANDY SILT (ML); ~60% fines, ~35% sand, fine to medium, ~5% gravel; slight naphthalene-like odor, moist, light brown to orange, very dense, likely marine deposited.
-15									
	30						NLO		
-20									
	35	S5	120/120						(35'- 36.5') WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); ~75% sand, fine to coarse, ~15% gravel, subrounded, ~10% fines; max. size 1, wet, brown, shale fragments, dense.
-25				>9999				WWSB-24 (38-40)	(36.5'- 37.7') WIDELY GRADED SAND (SW); ~90% sand, fine to medium, ~5% gravel, subrounded, ~5% fines, non plastic; max. size 1, tar-like staining and blebs. (37.7'- 39.5') WIDELY GRADED SAND (SW); ~90% sand, fine to medium, ~5% gravel, subrounded, ~5% fines, non plastic; max. size 1, tar saturated.
	40								(39.5'- 40.3') WIDELY GRADED SAND (SW); ~90% sand, fine to medium, ~5% gravel, subrounded, ~5% fines, non plastic; max. size 1, tar-like staining. (40.3'- 42') SANDY ELASTIC SILT (ML); ~70% fines, ~30% sand, fine; slight naphthalene-like odor, gray, dense.
							NLO		
-30									(42'- 47.7') SANDY SILT (ML); ~70% fines, ~30% sand, fine to medium; moist, gray, occasional sand lenses, slight burnt-like odor.

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Q_P = POCKET PENETROMETER
S_V = TORVANE PEAK

ppm = PARTS PER MILLION
IN. = INCHES
FT. = FEET

NLO = NAPHTHALENE LIKE ODOR
PLO = PETROLEUM LIKE ODOR
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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

GEI Consultants

GEI Consultants, Inc.
455 Winding Brook Road
Glastonbury, CT 06033
(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG

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WW-SB-24

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	45	S6	120/110						
-35				31.8			NLO		(47.7'- 53.4') WIDELY GRADED SAND WITH SILT (SW-SM); ~80% sand, fine to coarse, ~10% gravel, subangular, ~10% fines; moderate naphthalene-like odor, wet, brown, moderate organic-like odor.
	50								
-40								WWSB-24 (53-55)	(53.4'- 55') LEAN CLAY (CL); ~95% fines, ~5% sand; red, very small sand lenses.
	55								End of Boring at 55 feet. Grouted

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BORING LOG
PAGE 1 of 5
WW-SB-37

GROUND SURFACE ELEVATION (FT): 12.96 **LOCATION:** 50 Kent Ave
NORTHING (FT): 688768 **EASTING (FT):** 642054 **TOTAL DEPTH (FT):** 97.0
DRILLED BY: Boart Longyear / Craig Marsh **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Amy Malsbary **DATE START / END:** 12/28/2009 - 12/28/2009
DRILLING DETAILS: Sonic Coring
WATER LEVEL DEPTHS (FT):
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	0	S1	84/NM						(0.5'- 7') WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); ~70% sand, fine to coarse, ~20% gravel, fine to coarse, ~10% fines, non plastic; ~20% concrete fragments, max. size 1.5, dry, dark brown, hand cleared to 5 ft. FILL.
10									
	5								
		S2	120/78						(7'- 10.1') CONCRETE.
5									
	10			127			NLO		(10.1'- 12') SILTY SAND WITH GRAVEL (SM); ~65% sand, fine to coarse, ~20% fines, non plastic, ~15% gravel, fine to coarse, subangular to subrounded; max. size 4, moderate naphthalene-like odor, brown, sheen, lenses and seams of black staining.
0							NLO		(12'- 13.5') SILTY SAND WITH GRAVEL (SM); ~65% sand, fine to coarse, ~20% fines, non plastic, ~15% gravel, fine to coarse, subangular to subrounded; max. size 4, strong naphthalene-like odor, dark gray and black, sheen, lenses and seams of black staining, slight tar-like staining.
							NLO		(13.5'- 13.9') SILTY SAND (SM); ~75% sand, fine to coarse, ~15% fines, non plastic, ~10% gravel, fine to coarse; max. size 2.5, slight naphthalene-like odor, moist, light brown, sheen.
	15						NLO		(13.9'- 17') SILTY SAND (SM); ~75% sand, fine to coarse, ~15% fines, non plastic, ~10% gravel, fine to coarse; max. size 2.5, slight naphthalene-like odor, moist, light brown.
				46.2					
		S3	60/96						(17'- 17.6') COBBLE.
-5									(17.6'- 20.1') SILTY SAND (SM); ~80% sand, fine to coarse, ~15% fines, non plastic, ~5% gravel, fine to coarse, subangular to subrounded; max. size 1.5, moist, light reddish brown.
	20			239					

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BORING LOG
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WW-SB-37

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	20								(20.1'- 24.5') NARROWLY GRADED SAND (SP); ~100% sand, fine; slight naphthalene-like odor, dry, light gray, color change at 22 feet to light brownish gray, powder-like, cobble from 21.1 to 21.4 feet.
-10		S4	60/84	241			NLO		
	25								(24.5'- 26.3') COBBLE; black, light gray specks.
		S5	120/132				NLO		(26.3'- 27') WIDELY GRADED GRAVEL WITH SILT AND SAND (GW-GM); ~60% gravel, fine to coarse, ~30% sand, fine to coarse, ~10% fines, non plastic; max. size 4, reddish brown. (27'- 28.4') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, moist, brown, loose. (28.4'- 31.1') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, moist, brown, loose, tar-like staining and coating.
-15				3487			NLO		
	30						NLO		(31.1'- 32') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, moist, brown, loose, 3 inch lens of dense fine sand at 32 feet. (32'- 32.9') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, moist, brown, loose, sheen, tar-like staining and coating. (32.9'- 37') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moderate naphthalene-like odor, moist, brown, loose.
-20							NLO		
	35			148					
		S6	120/132						(37'- 41.5') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moist, brown, loose.
-25									
	40			11.1					
									(41.5'- 42.2') WIDELY GRADED SAND (SW); ~95% sand, medium to coarse, ~5% fines, non plastic; moist, orangish brown, loose. (42.2'- 45.2') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moist, brown, loose.
-30									

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BORING LOG
PAGE 3 of 5
WW-SB-37

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	45			6.3					(45.2'- 45.6') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; moist, brown. (45.6'- 49') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moist, brown, loose.
-35		S7	120/180						
	50			9.8					(49'- 50.2') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; moist, brown. (50.2'- 50.7') SILTY SAND (SM); ~80% sand, fine to medium, ~20% fines, non plastic; moist, brown. (50.7'- 57') SILT WITH SAND (ML); ~80% fines, low plasticity, ~20% sand, fine to medium; moist, brown, dense, 4 inch sand lens at 52.3 feet.
-40				105					
	55								
		S8	120/156						(57'- 59.7') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; moist, brown.
-45									
	60			3.2					(59.7'- 67') LEAN CLAY (CL); ~90% fines, medium plasticity, ~10% sand, fine; red with gray, color change to gray at 64.3 feet, very dense.
-50									
	65			2.4					
		S9	120/144						(67'- 72') LEAN CLAY (CL); ~90% fines, medium plasticity, ~10% sand, fine; olive brown, color change to gray at 71.2 feet, very dense.
-55				2.1					

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BORING LOG
PAGE 4 of 5
WW-SB-37

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	70								
-60				1.6					(72'- 74.5') SILT WITH SAND (ML); ~80% fines, low plasticity, ~20% sand, fine; moist, gray, dense.
	75								(74.5'- 75.8') SILTY SAND (SM); ~70% sand, fine to medium, ~30% fines, non plastic; dry, gray, dense, brittle.
									(75.8'- 78.3') SILTY SAND (SM); ~70% sand, fine to medium, ~30% fines, non plastic; moist, gray, dense.
		S10	120/138						
-65				1.4					(78.3'- 79.2') SANDY SILT (ML); ~70% fines, low plasticity, ~30% sand, fine; moist, gray, dense.
	80								(79.2'- 80.5') SILTY SAND (SM); ~70% sand, fine to medium, ~30% fines, non plastic; moist, gray, dense.
									(80.5'- 87.4') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moist, gray, loose.
-70									
				1.3					
	85								
		S11	120/144						
-75				1.4					(87.4'- 90.3') SILTY SAND (SM); ~75% sand, fine to medium, ~25% fines, non plastic; moist, whitish gray, dense.
	90								(90.3'- 92.8') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moist, whitish gray, loose.
-80									(92.8'- 93.3') SILTY SAND (SM); ~75% sand, fine to medium, ~25% fines, non plastic; moist, whitish gray, dense.

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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BORING LOG

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WW-SB-37

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	95			1.4				WW-SB-37 (96-97)	(93.3'- 94.5') WIDELY GRADED SAND (SW); ~95% sand, medium to coarse, ~5% fines, non plastic; moist, whitish gray, loose, lens of fine to medium dark gray sand. (94.5'- 95.3') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; moist, dark gray, dense. (95.3'- 97') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moist, gray.
									End of Boring at 97 feet. Grouted

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BORING LOG
PAGE 1 of 5
WW-SB-38

GROUND SURFACE ELEVATION (FT): 14.58 **LOCATION:** 50 Kent Ave
NORTHING (FT): 688633 **EASTING (FT):** 641969 **TOTAL DEPTH (FT):** 97.0
DRILLED BY: Boart Longyear / Craig Marsh **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Amy Malsbary **DATE START / END:** 12/28/2009 - 12/29/2009
DRILLING DETAILS: Sonic Coring
WATER LEVEL DEPTHS (FT):
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
10	0	S1	84/NM				NLO		(0'- 7') WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); ~70% sand, fine to coarse, ~20% gravel, fine to coarse, angular, ~10% fines, non plastic; max. size 2, slight naphthalene-like odor, dry, dark gray, brick fragments, hand cleared to 5 ft. FILL.
	5								
5	10	S2	120/57	34.6			NLO		(7'- 17') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to coarse, ~10% fines, non plastic; moderate naphthalene-like odor, moist, reddish brown, color change to gray at 10.7 feet, pepper-like odor, dark gray seam from 9.6 to 14.4 feet.
0	15			80.1					
		S3	120/138						(17'- 18.7') SILTY SAND (SM); ~85% sand, fine to coarse, ~15% fines, non plastic; moist, brown, dense, moderate pepper-like odor.
-5	20						NLO		(18.7'- 19.2') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to coarse, ~10% fines, non plastic; slight naphthalene-like odor, moist, brown.
							NLO		

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BORING LOG
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WW-SB-38

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	20			32.7			NLO		(19.2'- 23.1') SILTY SAND WITH GRAVEL (SM); ~55% sand, fine to coarse, ~30% fines, non plastic, ~15% gravel; max. size 3.5, slight naphthalene-like odor, moist, brown, dense, slight pepper-like odor.
-10	25			1476			NLO		(23.1'- 25.3') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, moist, brown and grayish brown, pockets of silt, sheen, pockets of tar-like staining.
							NLO		(25.3'- 26.6') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, moist, brown, sheen, tar-like staining.
							NLO		(26.6'- 27') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; strong naphthalene-like odor, moist, brown.
		S4	120/126						(27'- 31.3') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, wet, brown, loose, sheen.
-15	30			1491			NLO		
							NLO		(31.3'- 33.2') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moderate naphthalene-like odor, moist, brown, loose.
-20	35			70.1					(33.2'- 37') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moist, brown, loose.
		S5	120/126						(37'- 43.2') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, moist, brown with gray, sheen.
-25	40			114			NLO		
							NLO		(43.2'- 46') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; slight naphthalene-like odor, moist, reddish brown.

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BORING LOG
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WW-SB-38

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	45			14.4			NLO		(46'- 48') SANDY SILT (ML); ~70% fines, low plasticity, ~30% sand, fine to medium; moist, brown.
		S6	120/126						(48'- 49.4') SILTY SAND (SM); ~70% sand, fine to coarse, ~30% fines, low plasticity; moist, brown, dense.
-35	50			14.8					(49.4'- 50.3') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moist, brown, loose.
									(50.3'- 67') LEAN CLAY (CL); ~95% fines, medium plasticity, ~5% sand, fine; moist, red with gray, very dense, color change to gray at 65.5 feet.
-40	55			130					
		S7	120/156						
-45	60			12.2					
				2.9					
-50	65								
		S8	120/144	0.2					(67'- 77') LEAN CLAY (CL); ~90% fines, low plasticity, ~10% sand, fine; moist, gray, very dense, color change to light brown at 75.3 feet.

NOTES:

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IN. = INCHES
FT. = FEET

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

GEI Consultants

GEI Consultants, Inc.
455 Winding Brook Road
Glastonbury, CT 06033
(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG

WW-SB-38

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
-55	70								
-60	75			0.2					
		S9	120/120	0.2					(77'- 87') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; wet, whiteish gray, color change to gray at 86 feet.
-65	80								
-70	85			0.1					
		S10	120/144	0.2					(87'- 88.7') SILT WITH SAND (ML); ~85% fines, low plasticity, ~15% sand, fine; moist, grayish brown, dense. (88.7'- 89.1') SILTY SAND (SM); ~70% sand, fine to coarse, ~30% fines, non plastic; moist, brown. (89.1'- 89.5') SILT WITH SAND (ML); ~85% fines, low plasticity, ~15% sand, fine; moist, gray, dense. (89.5'- 92.8') SILTY SAND (SM); ~70% sand, fine to medium, ~30% fines, non plastic; moist, whiteish gray, dense, brittle.
-75	90								(92.8'- 93.7') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moist, whiteish gray.

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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BORING LOG

WW-SB-38

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
-80	95			0.2				WW-SB-38 (96.5-97)	(93.7'- 95.3') SILTY SAND (SM); ~85% sand, fine to coarse, ~15% fines, non plastic; gray to blackish gray, dense. (95.3'- 96.2') SILT WITH SAND (ML); ~85% fines, low plasticity, ~15% sand, fine; moist, gray, dense. (96.2'- 97') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to coarse, ~10% fines, non plastic; moist, gray. End of Boring at 97 feet. Grouted

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 1 of 5
WW-SB-39

GROUND SURFACE ELEVATION (FT): 11.92 **LOCATION:** 50 Kent Ave
NORTHING (FT): 688828 **EASTING (FT):** 641736 **TOTAL DEPTH (FT):** 97.0
DRILLED BY: Boart Longyear / Craig Marsh **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Amy Malsbary **DATE START / END:** 12/29/2009 - 12/30/2009
DRILLING DETAILS: Sonic Coring
WATER LEVEL DEPTHS (FT):
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
10	0	S1	84/NM						(0'- 0.3') ASPHALT. (0.3'- 0.8') CONCRETE. (0.8'- 7') WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); ~75% sand, fine to coarse, ~15% gravel, fine to coarse, ~10% fines, non plastic; ~30% brick and concrete fragments, max. size 2.5, hand cleared to 5 ft. FILL.
5	5								
0	10	S2	120/144	43.5			NLO		(7'- 10') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; ~30% brick and concrete fragments, moderate naphthalene-like odor, moist, brown with black, FILL. (10'- 12') SILTY SAND (SM); ~85% sand, fine to coarse, ~15% fines, non plastic; slight naphthalene-like odor, moist, brown, brick fragments. FILL.
-5	15	S3	120/138	180 274			NLO NLO NLO NLO NLO		(12'- 14') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, moist, brown, sheen, pockets of tar-like staining and blebs. (14'- 15') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moderate naphthalene-like odor, moist, brown. (15'- 16.5') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; moderate naphthalene-like odor, moist, gray. (16.5'- 17') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, moist, brown, tar-like staining and coating. (17'- 18.3') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to medium, ~10% fines, non plastic; strong naphthalene-like odor, moist, brown, sheen, tar-like blebs, and pockets of staining. (18.3'- 19.6') WIDELY GRADED SAND (SW); ~95% sand, fine to
	20								

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
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BORING LOG
PAGE 2 of 5
WW-SB-39

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	20								coarse, ~5% fines, non plastic; slight naphthalene-like odor, moist, brown.
-10									(19.6'- 24.4') SILTY SAND (SM); ~80% sand, fine to coarse, ~20% fines, non plastic; moist, brown.
	25			73.6					(24.4'- 25.7') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moist, brown.
-15									(25.7'- 27') SILTY SAND (SM); ~80% sand, fine to coarse, ~20% fines, non plastic; moist, brown.
		S4	120/84						(27'- 34.9') SILTY SAND (SM); ~75% sand, fine to coarse, ~15% fines, non plastic, ~10% gravel, fine to coarse; max. size 1, moist, brown, dense.
	30			4.3					
-20									
	35			20.4					(34.9'- 36.3') COBBLE.
-25									(36.3'- 37') SILTY SAND (SM); ~85% sand, fine to medium, ~15% fines, non plastic; moist, brown, dense.
		S5	120/138						(37'- 43.5') SILTY SAND WITH GRAVEL (SM); ~65% sand, fine to coarse, ~20% fines, non plastic, ~15% gravel, fine to coarse; max. size 3.5.
				81.5					
-30	40								
							NLO		(43.5'- 46.6') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moderate naphthalene-like odor,

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 3 of 5
WW-SB-39

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	45			1444			NLO		moist, brown, loose.
-35		S6	120/156				NLO		(46.6'- 47') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, moist, brown, loose, tar-like staining and coating.
							NLO		(47'- 48.7') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, brown, loose, sheen.
	50			1105			NLO		(48.7'- 48.9') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, brown, loose, sheen, tar-like staining and coating.
-40									(48.9'- 49.7') SILTY SAND (SM); ~70% sand, fine to coarse, ~30% fines, non plastic; moderate naphthalene-like odor, brown, dense.
									(49.7'- 67') LEAN CLAY (CL); ~95% fines, medium plasticity, ~5% sand, fine; moist, red with gray, dense.
	55			146					
-45		S7	120/138						
	60			2.2					
-50									
	65			0.7					
-55		S8	120/150						(67'- 71') SILTY SAND (SM); ~60% sand, fine to medium, ~40% fines, low plasticity; moist, brown, dense.

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 4 of 5
WW-SB-39

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	70			0.1					(71'- 71.8') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to medium, ~10% fines, non plastic; dry, gray, brittle. (71.8'- 81.8') SILTY SAND (SM); ~80% sand, fine to medium, ~20% fines, non plastic; moist, grayish brown, dense.
-60									
	75			0.0					
-65		S9	120/150						
	80			0.0					(81.8'- 84.6') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; moist, grayish brown.
-70									
	85			0.0					(84.6'- 86.2') SILTY SAND (SM); ~75% sand, fine to medium, ~25% fines, non plastic; moist, whiteish gray, dense. (86.2'- 87') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moist, whiteish gray, loose. (87'- 88.1') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moist, brown, loose.
-75		S10	120/162						
	90			0.0					(88.1'- 88.9') SILTY SAND (SM); ~60% sand, fine to medium, ~40% fines, non plastic; moist, brown, dense, wood fragments. (88.9'- 90.3') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moist, brown, loose, lens of silt at 89.6 feet. (90.3'- 91.1') SILTY SAND (SM); ~75% sand, fine to coarse, ~25% fines, non plastic; moist, brown, dense. (91.1'- 97') SILTY SAND (SM); ~60% sand, fine to medium, ~40% fines, non plastic; moist, gray with white, color change to greenish gray with white at 92.2 feet, dense.
-80									

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG

WW-SB-39

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	95			0.0				WW-SB-39 (96-97)	
-85									End of Boring at 97 feet. Grouted

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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CITY/STATE:	Brooklyn, New York
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BORING LOG

PAGE 1 of 5

WW-SB-40

GROUND SURFACE ELEVATION (FT):	11.70	LOCATION:	50 Kent Ave
NORTHING (FT):	688949	EASTING (FT):	641834
TOTAL DEPTH (FT):	97.0		
DRILLED BY:	Boart Longyear / Craig Marsh	DATUM VERT. / HORZ.:	NAVD 88 / NAD83 NY East Zone
LOGGED BY:	Amy Malsbary	DATE START / END:	12/23/2009 - 12/23/2009
DRILLING DETAILS:	Sonic Coring		
WATER LEVEL DEPTHS (FT):	▽ 9.90 12/23/2009		
GENERAL NOTE:			

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	0								(0'- 7') hand cleared to 5 ft.
10									
	5								
5		S1	120/84						(7'- 9.9') SILTY SAND WITH GRAVEL (SM); ~55% sand, fine to coarse, ~30% gravel, fine to coarse, subrounded, ~15% fines, non plastic; max. size 3, moist, brown.
				1.5					
▽	10								(9.9'- 14.1') SILTY SAND (SM); ~85% sand, fine to medium, ~15% fines, non plastic; moderate naphthalene-like odor, wet, brown, sheen.
0							NLO		
				24.1			NLO		(14.1'- 14.9') SILTY SAND (SM); ~85% sand, fine to medium, ~15% fines, non plastic; strong naphthalene-like odor, wet, brown, sheen, tar-like staining and blebs.
	15						NLO		(14.9'- 17') SILTY SAND (SM); ~85% sand, fine to medium, ~15% fines, non plastic; slight naphthalene-like odor, wet, brown, sheen.
-5		S2	120/126						(17'- 21.3') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to medium, ~10% fines, non plastic; slight naphthalene-like odor, wet, brown and dark gray.
				48.2			NLO		
	20								

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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BORING LOG

WW-SB-40

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	20						NLO		
-10							NLO		(21.3'- 22.7') WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); ~70% sand, fine to coarse, ~20% gravel, fine to coarse, subangular to subrounded, ~10% fines, non plastic; max. size 3, slight naphthalene-like odor, moist, brownish gray.
				9.4			NLO		(22.7'- 23.7') SILTY SAND (SM); ~85% sand, fine to coarse, ~15% fines, non plastic; slight naphthalene-like odor, light brown, dense.
	25						NLO		(23.7'- 24.1') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, moist, brown with red.
-15									(24.1'- 27') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to coarse, ~10% fines, non plastic; slight naphthalene-like odor, brown, dense.
		S3	120/36	3.3					(27'- 35.3') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to coarse, ~10% fines, non plastic; brown, dense.
	30			2.6					
-20									
	35								(35.3'- 37.4') COBBLE; max. size 6.
-25		S4	120/138						(37.4'- 47.7') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moist, brown, loose.
	40			45.7					
-30									
				151					

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

GEI Consultants

GEI Consultants, Inc.
455 Winding Brook Road
Glastonbury, CT 06033
(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG

WW-SB-40

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
-35	45								
		S5	120/162						(47.7'- 49.6') SANDY SILT (ML); ~70% fines, low plasticity, ~30% sand, fine; moist, brown, dense.
	50								(49.6'- 50') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; moist, brown, loose.
-40				28.1					(50'- 53.3') SILT WITH SAND (ML); ~80% fines, low plasticity, ~20% sand, fine; moist, brown, dense.
									(53.3'- 55.5') SANDY SILT (ML); ~60% fines, low plasticity, ~40% sand, fine to medium; moist, brown, lens of fine to coarse sand.
	55								
-45				3.0					(55.5'- 57.8') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moist, brown, loose, 2 inch lens with black staining and petroleum-like odor at 55.7 feet.
		S6	120/144						
	60								(57.8'- 78.3') LEAN CLAY (CL); ~95% fines, medium plasticity, ~5% sand, fine; red and gray, gray only from 64.5 to 67 and 77 to 78.3 feet, very dense.
-50				21.8					
	65								
-55				1.4					
		S7	120/114	1.5					

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BORING LOG

WW-SB-40

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	70								
-60									
	75			1.3					
-65		S8	120/144						(78.3'- 79.5') SANDY LEAN CLAY (CL); ~60% fines, medium plasticity, ~40% sand, fine to medium; light gray, very dense.
	80								(79.5'- 84.1') SILTY SAND (SM); ~60% sand, fine to medium, ~40% fines, low plasticity; light gray, dense.
-70				1.3					
	85								(84.1'- 87') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; wet, light gray, color change to gray at 86.2 feet.
-75				1.2					
		S9	120/132						(87'- 88.8') SILTY SAND (SM); ~80% sand, fine to coarse, ~20% fines, non plastic; moist, dark gray, dense.
	90								(88.8'- 91.5') LEAN CLAY WITH SAND (CL); ~80% fines, medium plasticity, ~20% sand, fine to medium; light gray, very dense.
-80				1.1					
									(91.5'- 93.4') SILTY SAND (SM); ~80% sand, fine to coarse, ~20% fines, low plasticity; light gray with white, seams of black.

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BORING LOG

WW-SB-40

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	95			1.1				WW-SB-40 (95-95.5)	(93.4'- 95.6') WIDELY GRADED SAND WITH GRAVEL (SW); ~65% sand, fine to coarse, ~30% gravel, fine to coarse, angular, ~5% fines, non plastic; max. size 2.5, light gray with white, seams of black. (95.6'- 97') COBBLE; gray.
-85									End of Boring at 97 feet. Grouted

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BORING LOG
PAGE 1 of 5
WW-SB-41

GROUND SURFACE ELEVATION (FT): 12.40 **LOCATION:** 50 Kent Ave
NORTHING (FT): 688784 **EASTING (FT):** 641834 **TOTAL DEPTH (FT):** 97.0
DRILLED BY: Boart Longyear / Craig Marsh **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Amy Malsbary **DATE START / END:** 12/21/2009 - 12/22/2009
DRILLING DETAILS: Sonic Coring
WATER LEVEL DEPTHS (FT): ▽ 3.50 12/22/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	PEN/REC IN./IN.	PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
10	0	S1	36/36	3.8					(0'- 0.2') CONCRETE. (0.2'- 1') WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); ~50% sand, fine to coarse, ~40% gravel, fine to coarse, subangular to subrounded, ~10% fines, non plastic; max. size 2, moist, light brown to brown, hand cleared. FILL. (1'- 3') SILTY SAND (SM); ~75% sand, fine to coarse, ~15% fines, non plastic, ~10% gravel, fine to coarse, subrounded; ~30% brick fragments, max. size 1.5, moist, brown with red, hand cleared. FILL.
▽		S2	48/60	28.2			NLO NLO NLO		(3'- 3.5') SILTY SAND (SM); ~75% sand, fine to coarse, ~15% fines, non plastic, ~10% gravel, fine to coarse, subrounded; ~30% brick fragments, max. size 1.5, slight naphthalene-like odor, moist, brown with red, hand cleared. FILL. (3.5'- 5') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine to medium, subrounded, ~5% fines, non plastic; max. size 0.5, moderate naphthalene-like odor, wet, black, hand cleared. FILL.
5	5	S3	120/126	31.2 793 797			NLO NLO NLO NLO		(5'- 5.75') WIDELY GRADED SAND WITH GRAVEL (SW); ~60% sand, fine to coarse, ~35% gravel, fine, subangular to subrounded, ~5% fines, non plastic; ~70% brick fragments, max. size 0.25, moist, red, FILL. (5.75'- 7') WIDELY GRADED SAND WITH GRAVEL (SW); ~70% sand, fine to coarse, ~25% gravel, fine to coarse, subrounded, ~5% fines, non plastic; max. size 3, slight naphthalene-like odor, wet, dark gray, FILL. (7'- 8') WIDELY GRADED SAND (SW); ~99% sand, fine to coarse, ~1% fines, non plastic; wet, dark brown, FILL. (8'- 9') WOOD; FILL. (9'- 9.5') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; ~80% wood fragments, moderate naphthalene-like odor, wet, brown to gray, sheen, slight tar-like staining. FILL. (9.5'- 11') WIDELY GRADED SAND WITH GRAVEL (SW); ~70% sand, fine to coarse, ~25% gravel, fine to coarse, subrounded, ~15% fines, non plastic; ~10% wood fragments, max. size 1, moderate naphthalene-like odor, moist, dark gray to brown, FILL. (11'- 14.5') WIDELY GRADED SAND (SW); ~85% sand, fine to coarse, ~10% gravel, fine to coarse, rounded, ~5% fines, non plastic; max. size 1, slight naphthalene-like odor, dark gray with brown.
0	10								
-5	15	S4	120/156						(14.5'- 15') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; moderate naphthalene-like odor, moist, dark gray, sheen. (15'- 16') WIDELY GRADED SAND WITH GRAVEL (SW); ~55% sand, fine to coarse, ~40% gravel, fine to coarse, subangular to subrounded, ~5% fines, non plastic; max. size 4, strong naphthalene-like odor, moist, dark gray, sheen.
	20								

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
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BORING LOG
PAGE 2 of 5
WW-SB-41

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	20			199					(16'- 17') WIDELY GRADED SAND (SW); ~85% sand, fine to coarse, ~10% gravel, fine to coarse, rounded, ~5% fines, non plastic; max. size 1, moderate naphthalene-like odor, light brown, dense. (17'- 23.2') WIDELY GRADED SAND (SW); ~90% sand, fine to medium, ~10% gravel, coarse, rounded; max. size 3, light brown, dense.
-10				483					(23.2'- 25.8') WIDELY GRADED SAND WITH GRAVEL (SW); ~65% sand, fine to coarse, ~30% gravel, coarse, rounded, ~5% fines, non plastic; max. size 5, brown.
	25						NLO		(25.8'- 27') WIDELY GRADED SAND WITH GRAVEL (SW); ~75% sand, fine to coarse, ~20% gravel, medium to coarse, rounded, ~5% fines, non plastic; max. size 1.5, moderate naphthalene-like odor, moist, grayish brown.
-15		S5	120/126				NLO		(27'- 29.9') WIDELY GRADED SAND WITH SILT (SW-SM); ~85% sand, fine to medium, ~10% fines, non plastic, ~5% gravel, medium to coarse, rounded; max. size 1.5, slight naphthalene-like odor, grayish brown.
	30			3368			NLO		(29.9'- 33.7') SILTY SAND (SM); ~60% sand, fine, ~40% fines, low plasticity; strong naphthalene-like odor, moist, brown, dense, seam of fine to coarse sand with tar-like staining and coating.
-20									
	35			580			NLO		(33.7'- 37') WIDELY GRADED SAND WITH GRAVEL (SW); ~80% sand, fine to coarse, ~15% gravel, fine to coarse, subangular to subrounded, ~5% fines, non plastic; max. size 2.5, strong naphthalene-like odor, moist, brown, tar-like staining with pockets of coating to 36 feet, heavy staining with coating from 36 to 37 feet.
-25		S6	120/138				NLO		(37'- 37.9') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, wet, reddish brown, tar saturated. (37.9'- 38.7') SILTY SAND (SM); ~70% sand, fine, ~30% fines, non plastic; brown, dense. (38.7'- 40.9') WIDELY GRADED SAND (SW); ~90% sand, fine to coarse, ~5% gravel, fine to coarse, ~5% fines, non plastic; max. size 0.75, strong naphthalene-like odor, seams of tar-like staining and coating.
	40			2533			NLO		(40.9'- 52') WIDELY GRADED SAND WITH GRAVEL (SW); ~80% sand, fine to coarse, ~15% gravel, fine to coarse, subrounded to rounded, ~5% fines, non plastic; max. size 2.5, strong naphthalene-like odor, brown, odor decreasing with depth, very dense, 6 inch lens of gravel up to 4 inches beginning at 49.3'.
-30				437			NLO		

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BORING LOG

WW-SB-41

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	45								
-35		S7	120/156				NLO		
	50								
-40							NLO		(52'- 52.8') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, moist, reddish brown, loose, dense silty lenses, tar-like staining. (52.8'- 57') LEAN CLAY (CL); ~95% fines, medium plasticity, ~5% sand, fine; slight naphthalene-like odor, red with gray, very dense.
				2447					
	55						NLO		
				332					
-45		S8	120/144						(57'- 69.3') LEAN CLAY (CL); ~90% fines, medium plasticity, ~10% sand, fine; red with gray, color change at 64.5 feet to gray, very dense.
	60								
				108					
-50									
	65								
				20.2					
-55		S9	120/156						

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	70			0.7					(69.3'- 70.8') SILTY SAND (SM); ~70% sand, fine to medium, ~30% fines, non plastic; dry, brown, dense.
-60									(70.8'- 75.8') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to medium, ~10% fines, non plastic; dry, brown, dense.
	75			0.3					
-65		S10	120/138						(75.8'- 76.4') WIDELY GRADED SAND WITH GRAVEL (SW); ~75% sand, fine to coarse, ~20% gravel, fine to coarse, subangular to subrounded, ~5% fines, non plastic; max. size 1.5, dry, light brown. (76.4'- 77') SILTY SAND (SM); ~80% sand, fine to medium, ~20% fines, non plastic; dry, grayish brown, streaks of dark gray, dense. (77'- 78.3') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; wet, brown. (78.3'- 83.1') SILT (ML); ~95% fines, non plastic, ~5% sand, fine; dark gray, very dense.
	80			0.4					
-70									(83.1'- 85.3') LEAN CLAY (CL); ~95% fines, medium plasticity, ~5% sand, fine; light gray, very dense.
	85			0.3					(85.3'- 87') SILTY SAND (SM); ~85% sand, fine to medium, ~15% fines, non plastic; dark gray, dense.
-75		S11	120/144						(87'- 92.4') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; moist, grayish brown.
	90			0.2					
-80				0.3					(92.4'- 94.1') WIDELY GRADED SAND (SW); ~95% sand, medium to coarse, ~5% fines, non plastic; wet, dark gray to light gray, loose.

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BORING LOG

WW-SB-41

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	95							WW-SB-41 (96-97)	(94.1'- 97') SILTY SAND (SM); ~85% sand, fine to coarse, ~15% fines, non plastic; dry, light gray, dense.
									End of Boring at 97 feet. Grouted

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BORING LOG
PAGE 1 of 5
WW-SB-42

GROUND SURFACE ELEVATION (FT): 12.50 **LOCATION:** 50 Kent Ave
NORTHING (FT): 688874 **EASTING (FT):** 641917 **TOTAL DEPTH (FT):** 97.0
DRILLED BY: Boart Longyear / Craig Marsh **DATUM VERT. / HORZ.:** NAVD 88 / NAD83 NY East Zone
LOGGED BY: Amy Malsbary **DATE START / END:** 12/22/2009 - 12/22/2009
DRILLING DETAILS: Sonic Coring
WATER LEVEL DEPTHS (FT): ▽ 7.00 12/22/2009
GENERAL NOTE:

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
10	0								(0'- 7') hand cleared to 5 ft. FILL.
	5								
▽ 5		S1	120/84	385			NLO		(7'- 17') WIDELY GRADED SAND WITH SILT (SW-SM); ~90% sand, fine to coarse, ~10% fines, non plastic; strong naphthalene-like odor, moist to wet, brown, sheen, seams of tar-like staining and blebs, coating from 14.5 to 15.6 feet, brick at 17 feet. FILL.
	10								
0									
	15			1921					
-5		S2	120/132				NLO		(17'- 21.5') SILTY SAND (SM); ~75% sand, fine to coarse, ~20% fines, non plastic, ~5% gravel, fine to coarse, subangular; max. size 3.5, moderate naphthalene-like odor, moist.
	20								

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CrLO= CREOSOTE LIKE ODOR
OLO = ORGANIC LIKE ODOR
SLO = SULFUR LIKE ODOR
MLO = MUSTY LIKE ODOR

ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

GEI Consultants, Inc.
455 Winding Brook Road
Glastonbury, CT 06033
(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 2 of 5
WW-SB-42

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	20			2634			NLO		
							NLO		(21.5'- 22.5') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, wet, brown, heavy sheen.
-10							NLO		(22.5'- 24.3') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, reddish brown with light brown, sheen, tar-like staining and coating.
	25						NLO		(24.3'- 26.5') WIDELY GRADED SAND WITH SILT (SW-SM); ~80% sand, fine to coarse, ~10% gravel, fine to coarse, ~10% fines, non plastic; max. size 1, strong naphthalene-like odor, moist, reddish brown, sheen.
				876			NLO		(26.5'- 27') SILTY SAND (SM); ~85% sand, fine to coarse, ~15% fines, non plastic; strong naphthalene-like odor, brown, seams of tar-like coating.
-15		S3	120/114	884					(27'- 32.8') WIDELY GRADED SAND WITH SILT (SW-SM); ~85% sand, fine to coarse, ~10% fines, non plastic, ~5% gravel, fine to coarse, subangular; max. size 3, moist, brown, dense.
	30								
-20									(32.8'- 35.9') SILTY SAND (SM); ~85% sand, fine to coarse, ~15% fines, non plastic; moderate naphthalene-like odor, brown, dense, one large 4 inch cobble.
	35						NLO		
				1261			NLO		(35.9'- 37') WIDELY GRADED SAND (SW); ~90% sand, fine to medium, ~10% gravel, fine to coarse, subrounded; max. size 1, moderate naphthalene-like odor, moist, reddish brown, two large 5 inch cobbles.
-25		S4	120/156	3127			NLO		(37'- 39.7') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; strong naphthalene-like odor, wet, brown, loose, sheen, tar-like staining, blebs from 37 to 37.8 feet, coating from 38.5 to 39.7 feet.
	40						NLO		(39.7'- 40.5') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; ~15% cobbles, strong naphthalene-like odor, moist, brown, loose, slight tar-like staining.
							NLO		(40.5'- 42') SILTY SAND (SM); ~55% sand, fine to coarse, ~35% fines, non plastic, ~10% gravel, fine to coarse; slight naphthalene-like odor, brown, dense.
-30							NLO		(42'- 43.5') SILT WITH SAND (ML); ~80% fines, low plasticity, ~20% sand, fine; slight naphthalene-like odor, brown, dense.
									(43.5'- 47') SILTY SAND (SM); ~60% sand, fine to coarse, ~40% fines, low plasticity; moist, brown, dense.

NOTES:

PEN = PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC = RECOVERY LENGTH OF SAMPLE
PID = PHOTOIONIZATION DETECTOR READING (PPM)
JHS = JAR HEADSPACE PID READING (PPM)

NA = NOT APPLICABLE
NM = NOT MEASURED
Q_P = POCKET PENETROMETER
S_V = TORVANE PEAK

ppm = PARTS PER MILLION
IN. = INCHES
FT. = FEET

NLO = NAPHTHALENE LIKE ODOR
PLO = PETROLEUM LIKE ODOR
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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

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CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG
PAGE 3 of 5
WW-SB-42

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	45			886					
-35		S5	120/126						(47'- 51.3') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; slight naphthalene-like odor, moist, brown, loose.
	50			554			NLO		
-40									(51.3'- 57') LEAN CLAY (CL); ~95% fines, medium plasticity, ~5% sand, fine; red with gray, dense.
	55			112					
-45		S6	120/144						(57'- 61.2') LEAN CLAY WITH SAND (CL); ~85% fines, medium plasticity, ~15% sand, fine; brown with gray, dense.
	60								
							NLO		(61.2'- 61.6') WIDELY GRADED SAND WITH SILT (SW-SM); ~80% sand, fine to medium, ~10% gravel, fine to coarse, angular, ~10% fines, non plastic; max. size 0.75, slight naphthalene-like odor, gray.
-50				838				WW-SB-42 (62-62.5)	(61.6'- 72') WIDELY GRADED SAND (SW); ~95% sand, fine to medium, ~5% fines, non plastic; moist, gray.
	65								
				6.3					
-55		S7	120/144						

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CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG

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ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	70			21.6					
-60									(72'- 85') LEAN CLAY (CL); ~95% fines, medium plasticity, ~5% sand, fine; gray, dense.
	75			2.3					
-65		S8	120/150	1.8					
	80								
-70									
	85			1.8					(85'- 87.8') SILTY SAND (SM); ~70% sand, fine to medium, ~30% fines, low plasticity; moist, light gray, very dense.
-75		S9	120/144	1.8					(87.8'- 89.5') WIDELY GRADED SAND (SW); ~95% sand, medium to coarse, ~5% fines, non plastic; wet, whiteish gray, loose.
	90								(89.5'- 94.9') WIDELY GRADED SAND (SW); ~95% sand, fine to coarse, ~5% fines, non plastic; wet, whiteish gray, color change at 90.3 feet to dark brown.
-80				1.4				WW-SB-42	

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ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

GEI Consultants

GEI Consultants, Inc.
455 Winding Brook Road
Glastonbury, CT 06033
(860) 368-5300

CLIENT: National Grid
PROJECT: Williamsburg MGP RI
CITY/STATE: Brooklyn, New York
GEI PROJECT NUMBER: 093060

BORING LOG

PAGE 5 of 5

WW-SB-42

ELEV. FT.	DEPTH FT.	SAMPLE INFO: TYPE and NO.	SAMPLE INFO: PEN/REC IN./IN.	SAMPLE INFO: PID (PPM)	STRATA	VISUAL IMPACTS	ODOR	ANALYZED SAMPLE ID	SOIL / BEDROCK DESCRIPTION
	95							(96.5-97)	(94.9'- 97') SILTY SAND (SM); ~70% sand, fine to coarse, ~30% fines, non plastic; whiteish gray, dense.
									End of Boring at 97 feet. Grouted

NOTES:

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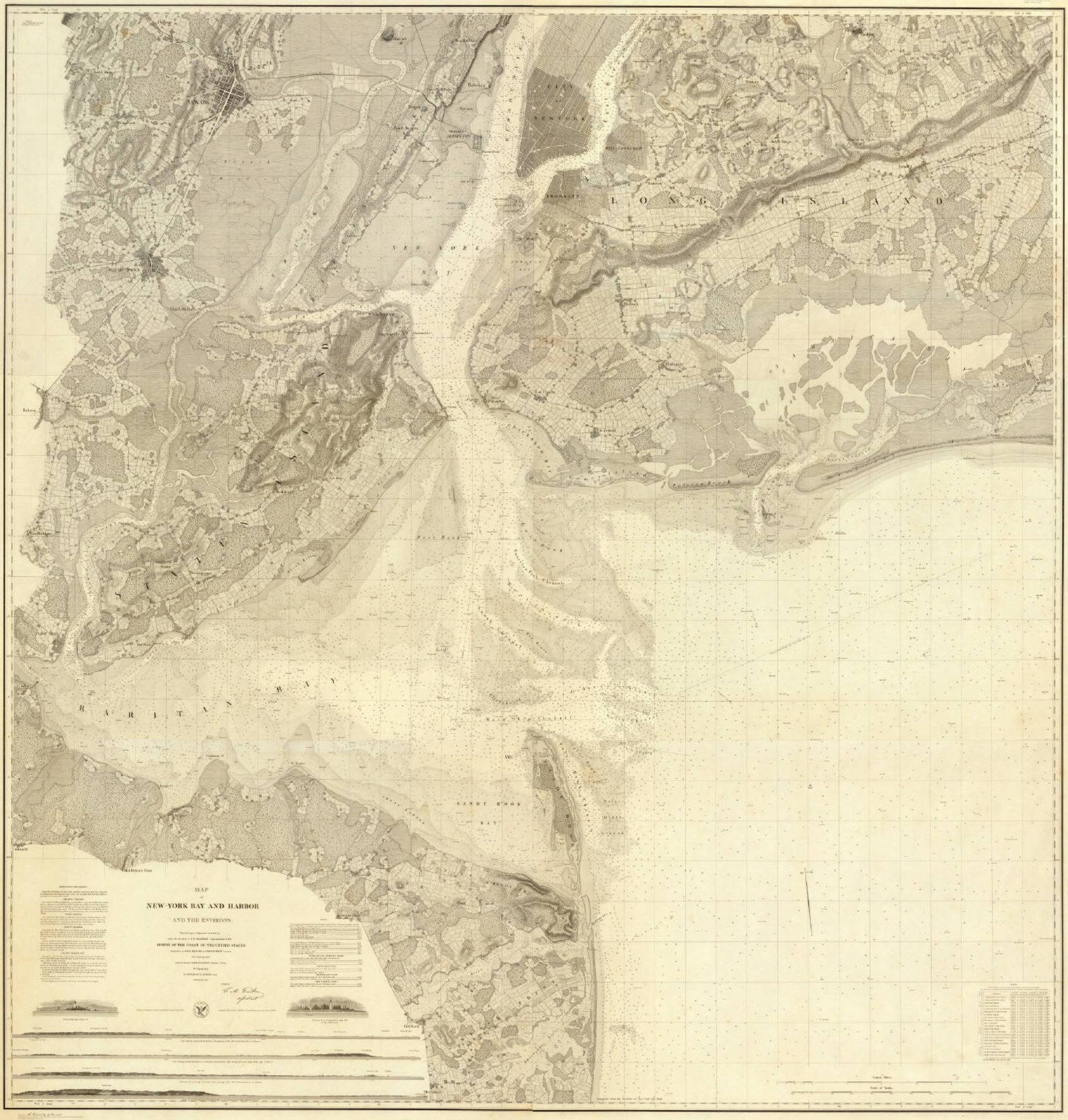
ENVIRONMENTAL BORING LOG WILLIAMSBURG W PREV. BORINGS.GPJ FULTON DATA TEMPLATE.GDT 3/27/13

APPENDIX E – HISTORICAL INFORMATION


MAP
of
NEW-YORK BAY AND HARBOR
AND THE ENVIRONS
SURVEY OF THE COAST OF THE UNITED STATES
NEW YORK BAY
LONG ISLAND
RARITAN BAY
SANDY HOOK BAY
CITY OF NEW YORK
BROOKLYN
NEWARK
Old Bedford Bank
Scale of Miles
Scale of Tenths

APPENDIX F – HEALTH AND SAFETY PLAN



GEI Consultants

Consulting
Engineers and
Scientists

Health and Safety Plan

Williamsburg Works Former MGP Site
Brooklyn, New York

National Grid
One MetroTech Center
Brooklyn, NY 11201

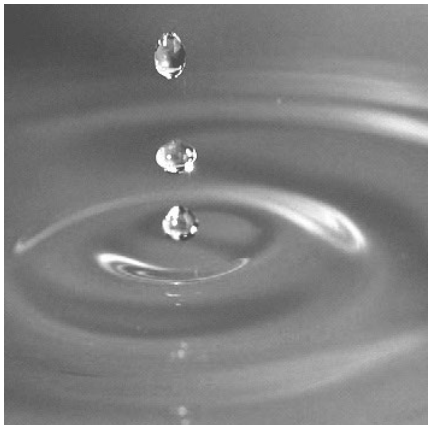
Prepared by:
455 Winding Brook Drive
Glastonbury, CT 06033
860-368-5300

October 2022

Project No. 093060-3.4

Melissa J. Felter
Project Manager, LEP, P.G.

Lesley Gastwirth
Regional Safety Manager



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C. Safety Data Sheets
D. Forms
E. GEI Health and Safety SOPs and Programs
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MF/AS:bdp
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1. Emergency Contact Information

Table 1. Emergency Contact Information

Site Information	
Project Name:	Williamsburg Works Former MGP Site
Project Address:	35 and 50 Kent Avenue and 2 and 20 N. 12th Street, Brooklyn, NY
Project Number:	093060
Important Phone Numbers	
Local Police:	911
Fire Department:	911
Ambulance:	911
Hospital and Occupational Clinic Information *(See Attached Map and Directions in Appendix A)*	
Local Hospital: Woodhull Medical and Mental Health Center 760 Broadway Brooklyn, NY 11206 **Urgent Care/Occupational Health Clinic: Contact Medcor Triage** 73-01 Grand Avenue Maspeth, NY 11378	(718) 250-8075 Call Medcor Triage 1-800-775-5866 (718) 457-5900
Contacts	
Project Manager: Melissa Felter	(860) 368-5328 office (860) 608-9717 cell
Safety Director: Steve Hawkins	(860) 368-5348 office (860) 916-4167 cell
Regional Safety Manager: Lesley Gastwirth	(404) 592-0127 office (404) 667-7444 cell
Site Safety Manager: Alina Salaiz	(860) 368-5385 office (978) 413-4332 cell
Medcor Triage	1-800-775-5866
Client Contact: Donald Campbell (Project Manager) Bill Ryan (SIR Regional Safety Lead)	718) 963-5453 office (347) 452-5973 cell (516) 545-2586 office (516) 790-1660 cell

Other Information	
Contractor Requesting/Performing Utility Clearance: ADT	Utility Clearance Ticket Number: TBD

2. GEI Safety Practices to Live By

Safety is what we do and how we do it every day. These Everyday Practices to Live Safe are simple yet concise reminders to our employees, clients, contractors, visitors of the steps that must be taken to avoid injury, illness, and incident so everyone can live safe every day. To maintain a safe work environment, GEI has established an organizational structure and a Corporate Health and Safety Program along with these safety practices.

1. Stop work if it is unsafe to continue, after any incident, injury, or near miss.

2. Prepare before starting work. Complete safety training and project-related safety requirements, such as preparation and review Health and Safety Plans (HASPs) as required by project or job-related duties.

3. Assess and control safety hazards/risks before starting any tasks and when previously unidentified safety hazards are observed.

4. Be attentive and aware of your environment. Constant focus and awareness will avoid complacency.

5. Properly use and maintain GEI-approved and required PPE in all appropriate circumstances.

6. Do not work or drive impaired, including under the influence of alcohol/drugs or while fatigued.

7. Follow all safety practices when operating a vehicle. Always wear your seatbelt while in any vehicle. Do not drive distracted, including using hand-held cell phones, when operating any vehicle.

8. Use tools, equipment, and safety devices in accordance with manufacturers recommendations and GEI expectations. Never modify or override safety devices.

9. When activities involve chemicals or hazardous substances, follow GEI's hazard communication requirements, including labeling, reviewing Safety Data Sheets (SDS), and keeping proper protections in place.

10. Be aware of and keep clear of equipment moving in all work areas, at all times.

11. Follow GEI's incident reporting procedure in the event of safety incidents, including injuries, illness, near misses, or observation of unsafe behaviors.

3. Site Background

This Health and Safety Plan (HASP) establishes policies and procedures to protect GEI Consultants, Inc. (GEI) personnel from the potential hazards posed by the activities at the Williamsburg Works Former Manufactured Gas Plant (MGP) Site, 35 and 50 Kent Avenue and 2 and 20 N. 12th Street, Brooklyn, New York (Figure 1). Reading, understanding, and compliance with the contents of the HASP is required for on-site GEI personnel and will be reviewed by GEI subcontractors. Subcontractors will prepare their own site-specific HASP but may use this HASP as a guide. This HASP identifies measures to minimize accidents and injuries which may result from site conditions or activities. A copy of this HASP will be maintained on site for the duration of the work.

Employees should review National Grid's Safety Procedure, Contractor Safety Requirements for reference (Appendix F). This document represents policies and safety-related work methods unique to National Grid and they may be more stringent than the Occupational Safety and Health administration (OSHA) regulations. Contractors must follow these requirements as well as their own rules or regulations that meet or exceed OSHA and other regulatory requirements.

3.1 Site Description

The Williamsburg Works Former MGP site is located in an industrial and commercial section of the Williamsburg neighborhood of Brooklyn, New York. The Site is also located in the 94th Precinct. The Site is bordered by North 12th Street to the northwest, industrial and commercial properties to the southeast, North 11th Street to the southwest, and the East River to the northeast.

The Site consists of four properties. The Parcel IDs, addresses, and tax map information for these properties are presented in the table below.

Parcel ID	Address	Block	Lot
Parcel 1	35 Kent Avenue Brooklyn, NY	2288	1
Parcel 2	21 North 12th Street (50 Kent Avenue) Brooklyn, NY	2287	1
Parcel 3	20 North 12th Street Brooklyn, NY	2287	16
Parcel 4	2 North 11th Street Brooklyn, NY	2287	30

The site history of the Williamsburg Works Former MGP and surrounding area was developed through the review of available Sanborn Fire Insurance (Sanborn) maps and other historic documents.

3.1.1 MGP History

The former Williamsburg Works MGP Site operated in a highly industrialized area that included dozens of historic, industrial, and manufacturing uses; large petroleum storage sites; and reported spills, all of which constitute sources of soil and groundwater contamination surrounding the Site. Historic property uses in the site vicinity included petroleum refining, fuel storage, a railroad terminal, iron works, varnishing works, chemical works, a brass foundry, laundry and dry-cleaning supply facilities, and other manufacturing facilities. Facilities that used or generated petroleum and tar-like substances include the former Pratt Works Refinery and former iron foundries. A more detailed Site history can be found in the Remedial Investigation Report (GEI, 2015) and the Construction Completion Report for 50 Kent Avenue (AECOM, 2018).

The Williamsburg Gas Light Company was incorporated in 1850 (Murphy, 1995) and was the first known operator of the Williamsburg Works MGP. The Williamsburg Works MGP was first shown on the 1887 Sanborn map. At that time, the gas production facilities consisted of coal carbonization facilities including a retort house, an engine room, a meter house, and a condenser house.

Gas storage and purification facilities included three gas holders, a governor house, a purifying house, two tar tanks, scrubbers and lime houses on the 1887 Sanborn map. Two of the gasholders were identified as relief holders built in 1863 and 1868 with two lifts each and had 315,000- and 306,000-cubic-foot capacities in a 2009 New York State Archives document. The third gasholder, built in 1884, was constructed with three lifts, and had a 460,000-cubic-foot capacity. All three holders were constructed with subsurface brick tanks and concrete foundations. The three holders are identified as Relief Holder, Holder No. 1, and Holder No. 2, respectively, on the 1921 Brooklyn Union Gas Company (BUG) drawing (2-G-130). In 1888, an additional holder with a capacity of 1,100,000 cubic feet and three lifts was built. The holder was constructed with subsurface brick and a concrete foundation (New York State Archives, 2009). It was identified as Holder No. 3 on the 1921 BUG drawing.

In the 1880s, H. H. Rogers, a Standard Oil trustee and vice president, and William A. Rockefeller, Jr., the president of the Standard Oil Company of New York, were on the board of the Williamsburg Gas Light Company, and by at least September 1893 the Williamsburg Works was operating a Loomis carbureted water gas process. In April, The Williamsburg Gas Light Company stopped buying naphtha from Standard Oil at above market prices. [1] In

[1] Progressive Age. Volume XI. 1893. p. 324.

1895, through the influence of H. H. Rogers and William A. Rockefeller, Jr., the Williamsburg Gas Light Company and several other Brooklyn gas manufacturing companies merged to form BUG. In 1896, H. H. Rogers and William A. Rockefeller, Jr. became board members of BUG (Murphy, 1995).

The 1905 Sanborn map indicated the former MGP was renamed the BUG Williamsburg Branch. According to the 1905 Sanborn map, the gas production facilities remained relatively unchanged, since construction, with the exception of the addition of iron tanks and a pump house. One circular gas tank, a generator house, a condenser house, exhauster houses, and purifying houses were added.

A 1912 map showing existing substructures prepared by the City of New York shows multiple 4 and 6-inch oil pipes along N. 12th Street and crossing into both Parcel 4 and the Pratt Works Refinery to the north of the MGP. On the 1912 map, the pipes are shown in two groups, one identified as '3-6" Oil Pipes' and the other identified variously as '9-4" Oil Pipes' and '11-4" Oil Pipes.' A 1908 BUG drawing shows an excavation plan for a pump house, settling tank, and oil separator to be built, and the generator house shown on the 1905 Sanborn is identified as the Old Loomis House. In the 1908 BUG drawing, two oil conduits are shown crossing the Site, within the area of Parcel 4. One of the conduits is identified as the "Pratt Oil Conduit" is shown to contain three pipes. The other conduit is labeled simply "Oil Conduit."

By 1916, the Sanborn map indicates the former Williamsburg Works MGP continued water gas production as evidenced by the addition of generators and conversion of the retort house to a generator house. A pump house and oil separator, similar to those shown in the 1908 BUG drawing, as well as two additional oil tanks and a tar slop tank are shown. An additional tank was added; the tank is identified as a gasometer on the Sanborn map and as a gas oil tank in a later 1921 BUG drawing.

The Williamsburg Works MGP ceased operation and the MGP structures were dismantled prior to 1941, as evidenced by the vacant lots shown in the 1941 Sanborn map. Subsequent to dismantlement, the former Williamsburg Works MGP property was subdivided and redeveloped for commercial, industrial and manufacturing uses.

3.1.2 Post-MGP History

Subsequent to dismantlement, the former Williamsburg Works MGP property was subdivided and redeveloped for commercial, industrial, and manufacturing uses. A brief history of the post-MGP use was developed from available BUG and Sanborn maps and is presented below by Site-specific Parcel IDs and tax lot. All of these properties are currently not owned by National Grid.

BUG drawing 1G122 dated June 23, 1909 and retraced October 5, 1939 includes hand written notes indicating Block 2287 (Parcels 2 through 4) was leased by the United States Navy beginning on July 1, 1945, with permission to stay until June 30, 1946 or six months after the end of the war. The same lease was noted for Block 2288 (Parcel 1), with a cancelation of the lease in June of 1946. Title searches for former MGP Parcels 1 through 4 did not indicate purchase of property by the United States Government between 1945 and 1946. The use and activity at the Site, if any, by the United States Navy is unknown. The Parcels were then under contract of sale in May 1946 with the condition that a railroad connection could be extended to the property. The connection was unable to be made and the contract was canceled as noted in the 1946 BUG drawing, which is included in Appendix A.

A July 1946 BUG drawing, 1G122, retraced July 16, 1946, which includes subsequent hand notes, indicates that modern-day Block 2287 Lot 1 (Parcel 2) was sold on January 30,1946, and that modern-day Block 2287 Lots Lot 16 and 30 (Parcels 3 and 4 respectively) were under contract for expected closing sale by February 1947. Block 2288 Lot 1 (Parcel 1) was sold on May 27, but the year is not legible.

- Parcel 1 [Block 2288 Lot 1]: The larger parcel within Parcel 1, still owned by BUG, was sold to Jerome Zirinsky in 1948. According to Sanborn maps, the property was developed as a beverage warehouse and garage in 1951 and had a gasoline storage tank. Subsequent Sanborn maps, 1965, 1978, and 1979 indicated the property use as a garage. Mr. Zirinsky was involved in property ownership until 1979 when the property was sold to NYC Industrial Development Agency. Colonial Mirror and Glass Corp. purchased the property on May 7, 1996. Colonial Mirror and Glass Corp. formerly operated a garage at the property. January 7, 2002 Colonial Mirror and Glass Corp. sold the property to George and Abe Weiner, aka, Abraham individually and as trustees of the Colonial trust. In August of 2013 Amazon opened a photography studio at the property.

- Parcel 2 [Block 2287 Lot 1]: Brooklyn Union Gas Company sold the property to Kent Industrial Corp. on July 22, 1946. A warehouse/industrial building was constructed by 1951 and was occupied by the Ferro-Co. Corp. for sheet metal product manufacturing. By 1965, the building was occupied by Commercial Corrugated Container Corp. On June 2, 1971 the property was owned by American Sandfill and Marine Corp. By 1978, the property was occupied by a New York City Department of Sanitation garage, which occupied the property until February 2009 when the building was demolished. The Parcel is currently a vacant, fenced lot used by the New York City Department of Parks and Recreation as a parking lot and an outdoor concert space during the summer.

- Parcel 3 [Block 2287 Lot 16]: The property was sold by the Brooklyn Union Gas Company to Havemeyer and Elder Inc. on January 31, 1947. Again, the property was purchased possibly to extend the Brooklyn Eastern District Terminal operations. Paragon Oil Co. Inc. purchased the property from the Brooklyn Eastern District Terminal on August 14, 1958. The 1965 Sanborn depicts two railroad spurs, a repair shop, office, scale, and scrap metal storage on the property. By 1978, the property and buildings were vacant except for the office. Texaco Inc. sold the property to Bridge Lumber Co. Inc. on May 24, 1982 which then sold the property to the New York City Industrial Development Agency on October 5, 1982. In 1983, the buildings were demolished and the property was used for parking. In March 26, 1987 the property was repurchased by the Bridge Lumber Co. Inc. which sold it to the R.A.R Realty Corp. on the same day. The current warehouse building was constructed in 1985 and used for lumber storage from 1988 until 1995 according to Sanborn maps. An underground storage tank, used as an oil/water separator for rainwater runoff from delivery trucks by the lumber company, was identified beneath the floor of the building in a 1998 Phase I ESA conducted by EEA. CitiStorage used the building for document storage until January 2015 when a fire destroyed the building. This parcel is currently vacant.

- Parcel 4 [Block 2287 Lot 30]: According to the title search, the property was sold from the Brooklyn Union Gas Company to Havemeyer and Elder Inc. on January 31, 1947. Havemeyer & Elder purchased multiple properties along the East River to expand their railroad terminal, the Brooklyn Eastern District Terminal. The 1965 Sanborn figure depicted three railroad spurs extending into the property from the west. Brooklyn Eastern District Terminal sold the property to Paragon Oil Company Inc. on August 14, 1958. The Sanborn maps depict oil truck parking operations occurred from approximately 1978 until 1982. Texaco Inc. sold the property to The Bridge Lumber Company Inc. on May 24, 1982. The current warehouse building was constructed in 1985 and used for lumber storage from 1988 until 1995 according to Sanborn maps. CitiStorage used the building for document storage until January 2015 when a fire destroyed the building. This parcel is currently vacant.

3.1.3 Current Site Conditions

The current site conditions of each property are summarized below.

Parcel ID	Address	Current Owner	Block	Lot	Land Use Description
1	35 Kent Avenue Brooklyn, NY 11211	North 12th Associates	2288	1	Industrial-factory building is used by Amazon as a photography studio.

Parcel ID	Address	Current Owner	Block	Lot	Land Use Description
2	21 North 12th Street (50 Kent Avenue) Brooklyn, NY 11211	Parks and Recreation	2287	1	Grassed fenced lot used by the New York City Department of Parks and Recreation as a pop-up park.
3	20 North 12th Street Brooklyn, NY 11211	10th Street, LLC.	2287	16	Vacant following the burning of former warehouse building.
4	2 North 11th Street Brooklyn, NY 11211	10th Street, LLC.	2287	30	Vacant following the burning of former warehouse building.

3.1.4 Investigation and Remedial History

On behalf of National Grid, GEI conducted a Remedial Investigation for the Williamsburg Works MGP site from June 2009 through December 2012. At their request, an interim data deliverable was submitted to NYSDEC in August 2010, and in September 2010 NYSDEC responded with a letter requesting that an excavation/stabilization-based IRM be performed at "the 50 Kent Ave. parcel (bounded by Citi Storage [Block 2278, Lot 16], N. 12th St., Kent Ave., and N. 11th St.)."

On August 2, 2011, NYSDEC approved, with modification, a GEI-prepared IRM Design Work Plan dated July 2011 and subsequently revised in August 2011. The IRM Design Work Plan was implemented by URS (URS has since become part of AECOM) between January 2012 and June 2015. URS submitted an IRM 100% Design Report (Design Report) to NYSDEC in June 2015. The Design Report was approved by NYSDEC on August 17, 2015. The IRM was conducted from December 2015 through June 2017.

During design of the IRM, GEI continued to implement RI field work. A RI Report, prepared by GEI, was submitted to NYSDEC on January 31, 2015.

3.2 Scope of Field Work

National Grid USA retained GEI to conduct a Remedial Investigation. Activities that GEI will be performing during the RI are listed below:

- Site Mobilization
- Soil Boring, Monitoring Well, Soil Vapor Point, and Test Pit Installation Observation
- Groundwater Sampling
- Non-Aqueous Phase Liquid (NAPL) Gauging and Recovery
- Site Survey

Table 2. GEI Employee Site Tasks and Descriptions

Task Number	Task Titles	Task Descriptions
1.	Site Mobilization	Mobilize equipment and contractors to Site, mark out sample locations, observe utility clearance activities.
2.	Soil Boring, Monitoring Well, Soil Vapor Point, and Test Pit Installation Observation	Observe contractor installing soil borings, monitoring wells, soil vapor points, and test pits and collect soil samples.
3.	Groundwater Sampling	Collect low flow groundwater samples.
4.	NAPL Gauging and Recovery	Gauge wells for NAPL and remove NAPL if necessary.
5.	Site Survey	Observe contractor surveying sample locations.

4. Potential Hazards

The potential hazards associated with site conditions and activity hazards related to GEI on-site activities have been identified in this section. Detailed information for these hazards and their control methods are discussed further in the Table 3 and the job hazard analysis (JHAs) included in Appendix B.

4.1 General Site Hazards

General hazards and control measures that are applicable to all site activities have been identified in Table 3.

Table 3. General Site Hazards

General Hazards These Hazards Apply to All Site Activities	Control Measure
Chemical / Contaminant Exposure – Skin and eye injury/irritation	• Wear protective coveralls (e.g. Tyvek®) with shoe covers, safety glasses, face shield, and Nitrile gloves (as needed). • Dispose of gloves after use and wash hands. • Avoid contact with pooled liquids and limit contact with contaminated soils/groundwater. • See SOP HS-009
Cold Stress – Hypothermia, Frostbite	• Take breaks in heated shelters when working in extremely cold temperatures. • Drink warm liquids to reduce the susceptibility to cold stress. • Wear protective clothing (recommended three layers: an outside layer to break the wind, a middle layer to provide insulation, and an inner layer of cotton of synthetic weave to allow ventilation). • Wear a hat and insulated boots. • Keep a change of dry clothing available in case clothes become wet. • Do heavy work during the warmer parts of the day and take breaks from the cold. • If possible, shield work areas from drafts of wind and use insulating material on equipment handles when temperatures are below 30°F • Watch for symptoms of cold stress and initiate first aid procedures (Section 4.3.2).

General Hazards These Hazards Apply to All Site Activities	Control Measure
Coronavirus-COVID-19	• Maintain a distance of 6 feet from others. • If tasks needed to be performed close to others, wear appropriate PPE including a face mask (surgical or cloth), gloves, and eye protection. • When travelling to project site, travel in separate vehicles. Carpooling is allowed if all passengers are vaccinated and are comfortable sharing a vehicle. • Frequent washing of hands with soap and warm water for 20 seconds. If soap is not available, use hand sanitizer with 60% alcohol. • Wipe down surfaces such as equipment surfaces, vehicle steering wheel, gear shifter, controls, and door handles with disinfectant routinely before and after use. • Wear Nitrile gloves as frequently as possible. • Wash hands after gloves removal. • Do not shake hands, hug, or engage in other personal contact.
Driving	• Employees must wear their safety belt while in a moving vehicle. • Vehicle accidents will be reported in accordance with GEI's accident reporting procedures. • Vehicles will be properly maintained and safely operated (refer to GEI's Fleet Maintenance Program). • Employees will follow safe driving behaviors, which include limiting distractions such as manipulating radios or other equipment that may cause a distraction. Employees should not exceed the posted speed limit and should maintain a safe distance between other vehicles. • Use defensive driving techniques. • Driving distance and time after a 12-hour shift should not exceed 30 miles or 30 minutes (whichever is greater). • See SOP HS-004
Dusty Conditions – Eye and respiratory irritation	• Avoid travel during times when dust causes hazardous driving conditions. • Wear protective gear – dust masks, safety glasses • • Use engineering methods to suppress dust if possible.
Heat stress – Fainting, Fatigue, Heat Stroke	• Increase water intake while working. • Increase number of rest breaks and/or rotate workers in shorter work shifts. Rest in cool, dry areas. • Watch for signs and symptoms of heat exhaustion and fatigue. • Plan work for early morning or evening during hot months. • Use ice vests when necessary. • In the event of heat stroke, bring the victim to a cool environment and initiate first aid procedures. • See Appendix C of the HASP

General Hazards These Hazards Apply to All Site Activities	Control Measure
Inclement Weather	• Listen to local forecasts for warnings about specific weather hazards such as tornados, thunderstorms, and flash floods. • If the storms produce thunder and/or lightning, leave the work area immediately and move to a safe area. • Discuss an action plan prior to the severe weather. • Wear appropriate PPE for the type of weather that could be encountered. • Stop work until conditions are suitable. Take cover in vehicles or shelter as appropriate. • See SOP HS-010
Insects – Bites, Stings, Allergic Reactions	• Apply insect repellent prior to performing field work and as often as needed throughout the work shift • Wear proper protective clothing (work boots, socks and light-colored clothing) • Wear shoes, long pants with bottoms tucked into boots or socks, and a long-sleeved shirt when outdoors for long periods of time, or when many insects are most active (between dawn and dusk). • When walking in wooded areas, avoid contact with bushes, tall grass, or brush as much as possible • Field personnel who may have insect allergies should have bee sting allergy medication on site and should provide this information to the SSM prior to commencing work. • Field personnel should perform a self-check at the end of the day for ticks. • See SOP HS-001
Physical Injury – Slips, Trips and Falls	• Wear PPE that properly fits, is in good condition and appropriate for the activities and hazards. • Maintain good visibility of the work area. • Avoid walking on uneven, steeply sloped or debris ridden ground surfaces. • Plan tasks prior to preforming them including an activity hazard analysis. • Keep trafficked areas free from slip/trip/fall hazards. • Maintain weed growth in sampling areas, especially on slopes. • Wear shoes with traction. • Avoid traversing steep areas in slippery conditions. • Do not carry heavy objects to sampling areas, on steeply sloped areas, or where steep areas must be traversed to arrive at sample points.
Repetitive Motion Injury – Standing, Squatting, and Bending Over	• Take regular breaks and do not work in unusual positions for long periods of time. • Walk and stretch between tasks. • See SOP HS-025

General Hazards These Hazards Apply to All Site Activities	Control Measure
Unsecured or High Crime Areas	• Be aware of your surroundings. • Use the buddy system. Do not remain on site alone. Accompany or be accompanied by others to vehicles. • Request police detail when appropriate. • Let the SSM know when you begin work in these areas and when you leave. • Call in regularly. • If you arrive in an area and it does not look safe to get out of your vehicle, lock the doors and drive off quickly but safely.
Utilities – Shock, Electrocution, Fire, Explosion	• A thorough underground utility survey must be conducted prior to intrusive activities. Coordination with utility locating services, property owner(s) or utility companies must be conducted. • Utilities are to be considered live or active until documented otherwise. • For overhead utilities within 50 feet, determine with the utility company the appropriate distance. Minimum distance for clearance is based on voltage of the line. • If exposing a utility, proper support and protection must be provided so that the utility will not be damaged. • If a gas line is contacted, the contractor must notify police, fire, and emergency personnel, and evacuate employees according to the site evacuation procedures. No attempt should be made to tamper with or correct the damaged utility. • See SOP HS-014
Vehicular Traffic – Struck by injury, crushing	• Increase visibility of the work area to others by using cones, flags, barricades, proper lighting and caution tape to define work area. • Use a "spotter" to locate oncoming vehicles. • Use vehicle to block work area. • Engage police detail for all work conducted in appropriate areas. • Wear high-visibility, reflective vest at all times. • Maintain minimum DOT defined distances to other traffic lanes. • See SOP HS-016.

4.1.1 Hazard Controls

On-site safety equipment to control the hazards listed above will include:

Site-Specific Safety Equipment *(check all that apply)*		
☒ Drinking water/electrolyte fluids	☒ Hand cleaner/sanitizer	☒ Tick removal kit
☒ Eye wash bottles	☒ Insect repellent	☒ Other: Tyvek clothing
☒ Fire extinguisher	☒ Phone charger	☐ Other:
☒ First aid kit	☐ Poison ivy/oak cleanser	☐ Other:
☐ Flashlight/head lamp	☒ Sunscreen	

GEI will ensure subcontractors are aware of pedestrian traffic safety for cyclers. GEI employees will ensure subcontractors are aware when a pedestrian is crossing the entrance and exit points to the Site on a bike.

Personal protective equipment (PPE) is discussed in further detail in Section 5.

4.1.2 Personal Safety

Field activities have the potential to take employees into areas which may pose a risk to personal safety. The following websites have been researched to identify potential crime activity in the area of the project:

- https://communitycrimemap.com/: No crimes identified in the past 30 days of preparing this HASP (June 2022) within a 3 mile radius of the Site.
- www.cityrating.com/crimestatistics.asp: New York crime statistics report an overall downward trend in crime based on data from 20 years with violent crime decreasing and property crime decreasing. With one exception to murder and manslaughter in 2019, but has decreased since then. Based on this trend, the crime rate in New York for 2022 is expected to be lower than in 2019.
- www.crimemapping.com : No crimes reported in the last 3 months within a 3 mile radius of the Site on this date, June 2022.

Employees must not knowingly enter into a situation where there is the potential for physical and violent behaviors to occur. If employees encounter hostile individuals or a confrontation develops in the work area, suspend work activities, immediately leave the area of concern, and contact local 911 for assistance. Notify the Site Safety Manager (SSM) and Safety Team (Safety Director and Regional Safety Managers – SafetyTeam@geiconsultants.com)mailto:Health%26safetyteam@geiconsultants.com of any incidents once you are out of potential danger.

In the event of an emergency, prompt communications with local emergency responders are essential. At least one charged and functioning cell phone to enable emergency communications will be on site. Confirmation of cellular phone operation will be confirmed at the start of each working day.

4.1.3 Communicable Diseases

Communicable diseases are illnesses caused by viruses or bacteria that people spread to one another through contact with contaminated surfaces, bodily fluids, blood products, insect bites, or through the air. Examples of communicable diseases include influenza, coronavirus 2019, hepatitis B, salmonella, measles, and blood-borne illnesses. Most common forms of spread include food, insect bites, droplets, or skin contact. Infections may range in severity from asymptomatic (without symptoms) to severe and fatal. Transmission of these biologic

agents can occur in a variety of ways including airborne (inhalation), direct physical contact with an infectious person, consuming contaminated foods or beverages, contact with contaminated body fluids, contact with contaminated inanimate objects, or being bitten by an infected insect or tick. Below are ways to prevent the infection or spread of communicable diseases:

1. Distancing - Maintain a distance of at least 6 feet (2 meters) from others. Minimize the number of employees in one location to the extent possible. If tasks need to be performed close to others (within 6 feet) and that cannot be avoided, wear appropriate PPE including a face mask (surgical or cloth), gloves, and eye protection.
2. Wash Hands Often - Frequent hand washing with soap and warm water for 20 seconds. If soap and water are not readily available, use hand sanitizer (containing 60% alcohol) until soap and water can be used.
3. Clean and Disinfect Commonly Used Surfaces - Wipe down surfaces with disinfectant on a routine basis. This includes field equipment and other items that may have previously been used by others. This is especially important while working in construction trailers. When using company and personal vehicles, wipe surfaces including the steering wheel, gear shifter, controls, and door handles before and after use.
4. Use Good Hygiene Practices – These include washing hands frequently, avoid touching your eyes, nose, and mouth, and cover coughs and sneezes.
5. Get Vaccinated - Vaccines can prevent many infectious diseases. There are also vaccines that are recommended or required for travel to certain parts of the world.
6. Avoid Touching Wild Animals - Be cautious around wild animals as they can spread infectious diseases.
7. Stay home when you are sick.

Appendix G includes National Grid's COVID-19 Health and Safety Plan. This guidance document, COVID-19 Health and Safety Plan, describes pandemic response measures, taken by National Grid, to help prevent the spread of COVID-19.

New York City Vaccine Mandate in effect. All employees, both management and union, who work in NYC, must be vaccinated, or request a medical or religious accommodation Visitors to NYC offices must also be vaccinated or have requested an accommodation.

4.2 Job Hazard Analysis

The site-specific tasks, potential hazards, and control measures established to reduce the risk of injury or illness are identified in step-by-step JHAs included in Appendix B. Prior to the start of work, project team members will determine what tasks are covered in the scope of work (Table 2) and then develop a JHA for each of these tasks and have them reviewed by

the Project Manager (PM) or their designee and approved by a member of the Safety Team. Indicated in each JHA are the specific PPE, training, equipment, health and safety SOPs and programs that apply to each task. Additional information on hazard controls can be found in GEI's SOPs and programs that apply to this project which are indicated in Appendix E.

4.2.1 Handling Drums and Containers

Regulations for handling drums and containers are specified by Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.120(j). Potential hazards associated with handling drums include vapor generation, fire, explosions, and possible physical injury. Handling of drums/containers during the Site investigation and remediation activities may be necessary. If drum/container handling is necessary, it will be performed in accordance with applicable regulations.

4.2.2 Electrical Hazards

4.2.2.1 Utilities

The Site may have shallow, buried utilities and also overhead utilities in certain areas. It will be necessary for parties disturbing the existing ground surface and conducting operations with heavy equipment having high clearances to exercise caution in performing project-related work with respect to the presence of utilities. Utility companies with active, buried lines in the Site area will be asked by the Contractor performing intrusive activities to mark their facilities. Employees will use these data to choose work locations.

4.2.2.2 Underground Utilities

No excavating, drilling, boring, or other intrusive activities will be performed until an underground utility survey, conducted by knowledgeable persons or agencies, has been made. This survey will identify underground and in-workplace utilities such as the following:

- Electrical lines and appliances.
- Telephone lines.
- Cable television lines.
- Gas lines.
- Pipelines.
- Steam lines.
- Water lines.
- Sewer lines.
- Pressurized air lines.

The location of utilities will be discussed with GEI employees and subcontractors during a Site Safety Briefing. Identified utilities should be marked or access to them otherwise restricted to avoid chance of accidental contact. 811 must be called at least 3-days prior to work starting and valid 811 tickets will be maintained on-site.

Even when a utility search has been completed, drilling, boring, and excavation should commence with caution until advanced beyond the depth at which such utilities are usually located. Utilities will be considered "live" or active until reliable sources demonstrate otherwise.

4.2.2.3 Overhead Utilities

Overhead transmission and distribution lines will be carried on towers and poles which provide adequate safety clearance over roadways and structures. Clearances will be adequate for the safe movement of vehicles and for the operation of construction equipment.

Overhead or above-ground electric lines should be considered active until a reliable source has documented them to be otherwise. Elevated work platforms, ladders, scaffolding, man-lifts, and drill or vehicle superstructures will be erected a minimum of 20 feet (the actual distance is dependent upon the voltage of the line) from overhead electrical lines until the line is de-energized, grounded, or shielded so arcing cannot occur between the work location or superstructure.

4.2.3 Precautions for Working in Confined Spaces

Work in confined spaces will be performed in accordance with 29 CFR 1910.146 and the GEI Permit Required Confined Space Entry program. Confined space work will not be performed without first notifying and receiving approval from a member of the Safety Team. The PM will work with the Safety Director to address confined space hazards as applicable prior to the start of the project. The PM will contact local emergency responders to plan for potential rescue. This correspondence will be documented on the Confined Space Permit and communicated to the project team. A confined space entry number will be obtained from the Safety Director or the RSM before entering space.

A JHA will be developed that includes the site-specific tasks and hazard controls in will be reviewed by the PM and included in Appendix B. A link to GEI's Confined Space program is available in Appendix E which directs you to the Safety Resources page of GEI Connections. Excavations and Trenches (Including Drilling)

The safety requirements for excavations and trenches must be determined by a competent person who is capable of identifying existing and predictable hazards and work conditions that are unsanitary, hazardous, or dangerous to GEI employees. The competent person must

also have the authorization to take prompt corrective measures to eliminate unsatisfactory conditions. GEI employees will not enter trenches.

The following are general requirements for work activities in and around excavations:

- Prior to initiation of excavation activity (or ground intrusive activity, such as drilling), the location of underground installations will be determined. The One-Call/Dig-Safe center will be contacted by the Contractor/Subcontractor a minimum of 72 hours prior to excavation activities. It may also be necessary to temporarily support underground utilities during excavation. When excavations approach the estimated location of underground installations, the exact location of the underground installations will be determined by means that are safe for GEI employees, i.e., hand dig, test pits, etc.
- Excavations should be inspected daily by the excavating company's competent person prior to commencement of work activities. Evidence of cave-ins, slides, sloughing, or surface cracks or excavations will be cause for work to cease until necessary precautions are taken to safeguard employees.
- Excavated and other materials or equipment that could fall or roll into the excavation, and vehicular traffic and heavy equipment will be placed at least 5 feet from the edge of the excavation.
- Excavation operations will cease immediately during hazardous weather conditions such as high winds, heavy rain, lightning, and heavy snow.
- Atmospheres are to be tested with a properly calibrated Combustion Gas Indicator (CGI) or Gas Measurement Instrument (GMI) in accordance with National Grid excavation procedures as required.

Employees will refer to GEI's Excavation Safety SOP for further information.

4.2.4 Fire and Explosion

When conducting excavating activities, the opportunity for encountering fire and explosion hazards exists from contamination in soil and the possibility of free product in underground structures and pipelines. Additionally, the use of diesel-powered excavating equipment could present the possibility of encountering fire and explosion hazards.

4.2.5 Hand and Power Tools

In order to complete the various tasks for the project, personnel may use hand and power tools. The use of hand and power tools can present a variety of hazards, including physical harm from being struck by flying objects, being cut or struck by the tool, fire, and electrocution. Work gloves, safety glasses, and hard hats will be worn by the operating personnel when using hand and power tools and Ground Fault Circuit Interrupter (GFCI)-equipped circuits will be used for power tools.

4.2.6 Slips, Trips, and Falls

Working in and around the Site may pose slip, trip, and fall hazards due to slippery and uneven surfaces. Excavation at the Site may cause uneven footing in trenches and around the soil piles. Steep slope and uneven terrain conditions at the Site are also a primary concern. GEI employees will wear proper foot gear and will employ good work practice and housekeeping procedures to minimize the potential for slips, trips, and falls.

4.2.7 Manual Lifting

Manual lifting of objects and equipment may be required. Failure to follow proper lifting technique can result in back injuries and strains. Employees should use a buddy system and/or power equipment to lift heavy loads whenever possible and should evaluate loads before trying to lift them (i.e., they should be able to easily tip the load and then return it to its original position). Carrying heavy loads with a buddy and proper lifting techniques include: 1) make sure footing is solid; 2) make back straight with no curving or slouching; 3) center body over feet; 4) grasp the object firmly and as close to your body as possible; 5) lift with legs; and 6) turn with your feet, don't twist.

4.2.8 Projectile Objects and Overhead Dangers

Overhead dangers, including but not limited to falling debris and equipment, can occur while operating drill rigs. GEI employees will maintain a minimum distance from large overhead operations and to maintain proper communication with heavy equipment operators and their handlers, should work necessitate their presence beyond the minimum safety distance. Proper PPE will be worn during these types of activities including steel-toed/shank boots, safety vests, and hard hats.

4.2.9 Cuts and Lacerations

The core sampling program may require employees or the contractor to use powered cutting tools (circular saw or shears) or a hooked knife to cut open the sample liner. Safety box cutters will be utilized for routine operations such as opening boxes of supplies or cutting rope or string. When using cutting tools, follow the safety precautions listed below:

- Keep free hand out of the way.
- Secure work if cutting through thick material.
- Use only sharp blades; dull blades require more force that results in less knife control.
- Pull the knife through the object and away from your body; pulling motions are easier to manage.
- Do not put the knife in your pocket.
- Wear leather or Kevlar® gloves when using knives or blades, or when removing sharp objects caught or dangling in sampling gear.

4.3 Heat and Cold Stress

4.3.1 Heat Stress

Employees may be exposed to the hazards associated with heat stress when ambient temperatures exceed 80ºF. To prevent heat-related illness, Project Managers (PMs) should plan for proper hydration (drinking plenty of water), acclimatization (getting used to weather conditions), and schedules that alternate work with rest. Employees should also be trained to recognize the symptoms of heat related illnesses and know how to administer first aid for heat-related illnesses and activate emergency medical services quickly when needed. Water and shade will be available to all project employees and located as close as practicable to the work areas when temperatures exceed 80°F.

CDC Heat Planning Tool
For the most recent details and tools for heat stress, use your smart phone to access the Centers for Disease Control for the latest information. Additional details can be found in GEI's Heat Stress Program located on the Safety Resources page of GEI Connections.

Prior to each workday, the forecasted temperature and humidity for the worksite will be reviewed and will be compared against the National Weather Service Heat Index to evaluate the risk level for heat illness. When the temperature equals or exceeds 95°F, or during a heat wave, high heat procedures will be used which include additional preventive measures including pre-shift meetings to encourage employees to drink plenty of water, working in the buddy system or regular communication so observations can be made for heat related illness, and to remind employees of their right to take a cool-down rest when necessary.

4.3.2 Cold Stress

Employees may be exposed to the hazards associated with cold stress when working in cold, wet, and/or windy conditions. Potential hazards in cold environments include frostbite, trench foot or immersion foot, hypothermia, as well as slippery surfaces, brittle equipment, and poor judgment.

CDC Cold Stress Info
For the most recent details and tools for cold stress, use your smart phone to access the Centers for Disease Control for the latest information. Additional details can be found in GEI's Cold Stress Program located on the Safety Resources page of GEI Connections.

4.4 Confined Spaces

Work in confined spaces will be performed in accordance with 29 CFR 1910.146 and the GEI Permit Required Confined Space Entry program. Confined space work will not be performed without first notifying and receiving approval from a member of the Safety Team. The PM will work with the Safety Director to address confined space hazards as applicable prior to the start of the project. The PM will contact local emergency responders to plan for potential rescue. This correspondence will be documented on the Confined Space Permit and communicated to the

project team. A confined space entry number will be obtained from the Safety Director or the RSM before entering space.

A JHA will be developed that includes the site-specific tasks and hazard controls in will be reviewed by the PM and included in Appendix B. A link to GEI's Confined Space program is available in Appendix E which directs you to the Safety Resources page of GEI Connections.

4.5 Noise

Noise is a potential hazard associated with the operation of heavy equipment, power tools, pumps, and generators. Employees who will perform suspected or established high noise tasks and operations will wear hearing protection. If deemed necessary by the SSM, the Safety Director will be consulted on the need for additional hearing protection and the need to monitor sound levels for Site activities. Other employees who do not need to be in proximity of the noise should distance themselves from the equipment generating the noise.

4.6 Constituents of Concern

The characteristics of constituents of concern (COC) at the site are discussed below for safety information purposes. A COC is any substance classified or defined as hazardous, extremely hazardous, toxic, or dangerous. The COC included in this health and safety plan will be the primary constituents that have been detected on site or are anticipated to be detected. These COC will be used to determine the action levels and PPE necessary for site personnel. Adherence to the safety and health guidelines in this HASP should reduce the potential for exposure to the COC discussed below.

4.6.1 Site-Specific COC

4.6.1.1 Asbestos-Containing Materials

The Site potentially contains asbestos-containing materials (ACM) in the forms of demolition debris within or without holders, ACM pipe insulation, and asbestos cement pipe. Chronic exposure to asbestos may cause asbestosis and mesothelioma. The primary route of exposure for asbestos is inhalation during the disturbance and/or removal of asbestos from the pipe insulation and cement pipes.

Asbestos is strictly regulated under OSHA 29 CFR 1910.1001/1926.1101. Employees that may be potentially exposed to ACM must participate in a medical surveillance program, have specific training in the hazards and controls of exposure to asbestos, and wear respirators with high efficiency particulate air (HEPA) filters. Work must be conducted in demarcated regulated areas to minimize the amount of people within the exposure area. Employers must conduct air sampling and provide signs and labels regarding the presence of asbestos.

4.6.1.2 Chlorinated Hydrocarbons

Chlorinated hydrocarbons (organochlorides) are a very large and diverse group of hydrocarbon molecules that also have at least one covalently bound chlorine atom chemically bonded to them. Chlorinated hydrocarbons are used predominantly as solvents and have historically been used as industrial degreasers, dry cleaning solvents, anesthetic agents and as refrigerants. They are colorless, volatile liquids with a moderately sweet aroma and partially soluble in but denser than water. They are the most common dense non-aqueous phase liquid (DNAPL).

The more common forms of chlorinated solvent contamination of soils and ground waters include:

- Tetrachloroethene (PCE, Tetrachloroethylene)
- Carbon tetrachloride (Tetrachloromethane or carbon tet)
- Trichloroethylene (TCE, Trichloroethene)
- 1,1,1-TrichloroMethane (Chloroform)
- 1,1,1-Trichloroethane (TCA, methyl chloroform, chlorothene, Solvent 111)
- Dichloromethane (DCM or methylene chloride)

As a class, the chlorinated hydrocarbons are potent central nervous system depressants or stimulants. They also cause greater liver and kidney damage compared to other organic solvents. Many have been shown to cause cancer in laboratory animals; due to widespread industrial use, the issue of carcinogenic risk to humans is one of the most controversial issues in regulatory toxicology.

Exposure to chlorinated hydrocarbon compounds in the occupational setting is primarily through inhalation. Skin absorption is variable and usually insignificant, although dermal absorption following prolonged or extensive skin contact can cause systemic toxicity.

4.6.1.3 Coal Tar and Coal Tar Products

Coal tar products, which are semi-volatile organic compounds (SVOCs) consist of a mixture of acenaphthene, acenaphthylene, anthracene, benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluorethene, benz(a)pyrene, benzo(e)pyrene, benzo(g,h,i)peryline, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3cd)pyrene, 2-methyl naphthalene, naphththalene, phenanthrene, phenols, pyrene.

Coal tar products and other SVOCs are present at the Site within impacted soil and groundwater and as a DNAPL by-product of gas production within soils, former MGP structures, and abandoned pipelines.

Coal tar products such as those listed above may cause contact dermatitis. Direct contact can be irritating to the skin and produce itching, burning, swelling, and redness. Direct contact or exposure to the vapors may be irritating to the eyes. Conjunctivitis may result from prolonged exposure. Coal tar is considered to be very toxic, if ingested. High levels of exposure to coal tar, though not anticipated during work activities conducted during this project, may increase the risk of cancer including lung, kidney, and skin cancer. Naphthalene is also an eye and skin irritant and can cause nausea, headache, fever, anemia, liver damage, vomiting, convulsions, and coma. Poisoning may occur by ingestion of large doses, inhalation, or skin absorption.

The major route of entry for the work activities to be conducted at this Site is through direct contact. Exposure is most likely when handling soil and water samples. Inhalation may occur when the soil is disturbed causing respirable and nuisance dust particles to become airborne.

4.6.1.4 Cyanide

Cyanide compounds are common by-products of manufactured gas production. Hydrogen cyanide is toxic because it is a chemical asphyxiate. It replaces the oxygen in the blood and thereby suffocates the cells. Ferro cyanides are not considered toxic because the hydrogen cyanide ion is bound too tightly to the iron and cannot therefore replace the oxygen. It takes a great amount of heat and/or acid to release cyanide gas from the ferro cyanide molecule; therefore, hydrogen cyanide is not a concern at this Site. However, it is National Grid's policy to monitor for hydrogen cyanide during earth-disturbing activities at sites where MGP-related contaminants have been found.

4.6.1.5 Heavy Metals

Exposure to high concentrations of arsenic can cause dermatitis, gastrointestinal disturbances, peripheral neuropathy, respiratory irritation, and hyper pigmentation of skin. Chronic exposure to arsenic has resulted in lung cancer in humans.

Exposure to high concentrations of aluminum can cause irritation of the eyes, skin, and the respiratory system.

Exposure to high concentrations of antimony can cause irritation of eyes, skin, nose, throat, and mouth; coughing; dizziness; headache; nausea, vomiting, diarrhea; stomach cramps; insomnia; anorexia; and could be unable to smell properly. Chronic exposure to antimony can produce respiratory effects that include antimony pneumoconiosis (inflammation of the lungs due to irritation caused by the inhalation of dust), alterations in pulmonary function, chronic bronchitis, chronic emphysema, inactive tuberculosis, pleural adhesions, irritation; cardiovascular effects (increased blood pressure, altered EKG readings and heart muscle damage) and gastrointestinal disorders in humans.

Exposure to high concentrations of beryllium can result in "beryllium sensitization," which is an allergic response to beryllium. Symptoms of the disease include cough, shortness of breath, fatigue, fevers, skin rash, and night sweats. In the later stages, lung tissue becomes scarred. In severe cases, the right side of the heart may be strained due to increased pressure in the pulmonary artery from lung damage.

Exposure to high concentrations of cadmium can cause acute symptoms such as pulmonary edema, dyspnea (breathing difficulty), cough, chest tightness and pain; headache; chills, muscle aches; nausea, vomiting, diarrhea; loss of the sense of smell), mild anemia; and is considered a potential occupational carcinogen.

Exposure to chromium can cause acute symptoms such as irritation of the eyes, nose and throat as well as wheezing and coughing. Chronic effects include nosebleeds, nasal congestion, dermatitis, and loss of sight.

Exposure to high concentrations of copper through inhalation can cause irritation of the eyes, nose, pharynx, nasal septum. Ingestion may cause a metallic taste. Skin irritation may result from direct contact with skin. Damage to the liver and kidneys may occur.

No adverse health effects are associated with environmental exposure to iron. Target organs for iron via ingestion of iron (most often in supplement form) are the liver, cardiovascular system, and kidneys. Exposure to high concentrations of iron through ingestion can cause salivation nausea, vomiting, diarrhea, and abdominal pain.

Exposure to lead may cause acute symptoms such as eye irritation, weakness, weight loss, abdominal pain, and anemia. Chronic exposure to lead may result in kidney disease, effects to the reproductive system, blood forming organs, and Central Nervous System (CNS).

Lead and arsenic are regulated by specific OSHA standards. They are 29 CFR 1910.1025/1926.52 and 29 CFR 1910.1018/1926.1118, respectively. These standards include specific requirements for air monitoring, signs and labels, training and medical surveillance.

Exposure to high concentrations of manganese can cause manganism, metal fume fever, flu-like fever, and kidney damage.

Exposure to high concentrations of nickel may cause sensitization dermatitis, allergic asthma, and pneumonitis. Exposure to mercury can cause dizziness, salivation nausea, vomiting, diarrhea, constipation, emotional disturbance, and kidney injury. Chronic exposure to mercury can cause CNS damage.

Exposure to high concentrations of selenium can cause mucous membrane irritation, coughing, sneezing, shortness of breath, chills, headaches, hypotension, and CNS depression.

Chronic exposure to selenium could cause bronchial irritation, gastrointestinal distress, excessive fatigue, and skin discoloration.

Exposure to high concentrations of thallium can cause nausea, diarrhea, abdominal pain, vomiting; tremor; chest pain, pulmonary edema; convulsions, psychosis; liver, kidney damage; and alopecia.

Vanadium may cause greenish-black discoloration of the tongue and is a possibly carcinogenic to humans. Long-term or repeated exposure to vanadium may have effects on the respiratory tract, resulting in chronic rhinitis and chronic bronchitis.

Exposure to high concentrations of zinc through ingestion can cause abdominal pain, nausea, vomiting, and diarrhea. Chronic exposure can lead to low blood pressure, jaundice, and seizures.

These metals are at environmental concentrations and are not expected to be at concentrations that exposure symptoms would occur. As with SVOCs, the primary route of exposure is through inhalation of dust particles when soil is disturbed and becomes airborne.

4.6.1.6 Hydrogen Sulfide

Hydrogen sulfide is another common by-product of manufactured gas production. Exposure to lower concentrations can result in eye irritation, a sore throat and cough, shortness of breath, and fluid in the lungs. These symptoms usually go away in a few weeks. Long-term, low-level exposure may result in fatigue, loss of appetite, headaches, irritability, poor memory, and dizziness. Breathing very high levels (> 800 parts per million [ppm]) of hydrogen sulfide can cause death within just a few breaths. The primary route of exposure is through inhalation and, therefore, respiratory protection is the primary control against exposure to hydrogen sulfide.

4.6.1.7 Pesticides

Pesticide exposures, in general, affect the CNS, liver, kidneys, and skin. At high concentrations, pesticides can cause headache, dizziness, nausea, vomiting, malaise (vague feeling of discomfort), sweating, limb jerks, convulsions, and coma. The pesticides detected at the site are at environmental concentrations and are not expected to be at concentrations that exposure symptoms would occur.

4.6.1.8 Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons (PAHs), are a group of chemicals consisting of numerous carbon atoms joined together to form multiple rings. PAHs include acenaphthene, acenaphthylene, anthracene, benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluorethene, benz(a)pyrene, benzo(e)pyrene, benzo(g,h,i)peryline, chrysene, dibenz(a,h)anthracene,

fluoranthene, fluorene, indeno(1,2,3cd)pyrene, 2-methylnaphthalene, naphthalene, phenanthrene, phenols, and pyrene. Most are formed from the incomplete combustion of plant or animal matter, or carbon fuels, such as coal or petroleum. These compounds are at environmental concentrations and are not expected to be at concentrations that exposure symptoms would occur. PAHs may cause contact dermatitis. Direct contact can be irritating to the skin and produce itching, burning, swelling, and redness. Direct contact or exposure to the vapors may be irritating to the eyes. Conjunctivitis may result from prolonged exposure. High levels of exposure to PAHs, though not anticipated during work activities conducted during this project, may increase the risk of cancer including lung, kidney, and skin cancer. Naphthalene is also an eye and skin irritant and can cause nausea, headache, fever, anemia, liver damage, vomiting, convulsions, and coma. Poisoning may occur by ingestion of large doses, inhalation, or skin absorption.

The major route of entry for the work activities to be conducted at this Site is through direct contact. Exposure is most likely when handling soil and water samples. Inhalation may occur when the soil is disturbed causing respirable and nuisance dust particles to become airborne.

4.6.1.9 Polychlorinated Biphenyls

Polychlorinated biphenyls (PCBs) have previously been encountered during MGP site investigations at other sites. PCBs have historically been used from a number of sources including, but not limited to; electrical systems, hydraulic oils, lubricants, cutting oils, printer's ink, and asphalt. Exposure to PCBs can occur through unbroken skin without immediate pain or irritation. PCBs detected at the site are at environmental concentrations and are not expected to be at concentrations that exposure symptoms would occur. Acute effects of exposure to high concentrations of PCB can include eye, skin, nose, and throat irritation. Chronic effects of PCB exposure can include skin swelling and redness, gastro-intestinal disturbances, and neurological effects such as headache, dizziness, nervousness, and numbness of extremities. PCBs are suspected human carcinogens that can cause liver cancer. PCBs can accumulate in fatty tissues and result in health effects after the initial exposure has occurred. The primary route of exposure for PCBs is inhalation, dermal contact, and ingestion. Analysis of soils from the Site did not indicate elevated PCB concentrations.

4.6.1.10 SVOCs

SVOCs are present at the Site within impacted soil and groundwater and as a dense DNAPL by-product of gas production within soils, former MGP structures, and abandoned pipelines.

These compounds are at environmental concentrations and are not expected to be at concentrations that exposure symptoms would occur. SVOCs such as those listed above may cause contact dermatitis. Direct contact can be irritating to the skin and produce itching,

burning, swelling, and redness. Direct contact or exposure to the vapors may be irritating to the eyes. Conjunctivitis may result from prolonged exposure. Many SVOCs are considered to be very toxic, if ingested. High levels of exposure to SVOCs, though not anticipated during work activities conducted during this project, may increase the risk of cancer including lung, kidney, and skin cancer. Naphthalene is also an eye and skin irritant and can cause nausea, headache, fever, anemia, liver damage, vomiting, convulsions, and coma. Poisoning may occur by ingestion of large doses, inhalation, or skin absorption.

The major route of entry for the work activities to be conducted at this Site is through direct contact. Exposure is most likely when handling soil and water samples. Inhalation may occur when the soil is disturbed causing respirable and nuisance dust particles to become airborne.

4.6.1.11 Volatile Organic Compounds

Volatile organic chemicals (VOCs), such as benzene, toluene, ethyl benzene, and xylene (BTEX) are present as soil and groundwater contaminants, and in some cases chemical components in NAPL such as oil or tar within soils and abandoned pipelines. These compounds are at environmental concentrations and are not expected to be at concentrations that exposure symptoms would occur. These compounds generally have a depressant effect on the CNS, may cause chronic liver and kidney damage, and some are suspected human carcinogens. Benzene is a known human carcinogen. Acute exposure may include headache, dizziness, nausea, and skin and eye irritation. The primary route of exposure to VOCs is through inhalation and, therefore, respiratory protection is the primary control against exposure to VOCs.

4.6.1.12 Coal Ash

Coal ash, also referred to as coal combustion residuals or CCRs, is produced primarily from the burning of coal in coal-fired power plants. Coal ash includes a number of by-products produced from burning coal. Coal ash contains contaminants like mercury, cadmium and arsenic. Ash is a solid, grey/black or brown/tan, odorless powder which may contain solidified masses. It is not combustible or explosive. Airborne dust may cause immediate or delayed irritation or inflammation to the eyes, nose, throat, or lungs depending on the degree of exposure. Ash may contain trace amounts of ammonia or ammonia bisulfate. Contact with water or moisture can cause the ammonia to be released from the ash into the air. Inhalation of ammonia can cause coughing and irritation or burns to the nose throat and lungs. These effects depend on the concentration of ammonia inhaled. Inhalation may occur when the soil is disturbed causing respirable and nuisance dust particles to become airborne. For dust generated during site activities which exceed site specific limits, engineering controls such as water application will be used to control dust concentrations.

4.6.1.13 Evaluation of Organic Vapor Exposure

Air monitoring reduces the risk of overexposure by indicating when action levels have been exceeded and when PPE must be upgraded or changed. Action Levels for VOCs and associated contingency plans for the work zone are discussed within Section 9 of this HASP.

Exposure to organic vapors will be evaluated and/or controlled by:

- Monitoring air concentrations for organic vapors in the breathing zone with a photoionization detector (PID) or a flame ionization detector (FID).
- When possible, engineering control measures will be utilized to suppress the volatile organic vapors. Engineering methods can include utilizing a fan to promote air circulation, utilizing volatile suppressant foam, providing artificial ground cover, or covering up the impacted material with a tarp to mitigate volatile odors.
- When volatile suppression engineering controls are not effective and organic vapor meters indicate concentrations above the action levels, then appropriate respiratory protection (i.e., air purifying respirator with organic vapor cartridge) will be employed.

4.6.1.14 Evaluation of Skin Contact and Absorption

Skin contact by contaminants may be controlled by use of proper hygiene practices, PPE, and good housekeeping procedures. The proper PPE (e.g., Tyvek®, gloves, safety glasses) as described in Section 5 will be worn for activities where contact with potential contaminated media or materials are expected.

Table 4. Primary Constituents of Concern Data

Constituent	Exposure Limit(s)	Route of Exposure	Primary Hazard/ Symptoms of Exposure
Aluminum	TWA 15 mg/m^3 (total) TWA 5 mg/m^3 (resp)	Inhalation, skin and/or eye contact	Irritation eyes, skin, respiratory system
Antimony	TWA 0.5 mg/m^3	Inhalation, ingestion, skin contact, eyes	Irritation eyes, skin, nose, throat, mouth; cough; dizziness; headache; nausea, vomiting, diarrhea; stomach cramps; insomnia; anorexia; unable to smell properly
Arsenic	0.01 mg/m^3 A.L. 0.005mg/m^3	Inhalation, skin absorption, ingestion, skin contact	Ulceration of nasal septum, dermatitis, GI disturbances, peripheral neuropathy, respiratory irritation, hyperpigmentation of skin, potential carcinogen
Asbestos	0.1 f/cc over 8 hr. period or 1.0 f/cc over 30 min.	Inhalation, ingestion, skin contact	Asbestosis (chronic exposure); mesothelioma, breathing difficulty, interstitial fibrosis' restricted pulmonary function, finger clubbing; irritate eyes, potential carcinogen

Constituent	Exposure Limit(s)	Route of Exposure	Primary Hazard/ Symptoms of Exposure
Barium	TWA 15 mg/m^3 (total) TWA 5 mg/m^3 (resp)	Inhalation, skin and/or eye contact	Irritation eyes, nose, upper respiratory system; benign pneumoconiosis (baritosis)
Benzene	1 ppm TWA 5 ppm STEL	Inhalation, skin absorption, ingestion skin contact	Irritation of eyes, skin, nose, respiratory system, giddiness, headache, nausea; staggering gait, fatigue, anorexia, weakness, dermatitis, bone marrow depression, potential carcinogen
Beryllium	TWA 0.002 mg/m^3 C 0.005 mg/m^3 (30 minutes), with a maximum peak of 0.025 mg/m^3	Inhalation, skin and/or eye contact	Berylliosis (chronic exposure): anorexia, weight loss, lassitude (weakness, exhaustion), chest pain, cough, clubbing of fingers, cyanosis, pulmonary insufficiency; irritation eyes; dermatitis; [potential occupational carcinogen]
Cadmium	TWA 0.005 mg/m^3	Inhalation, ingestion	Pulmonary edema, dyspnea (breathing difficulty), cough, chest tightness, substernal (occurring beneath the sternum) pain; headache; chills, muscle aches; nausea, vomiting, diarrhea; anosmia (loss of the sense of smell), emphysema, proteinuria, mild anemia; [potential occupational carcinogen]
Carbon Disulfate	30 ppm C	Inhalation, ingestion, skin absorption, skin contact, eye contact	Dizziness, headache, poor sleep, lassitude, anxiety
Carbon Monoxide	50 ppm	Inhalation, skin and/or eye contact (liquid)	Headache, tachypnea, nausea, lassitude (weakness, exhaustion), dizziness, confusion, hallucinations; cyanosis; depressed S-T segment of electrocardiogram, angina, syncope
Carbon Tetrachloride	Ca ST 2 ppm (12.6 mg/m^3) [60-minute]	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin; central nervous system depression; nausea, vomiting; liver, kidney injury; drowsiness, dizziness, incoordination; [potential occupational carcinogen]
Chromium (Chromic Acid and Chromates)	0.1 mg/m^3	Inhalation, ingestion, skin contact	Irritates respiratory system, nasal, septum perforation, liver and kidney damage, leukocytosis (increased blood leucocytes), leukopenia (reduced blood leucocytes), moncytosis (increased monocytes), Eosinophilia, eye injury, conjunctivitis, skin ulcer, sensitivity dermatitis, potential carcinogen
Copper (as a fumes)	TWA 1 mg/m^3	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, nose, pharynx; nasal septum perforation; metallic taste; dermatitis; In Animals: lung, liver, kidney damage; anemia

Constituent	Exposure Limit(s)	Route of Exposure	Primary Hazard/ Symptoms of Exposure
Cresol	TWA 5 ppm (22 mg/m^3) [skin]	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin, mucous membrane; central nervous system effects: confusion, depression, respiratory failure; dyspnea (breathing difficulty), irregular rapid respiration, weak pulse; eye, skin burns; dermatitis; lung, liver, kidney, pancreas damage
Ethylbenzene	100 ppm	Inhalation, ingestion, skin contact	Eye, skin, mucous membrane irritation; headache; dermatitis, narcosis; coma
Hydrogen cyanide	10 ppm (11 mg/m^3) [skin]	Inhalation, ingestion, absorption, skin/eye contact	Asphyxia; weakness, headache, confusion; nausea, vomiting; increased rate and depth of respiration or respiration slow and gasping; thyroid, blood changes
Hydrogen sulfide (H2S)	20 ppm C 50 ppm [10-min. Maximum peak]	Inhalation, skin/eye contact	Irritation eyes, respiratory system; apnea, coma, convulsions; conjunctivitis, eye pain, lacrimation (discharge of tears), photophobia (abnormal visual intolerance to light), corneal vesiculation; dizziness, headache, fatigue, irritability, insomnia; gastrointestinal disturbance; liquid: frostbite
Iron	Iron oxide dust and fume: 10 mg/m^3	Inhalation, ingestion, eye contact	Respiratory tract irritation, coughing, shortness of breath, overdose of iron may cause vomiting, abdominal pain, bloody diarrhea, vomiting blood, lethargy, and shock; acidity in the blood, bluish skin discoloration, fever, liver damage, and possibly death; eye and cornea irritation and discoloration
Lead	0.05 mg/m^3 A.L. 0.03 mg/m^3	Inhalation, ingestion, skin contact	Weakness, insomnia; facial pallor; pal eye, anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis of wrist and ankles; irritates eyes, hypo tension
Manganese	C 5 mg/m^3	Inhalation, ingestion	Manganism; asthenia, insomnia, mental confusion; metal fume fever: dry throat, cough, chest tightness, dyspnea (breathing difficulty), rales, flu-like fever; low-back pain; vomiting; malaise (vague feeling of discomfort); lassitude (weakness, exhaustion); kidney damage
Mercury	0.10 mg/m3	Inhalation, ingestion, skin contact, skin absorption	Irritates eyes and skin, chest pain, cough, difficulty breathing, bronchitis, pneumonitis, tremor, insomnia, irritability, indecision, headache, fatigue, weakness, stomatitis, salivation, Gastrointestinal disturbance, weight loss, proteinuria
Naphthalene	10 ppm (50 mg/m^3) TWA	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes; headache, confusion, excitement, malaise (vague feeling of discomfort); nausea, vomiting, abdominal pain; irritation bladder; profuse sweating; jaundice; hematuria (blood in the urine), renal shutdown; dermatitis, optical neuritis, corneal damage

Constituent	Exposure Limit(s)	Route of Exposure	Primary Hazard/ Symptoms of Exposure
Nickel	TWA 1 mg/m^3 [*Note: The PEL does not apply to Nickel carbonyl.]	Inhalation, ingestion, skin and/or eye contact	Sensitization dermatitis, allergic asthma, pneumonitis; [potential occupational carcinogen]
PCBs (polychlorinated biphenyls)	0.5 mg/m^3 (Skin)	Inhalation, skin absorption, ingestion, skin contact	Irritate eyes; chloracne; liver damage
Phenol	5 ppm (19 mg/m^3) [skin]	Inhalation, skin, absorption, ingestion, skin contact	Irritates eyes, nose, throat, anorexia, weight loss, weakness, muscle ache, pain, dark urine, cyanosis, liver and kidney damage, skin burns, dermatitis, tremors, convulsions, twitching,
Portland Cement	TWA 50 mppcf	Inhalation, ingestion, Skin and/or Eye Contact	Irritation eyes, skin, nose; cough, expectoration; exertional dyspnea (breathing difficulty), wheezing, chronic bronchitis; dermatitis
Selenium	0.2 mg/m^3	Inhalation, ingestion, skin contact	Irritant to eyes, skin, nose and throat, visual disturbance, headache, chills, fever, breathing difficulty, bronchitis, metallic taste, garlic breath, GI disturbance, dermatitis, eye, and skin burns,
Thallium	OSHA PEL: TWA 0.1 mg/m^3 [skin]	Inhalation, skin absorption, ingestion, skin and/or eye contact	Nausea, diarrhea, abdominal pain, vomiting; ptosis, strabismus; peri neuritis, tremor; retrosternal (occurring behind the sternum) tightness, chest pain, pulmonary edema; convulsions, chorea, psychosis; liver, kidney damage; alopecia; paresthesia legs
Toluene	200 ppm	Inhalation, skin absorption, ingestion, skin contact	Eye, nose irritation; fatigue, weakness, confusion, euphoria, dizziness, headache; dilated pupils, tearing of eyes; nervousness, muscle fatigue, insomnia, tingling in limbs; dermatitis
1,2,4-Trimethyl-benzene	None	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, nose, throat, respiratory system; bronchitis; hypochromic anemia; headache, drowsiness, lassitude (weakness, exhaustion), dizziness, nausea, incoordination; vomiting, confusion; chemical pneumonitis (aspiration liquid)
1,3,5 – Trimethylbenzene	NA	inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, nose, throat, respiratory system; bronchitis; hypochromic anemia; headache, drowsiness, lassitude (weakness, exhaustion), dizziness, nausea, incoordination; vomiting, confusion; chemical pneumonitis (aspiration liquid)
Vanadium	C 0.5 mg	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, throat; green tongue, metallic taste, eczema; cough; fine rales, wheezing, bronchitis, dyspnea (breathing difficulty)

Constituent	Exposure Limit(s)	Route of Exposure	Primary Hazard/ Symptoms of Exposure
Xylene	100 ppm	Inhalation, skin absorption, ingestion, skin contact	Eye, skin, nose, throat irritation; dizziness, excitement, drowsiness; incoordination, staggering gait; corneal damage; appetite loss, nausea, vomiting, abdominal pain; dermatitis
Zinc	TWA 15 mg/m^3 (total dust) TWA 5 mg/m3 (resp dust)	Inhalation	Metal fume fever: chills, muscle ache, nausea, fever, dry throat, cough; lassitude (weakness, exhaustion); metallic taste; headache; blurred vision; low back pain; vomiting; malaise (vague feeling of discomfort); chest tightness; dyspnea (breathing difficulty), rales, decreased pulmonary function

Notes:
A.L. - Action Level
C - ceiling limit, not to be exceeded
Ca – carcinogen
f/cc - fibers per cubic centimeter
mg/m^3 - micrograms per cubic meter
mppcf - millions of particulates per cubic foot of air
ppm - parts per million
STEL - Short-term exposure limit (15 minutes)
TWA - Time-weighted average (8 hours)

4.6.2 Chemicals Brought on Site

Potential hazards associated with chemicals brought on site (e.g., decontamination chemicals, sample preservatives, fuels, calibration fluids) for the work will be mitigated through training, administrative controls (e.g., proper labeling and storage), and proper use of PPE. Safety data sheets (SDSs) for all chemicals brought on site shall be maintained by the SSM and are included in Appendix C.

5. Personal Protective Equipment

The PPE required to be worn on the project site is listed in the table below. Additional PPE required for the tasks to be performed is listed on the JHAs in Appendix B.

Site Required PPE *(check all that apply)*		
☒ Hard Hat	☐ Respirator	☒ Tyvek clothing/boots
☒ Safety Glasses	☐ Flame Resistant Clothing	☐ Other:
☒ Safety Boots	☐ Personal Flotation Device	☐ Other:
☐ Long Sleeve Shirt	☐ Snake Chaps	☐ Other:
☒ High Visibility Safety Vest	☐ EH-Rated Boots	☐ Other:

If site conditions suggest the existence of a situation more hazardous than anticipated, the site personnel will evacuate the area to a safe distance. The hazard, the level of precautions, and the PPE will then be reevaluated with the assistance and approval of the Safety Director and the PM. If conditions indicating the need for Level A or Level B PPE are encountered, personnel will leave the site and notify the PM or a member of the Safety Team. GEI's PPE Program can be found on the Safety Resources page of GEI Connections.

5.1 Respiratory PPE

GEI personnel who have the potential to don a respirator must have a valid fit test certification and medical clearance. Both the respirator and cartridges specified for use in Level C protection must be fit-tested prior to use in accordance with OSHA regulations (29 CFR 1910.134). Air purifying respirators cannot be worn under the following conditions:

- Oxygen deficiency (less than 20.7%).
- Imminent Danger to Life and Health (IDLH) concentrations.
- If contaminant levels exceed designated use concentrations.

Upgrades to respiratory protection may be required based on the designated Action Levels found in Section 9.

6. Responsibilities and Lines of Authority

6.1 GEI Personnel Responsibilities

The implementation of health and safety at this project location will be the shared responsibility of the Safety Director, Regional Safety Director, PM, the Site Safety Manager (SSM), and each GEI personnel implementing the proposed scope of work.

6.1.1 GEI Safety Director

The Safety Director is responsible for the overall management of GEI's safety programs, policies, and procedures. Modifications to this HASP which may result in the reduction in the identification, evaluation, and control of safety and health hazards cannot be undertaken by the project team without the approval of the Safety Director.

6.1.2 GEI Project Manager

The PM is responsible for confirming that the requirements of this HASP are implemented. The PM's specific responsibilities include:

- Conducting and documenting the Project Safety Briefing.
- Verifying that the GEI staff and subcontractors selected to work on this program are sufficiently trained for site activities and have reviewed this HASP.
- Maintaining regular communications with the SSM and, if necessary, the Safety Director.

6.1.3 GEI Regional Safety Manager

The RSM is responsible for supporting the safety needs and requirements specified in this HASP. The RSM's specific responsibilities include:

- Reviewing and approving the HASP and applicable JHAs.
- Working with the PM and SSM to meet client safety requirements.
- Providing approval for fall protection plans and confined space entries (permit numbers), as applicable.
- Providing safety support regarding safety programs and procedures as applicable to the project.

6.1.4 GEI Site Safety Manager

The SSM is responsible for implementing and enforcing the safety requirements specified in this HASP and will be on-site during activities covered in the HASP. The SSM's specific responsibilities include:

- Enforcing the requirements of this HASP and notify the PM of noncompliance.
- Conduct daily Safety Tailgate meetings for site-related work.
- Maintaining a high level of health and safety consciousness among employees implementing the proposed activities.
- Procuring the air monitoring instrumentation, PPE, and safety equipment needed for GEI project employees and verifying that each is in good working order.
- Verifying that GEI subcontractors are utilizing the correct PPE and safety equipment.

6.1.5 All GEI Field Personnel

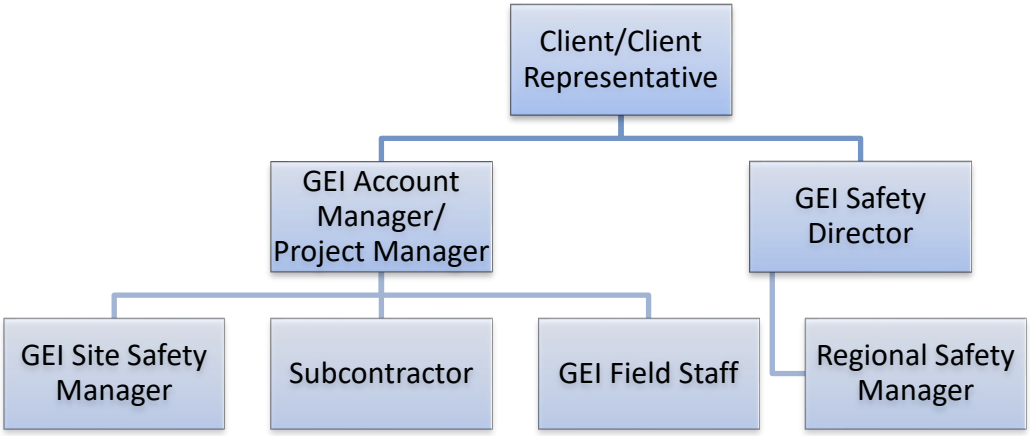
All GEI field personnel (including the PM and SSM) covered by this HASP are responsible for following the health and safety procedures in this HASP and for performing their work in a safe and responsible manner. The specific responsibilities that apply to all field personnel include:

- Reading and signing the HASP prior to the start of on-site work.
- Bringing forth any questions or concerns regarding the content of the HASP to the PM or the SSM.
- Attending and actively participating in the required Project Safety Briefing prior to beginning on-site work and any subsequent safety meetings.
- Complying with the requirements of this HASP and the requests of the SSM.
- Stopping work in the event that an immediate danger situation is perceived.
- Reporting accidents, injuries, and illnesses, regardless of their severity by following GEI's incident reporting procedures.

6.2 Lines of Authority

GEI will have responsibility for safety of its employees during the work performed at the site. GEI's SSM will have a cell phone available to contact the appropriate local authorities, in the event of an emergency. GEI's SSM will be available for communication with the GEI PM and with National Grid's representative.

Project Lines of Authority



6.2.1 Stop Work Authority

GEI employees have the authority to stop work activities if an unanticipated hazard is encountered or a potential unsafe condition is observed. The GEI employee should contact the Safety Director and the Project Manager to discuss the stop work conditions and potential control methods that can be implemented.

6.3 Subcontractors

GEI has subcontracted the following firms to assist in performing work on this project:

Subcontractor Information	
Aquifer Drilling & Testing 75 E 2nd St Mineola, NY 11501	
Contact Name: Joe McGill	Cell: (631) 889-2927
Scope of Work: Preclearing, test pit excavation, drilling, well construction, well development.	

GEI requires its subcontractors to work in a responsible and safe manner. Subcontractors hired by GEI are required to submit documentation of their safety practices as part of GEI's Subcontractor Safety Prequalification for evaluation and approval before the start of work. Subcontractors for this project will be required to develop their own HASP for protection of their employees, but, at a minimum, must adhere to applicable requirements set forth in this HASP. The PM will obtain applicable safety certifications and training records from the subcontractor's site supervisor prior to the initiation of work.

7. Training Requirements

Prior to commencement of field activities, the PM or their designee will verify GEI field personnel assigned to the project will have completed training that will specifically address the activities, procedures, monitoring, and equipment used in the site operations. This training will be documented on the applicable JHAs (Appendix B). Personnel that have not received project-specific training will not be allowed on site.

Applicable Site-Specific Training Requirements *(check all that apply)*		
☒ HAZWOPER (8Hr Refresher)	☐ Railroad	☐ Other:
☒ HAZWOPER (Site Supervisor)	☐ Transportation Worker Identification Credential (TWIC)	☐ Other:
☒ First Aid/CPR	☐ MSHA (Mine Safety and Health Administration)	☐ Other:

7.1 On-Site Safety Briefings

GEI personnel will be given health and safety briefings daily (or as frequently as needed) by the SSM or their designee to plan for conducting work activities safely. The briefing will include GEI subcontractors and others as appropriate. The briefings can include information on:

- Applicable JHAs.
- Changes in work practices.
- Changes in environmental conditions.
- Anticipated weather.
- Evacuation/emergency procedures.
- Air monitoring results.
- Safety inspection results.
- Pedestrian Cycling Awareness.

Documentation of these briefings will be recorded in the GEI field book or the Tailgate Safety Briefing Form (Appendix D). For long-term projects, the Tailgate Safety Briefing Form is preferred.

8. Medical Surveillance Program

GEI maintains a medical surveillance program under the supervision of the Safety Director that includes a plan designed specifically for field personnel engaged in work at sites where hazardous materials may be present. Field personnel undergo an initial physical examination, including a detailed medical and occupational history before they are able to engage in work at hazardous waste sites. Upon successful completion of the examination, personnel are provided a medical clearance from an occupational health physician stating their fitness to perform the specified work activities. Employees who are part of this program will schedule and attend annual exams 12 months from the date of their previous exam.

If a GEI employee or other project worker shows symptoms of exposure to a hazardous substance and wishes to be seen by a doctor, GEI will consult with their third-party medical administrator and provide access to the nearest area hospital or medical facility.

GEI subcontractor personnel that will enter any hazardous waste sites must certify that they are participating in a medical surveillance program that complies with OSHA regulations for hazardous waste operations (i.e., 29 CFR 1910.120 and 29 CFR 1926.65). A copy of their medical clearance will be submitted to the GEI PM or SSM prior to the start of field activities.

9. Atmospheric Monitoring

Air Monitoring Required?	
☒ Yes	☐ No*

Air monitoring will be performed to identify and quantify airborne levels of hazardous substances and atmospheric hazards to determine the appropriate level of worker protection needed on-site. Work on this project requiring air monitoring includes:

Air Monitoring Tasks *(check all that apply)*		
☒ Excavation	☐ Confined Space Entry	☐ Other:
☒ Soil Sampling	☐ Indoor Drilling	☐ Other:
☐ GW Monitoring Well Headspace	☒ Product Sampling	☐ Other:

The following air monitoring equipment will be on site:

Air Monitoring Equipment *(check all that apply)*	
☒ PID with 10.6 eV lamp or equivalent	☒ Particulate Meter (PM-10 capable)
☐ Drager Chip Measurement System (CMS) with appropriate gas detection chips	☒ Multi-gas meter: lower explosive limit (LEL) / oxygen (O_2) / hydrogen sulfide (H_2S) / hydrogen cyanide (HCN) or carbon monoxide (CO) meter
☐ Sensodyne Gas Detection Pump with appropriate gas detector tubes	☐ Other:

GEI will conduct and document on-site work zone monitoring and will inform GEI employees of the results. ***If Action Levels are exceeded, immediately implement site action(s) according to Action Table below and notify the PM***.

9.1 Calibration

Air monitoring equipment will be calibrated and maintained in accordance with manufacturer's requirements. Calibrations will be recorded in the project notes daily or on a daily calibration form.

9.2 Action Levels

The tables below provide a summary of real time air monitoring Action Levels and contingency plans for work zone activities. The below Action Levels are determined by halving the Permissible Exposure Limits (PELs) or Threshold Limit Values (TLVs) as set forth by OSHA and the American Conference of Government Industrial Hygienists (ACGIH).

9.2.1 VOC Monitoring and Control

Air monitoring reduces the risk of overexposure by indicating when action levels have been exceeded and when PPE must be upgraded or changed. Based on the volatile organic compounds (VOCs) listed in Table 4, determine which constituent has the lowest permissible exposure limit (PEL). This data is used to determine the action levels needed including respiratory protection at the project site. GEI's action level is half of the PEL listed in Table 4.

Exposure to organic COC can be evaluated and/or controlled by:

- Monitoring worker breathing zone atmospheric concentrations for organic COC in the breathing zone with a photoionization detector (PID) or a flame ionization detector (FID).
- When possible, engineering control measures will be utilized to suppress the volatile organic vapors. Engineering methods can include utilizing a fan to promote air circulation, utilizing volatile suppressant foam, providing artificial ground cover, or covering up the impacted material with a tarp to mitigate volatile odors.
- When volatile suppression engineering controls are not effective and organic vapor meters indicate concentrations above the action levels, then appropriate respiratory protection (i.e., air purifying respirator with organic vapor cartridge) will be employed.

Air Monitoring Instrument	Action Level (above background)	Site Action
Action Levels for the following parameters are 15-minute time weighted averages (TWA), not a single exceedance.		
PID (Monitoring for VOCs)	0.0 – 50 ppm	No respiratory protection is required if VOCs are not present.
	50 – 100 ppm	Stop work, withdrawal from work area, institute engineering controls, if levels persist, upgrade to Level C.
	> 100 ppm	Stop work, withdraw from work area, notify PM and Safety Team.
PID (Monitoring for benzene)	1.0 ppm	Use detector tube for benzene to verify if concentration is benzene. No respiratory protection is required if benzene is not present.
	1.0 – 50 ppm	No respiratory protection is required if benzene is not present. If benzene is present, stop work and contact your PM. If work continues, upgrade to Level C.
	50 – 100 ppm	Stop work, withdrawal from work area, institute engineering controls, if levels persist, stop work, contact PM and upgrade to Level C.
	> 100 ppm	Stop work, withdraw from work area, notify PM and Safety Team.

Air Monitoring Instrument	Action Level (above background)	Site Action
PID (Monitoring for naphthalene)	0.0 - 10 ppm	Use Sensodyne detector tube for naphthalene to verify if concentration is naphthalene. No respiratory protection is required if naphthalene is not present. If naphthalene is present, stop work and contact your PM. If work continues, upgrade to Level C.
	10 – 50 ppm	No respiratory protection is required if naphthalene is not present.
	50 – 100 ppm	Stop work, withdrawal from work area, institute engineering controls, if levels persist, stop work, contact PM and upgrade to Level C.
	> 100 ppm	Stop work, withdraw from work area, notify PM and Safety Team.

9.2.2 Dust Monitoring and Control

Some COC hazards may become hazardous when they are associated with dust/particles and become airborne. For worker safety, dust levels must be managed to eliminate this hazard. Dust generated during activities can cause irritation to the respiratory system and eyes. Contaminants can also be carried in airborne dust causing potential exposure to workers through skin contact and inhalation. Constituent concentrations on site are expected to be low therefore the exposure hazard through inhalation should be minimal; however, contaminant contact through skin and clothing can introduce additional exposures.

For dust generated during site activities which exceed site-specific limits, engineering controls such as water application will be used to control dust concentrations. However, if excessive dust concentrations cannot to be handled through engineering controls, then respirators will be required to be worn.

Air Monitoring Instrument	Action Level (above background)	Site Action
Action Levels for the following parameters are 15-minute time weighted averages (TWA), not a single exceedance.		
Particulate Meter	150 µg/m^3	Implement work practices to reduce/minimize airborne dust generation, e.g., spray/misting of soil with water. Don respirator with particulate filters if action levels remain in exceedance.

9.2.3 H_2S, CO, and Explosive Atmosphere Monitoring and Control

The SSM monitor operational areas for hydrogen sulfide (H_2S) and/or carbon monoxide (CO) prior to the start of work each day. Periodic readings will be taken throughout the day

and prior to any confined space entry. Oxygen (O_2) values are based on the maximum use limits of a full-face respirator if oxygen were being displaced by a chemical. Results will be compared to the published exposure limits/action levels listed below.

Air Monitoring Instrument	Action Level (above background)	Site Action
Action Levels for the following parameters are real time and should not be exceeded at any point.		
O_2 Meter	< 20.7%	Stop work, withdraw from work area, ventilate area, notify PM and Safety Team.
	> 21.1%	Stop work, withdraw from work area, notify PM and Safety Team.
H_2S Meter	< 5.0 ppm	No respiratory protection is required.
	> 5.0 ppm	Stop work, cover excavation, withdraw from work area, institute engineering controls, notify PM and Safety Team.
HCN Meter	< 1.0 ppm	Run CMS Drager tube. Continue monitoring with real-time meter and continue work if CMS Drager tube reading is less than 2.0 ppm.
	> 1.0 ppm HCN Concentrations < 2.0 ppm	Run CMS Drager tube and confirm concentration is less than 2.0 ppm, notify PM and Safety Team. Run CMS tube for sulfur dioxide, hydrogen sulfide, and phosphine chip potential interferences. Continue to monitor with real-time meter.
	> 2.0 ppm	Stop work and move (with continuous HCN monitoring meter) at lease 25 ppm upwind of the excavation until continuous meter reads less than 1 ppm, notify PM and Safety Team. Run CMS Drager hydrogen cyanide chip and re-evaluate activity, continue monitoring with a real-time meter, resume work if concentrations read less than 1.0 ppm.
Lower Explosive Limit	< 10% LEL	Investigate possible causes, allow excavation to ventilate, use caution during procedures.
	> 10% LEL	Stop work, allow excavation/borehole to ventilate to < 10% LEL, if ventilation does not result in a decrease to < 10% LEL, withdraw from work area, notify PM and Safety Team.
Carbon Monoxide	> 35 ppm	Stop work, withdraw from work area, ventilate area, notify PM and Safety Team.

10. Site Control

10.1 Site Zones

Site zones are intended to control the potential spread of contamination and to assure that only authorized individuals are permitted into potentially hazardous areas. This project is being conducted under the requirements of 29 CFR 1910.120, and any personnel working in an area where the potential for exposure to site contaminants exists, will only be allowed access after proper training and medical documentation.

10.2 Buddy System

GEI personnel should be in line-of-site or communication contact with another on-site person. The other on-site person should be aware of his or her role as a "buddy" and be able to help in the event of an emergency. Some projects may not support the need for the buddy system to be implemented. If this is the case, the PM is required to conduct regular check-ins with the employee on site.

10.3 Sanitation for Temporary Work Sites

Sanitation requirements identified in the OSHA Standard 29 CFR 1926.51 "Sanitation" specifies that employees working at temporary project sites have at least one sanitary facility available to them. Public restrooms are available in Bushwick Inlet Park, near the intersection of Kent Avenue and N. 9th Street.

Illumination requirements identified by OSHA are directed to work efforts inside buildings and/or during non-daylight hours. Activities planned for the site are anticipated to occur outside during daylight hours. However, if work areas do not meet illumination requirements, they will be equipped with appropriate illumination that meets or exceeds requirements specified in OSHA Standard 29 CFR 1926.56. Employees will not work on sites that are not properly lighted.

10.4 Smoking

Smoking is prohibited at or in the vicinity of hazardous operations or materials. Where smoking is permitted, safe receptacles will be provided for smoking materials.

10.5 Alcohol and Drug Abuse Prevention

Alcohol and drugs will not be allowed on the site. Project personnel under the influence of alcohol or drugs will not be allowed to enter the site. All GEI employees must comply with

GEI's Controlled Substance Use & Alcohol Misuse Policy found on the Safety Resources page of GEI Connections. Employees may be subject to random drug and/or alcohol testing if required by a client at a project site.

11. Incident Reporting

GEI will report incidents involving GEI personnel or subcontractor personnel, such as: lost time injuries, injuries requiring medical attention, near miss incidents, fires, fatalities, accidents involving the public, chemical spills, vehicle accidents, and property damage. The following steps must be followed when an incident occurs:

1. For incidents involving life-threatening situations or serious injury that require emergency response personnel (Police, Fire, EMS), call 9-1-1 from a safe area.
2. Stop work activity to address any injury, illness, property damage, spill or other emergency.
3. Call Medcor Triage at 1-800-775-5866 to speak with a medical professional following any injury or illness.
4. Notify the Project Manager of the incident or injury.
5. The Project Manager will immediately inform the Safety Director, GEI National Grid Client Manager, and the Project-Specific National Grid Representative of any accident, incident, injury or near miss.
6. Complete an incident report using the GEI Incident Report Form located on the GEI Safety Smartphone App, GEI Connections intranet page, or in the project HASP.
7. Resume work activity if all steps above have been completed and it is safe to do so.
8. A DRAFT Incident Report Form including root cause/corrective actions will be completed by a member of the Safety Team and submitted to the Project-Specific National Grid Representative within 4 hours.
9. A FINAL Incident Report will be submitted within 24 hours via e-mail to the Project-Specific National Grid PM, National Grid Regional Safety Lead, and/or the person to whom the verbal notification was initially provided.

All work will be suspended until contact is made with the Project-Specific PM so that National Grid can assess if continued work suspension or if a stand down is necessary. If the National Grid PM cannot be reached, contact the National Grid SIR Regional Safety Lead as noted on the following table.

Name	Region	Phone Numbers	E-Mail
William Ryan	Downstate NY	W- (516) 545-2586 C - (516) 790-1660	William.Ryan@nationalgrid.com
Brian Stearns	Upstate NY	W- (315) 428-5731 C - (315) 461-7892	Brian.Stearns@nationalgrid.com
Elizabeth Greene	MA/RI	W- (781) 907-3656 C- (781) 248-6469	Elizabeth.Greene@nationalgrid.com

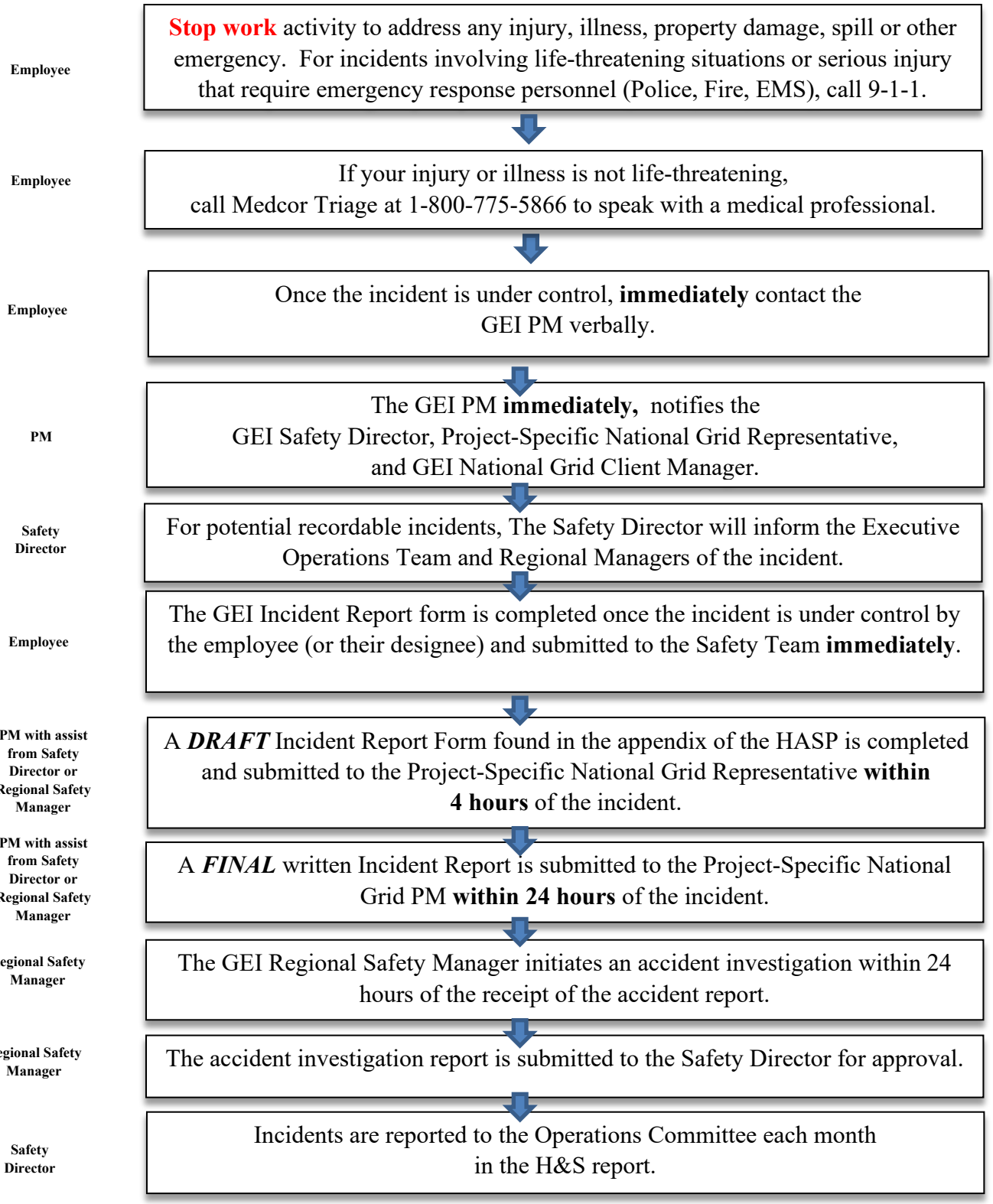
For vehicle accidents involving another vehicle or damage to property, the employee will take pictures of each vehicle or property involved in the incident and obtain a police report. In some municipalities police will not be dispatched to a non-injury accident, but every effort needs to be made to try and obtain the report.

The Incident Report Form and the Near Miss Reporting Form can be found in Appendix D, on the GEI Health and Safety smartphone app, or on the Safety Resources page of GEI Connections. To report subcontractor injuries or incidents, follow the same verbal reporting procedures and submit an email describing the event to the PM and the Safety Team. A representative with knowledge of the incident should be available to provide incident information until the investigation is completed by National Grid.

11.1 Injury Triage Service

If a GEI employee experiences a work-related injury that is not life-threatening, the employee will initiate a call to Medcor Triage at 1-800-775-5866. The injured employee will detail any medical symptoms or complaints which will be evaluated by a Registered Nurse (RN) specially trained to perform telephonic triage. The RN will recommend first aid self-treatment or refer the injured employee for an off-site medical evaluation by a health professional at a clinic within GEI's workers compensation provider network. GEI employees are still required to follow our Accident Reporting procedures as listed above.

11.2 Flow Chart for Accident Reporting



12. Decontamination Procedures

Site decontamination procedures are designed to achieve an orderly, controlled removal or neutralization of contaminants that may come in contact with personnel or equipment. These procedures minimize contact with contaminants and protect against the transfer of contaminants to clean areas. They also extend the useful life of PPE by reducing the amount of time that contaminants contact and can permeate PPE surfaces. This project is being conducted under the requirements of 29 CFR 1910.120(k), and any personnel or equipment that are exposed to site contaminants will follow applicable decontamination procedures.

12.1 Personnel and PPE Decontamination

A decontamination station where employees can drop equipment and remove PPE will be set up to minimize the potential for hazardous skin or inhalation exposure and to avoid cross-contamination and chemical incompatibilities. It will be equipped with basins for water and detergent, and trash bag(s), or cans for containing disposable PPE and discarded materials. Once personnel have decontaminated at this station and taken off their PPE, they will wash themselves wherever they have potentially been exposed to any contaminants (e.g., hands, face, etc.)

The following specific decontamination procedure will be used as necessary by GEI personnel or subcontractor personnel wearing PPE from Level D through Level C.

- ***Step 1*** **–** Equipment drop (respirator, tools, monitoring equipment, etc.) Decontaminate as appropriate (per GEI's field representative's instructions).
- ***Step 2*** **–** Boot wash/rinse (wash with non-foaming detergent, rinse with fresh water spray). Remove boots. If inner and outer gloves are worn, wash outer gloves, remove and save for later use, or remove and discard outer gloves and place in trash bag/can provided in the decontamination area.
- ***Step 3*** **–** Hard hat removal; wash if visibly contaminated (use same wash as in Step 2).
- ***Step 4*** **–** If Tyvek® (or equivalent) suit was worn and is visibly contaminated, remove and place in trash bag/can provided in the decontamination area or decontaminate (wash) and store for reuse. Contaminated washable coveralls should be removed and bagged for washing.
- ***Step 5*** **–** Respirator and/or eye protection removal (as applicable). Wash (per Step 2) to remove visible contamination.
- ***Step 6*** **–** Remove outer gloves.
- ***Step 7*** **–** Wash potentially exposed skin (use water and soap at indoor sink).
- ***Step 8*** **–** Disinfect respirator per manufacturer's recommendations.

Decontamination wastewater and used cleaning fluids will be collected and disposed of in accordance with applicable state and federal regulations.

Contaminated PPE (gloves, suits, etc.) will be decontaminated and stored for reuse or placed in plastic bags (or other appropriate containers) and disposed of in an approved facility. Decontamination wastewater and used cleaning fluids will be collected and disposed of in accordance with applicable state and federal regulations.

12.2 Heavy Equipment Decontamination

Heavy equipment decontamination will be performed by the Contractor within the limits of the on-site decontamination pad in accordance with the contract specifications. A steam generator and brushes will be used to clean demolition equipment and other tools. No heavy equipment will be permitted to leave the Site unless it has been thoroughly decontaminated.

Wastewater from the heavy equipment and personnel decontamination areas will be collected and disposed of in accordance with applicable state and federal regulations. The Contractor will be responsible for ultimate disposal of investigation-derived wastes.

12.3 Decontamination Equipment Requirements

The following equipment, if required, should be in sufficient supply to implement decontamination procedures for GEI's equipment.

- Buckets
- Alconox™ detergent concentrate
- Hand pump sprayers
- Long handled soft bristle brushes
- Large sponges
- Cleaning wipes for respirators
- Bench or stool(s)
- Methanol and/or Nitric Acid
- Liquid detergent and paper towels
- Plastic trash bags

The Contractor performing decontamination procedures is responsible for verifying that the above materials, as required for their operation, are in sufficient supply.

13. Emergency Response

13.1 Evacuation

Prior to the start of work, emergency procedures must be identified and communicated to workers on site. This includes evacuation routes, safe areas, and/or muster points. Also communicate how employees will be notified that an emergency or evacuation of the site is occurring (audio alarms, visible (light) alarms, radios, sirens, etc.) Upon discovering an emergency situation, personnel will notify the SSM, who will initiate an appropriate response. Once the scene is safe, use the incident report procedures to report the evacuation to the PM and Safety Team.

13.2 Fire

In the event of a fire personnel will evacuate the area to the muster point located on Figure 1. GEI's SSM will contact the local fire department with jurisdiction and report the fire. The SSM will account for GEI personnel and subcontractor personnel and report their status to the PM. Incident reporting procedures will be followed once the scene is safe.

13.3 Spills or Material Release

If a hazardous waste spill or material release occurs, if safe, the SSM or their representative will immediately assess the magnitude and potential seriousness of the spill or release based on the following:

- SDS for the material spilled or released.
- Source of the release or spillage of hazardous material.
- An estimate of the quantity released and the rate at which it is being released.
- The direction in which the spill or air release is moving.
- Personnel who may be or may have been in contact with the material, or air release, and possible injury or sickness as a result.
- Potential for fire and/or explosion resulting from the situation; and
- Estimates of area under influence of release.

If the spill or release is determined to be within the on-site emergency response capabilities, the SSM will verify implementation of the necessary remedial action. If the release is beyond the capabilities of the site personnel, personnel will be evacuated from the immediate area and the fire department will be contacted. The SSM will notify the PM and follow the incident reporting procedures.

13.4 Medical Support

In case of minor injuries, on-site care will be administered with the site first aid kit. A GEI employee certified by the American Red Cross or other American Health & Safety Institute (ASHI) will be on-site at all times. For serious injuries, call 911 and request emergency medical assistance. Seriously injured persons should not be moved unless they are in immediate danger. Notify the PM of the emergency and follow incident reporting procedures.

In the event of an emergency, prompt communications with local emergency responders are essential. At least one charged and functioning cell phone to enable emergency communications will be on site. Confirmation of cellular phone operation will be confirmed at the start of each working day.

Table 1 of this HASP contains detailed emergency information, including directions to the nearest hospital, and a list of emergency services and their telephone numbers. In addition, Appendix A includes a map to the local hospital/emergency room and Figure 1 indicates the evacuation route (including muster point).

13.5 Severe Weather

The contingency plan for severe weather includes reviewing the expected weather to determine if severe weather is in the forecast. Severe weather includes high winds over 40 miles per hour (mph), heavy rains or snow squalls, thunderstorms, tornados, and lightning storms. If severe weather is approaching, the decision to evacuate GEI personnel and subcontractor personnel from the site will be the responsibility of GEI's SSM. Notification of evacuation will be made to the PM. The SSM will account for GEI personnel and subcontractor personnel and report their status to the PM. If safe, work can resume 30 minutes after the last clap of thunder or flash of lightning.

13.6 Hazard Communication Plan

GEI personnel have received hazard communication (HAZCOM) training as part of their annual safety training and new employee safety orientation training. Hazardous materials brought on site will be properly labeled, stored, and handled. SDSs for each chemical will be included in this HASP in Appendix C. GEI's HAZCOM program can be found on the Safety Resources page of GEI Connections (Appendix E).

14. Health and Safety Plan Sign-Off

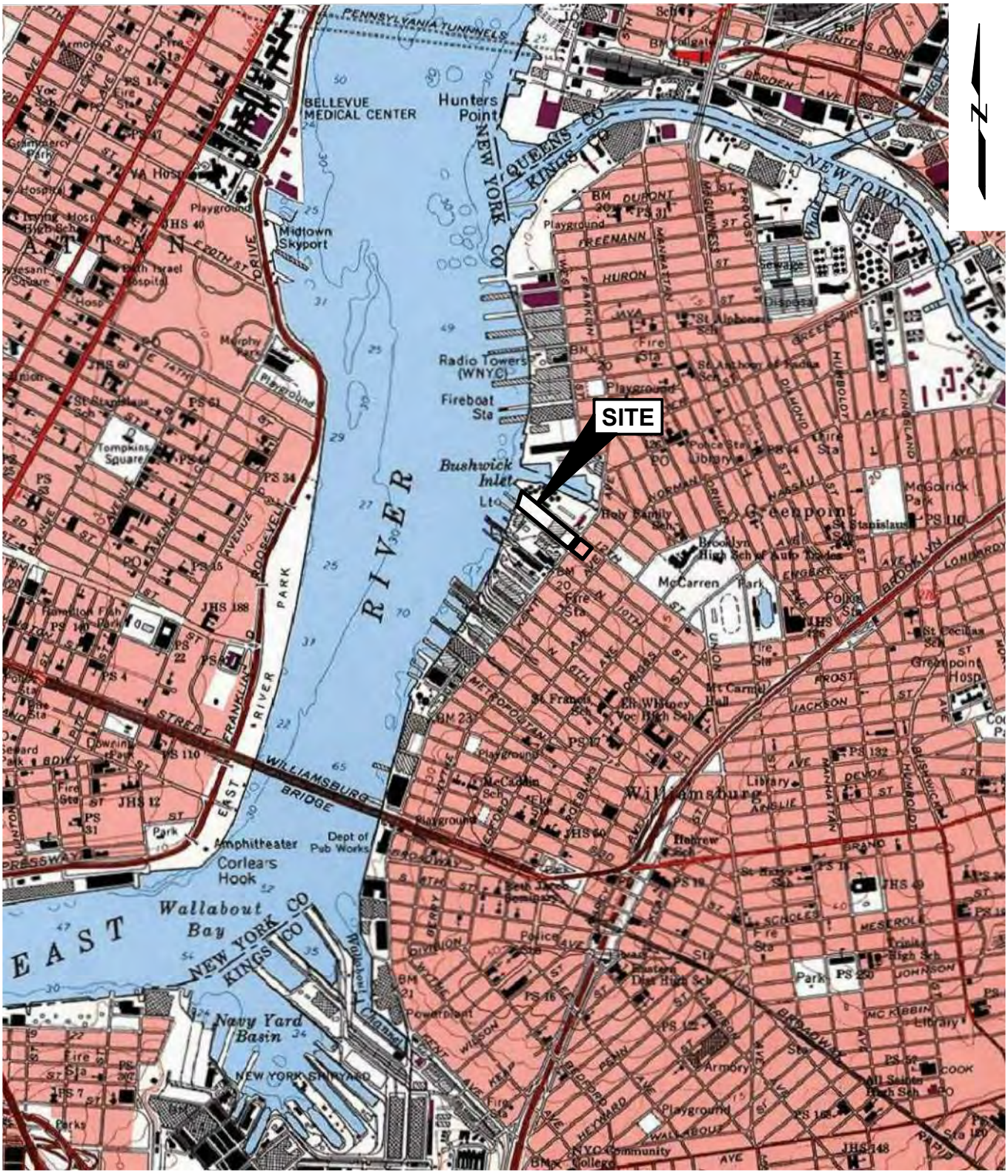
GEI personnel conducting site activities will be familiar with the information in this HASP. After reviewing this plan, please sign the copy in the project files, and bring a copy of the plan with you to the site. By signing this site-specific HASP, you are agreeing that you have read, understand, and will adhere to the provisions described in this plan while working on the site below.

Site Name: Williamsburg Works MGP Site

GEI Project No: 093060

Print Name	Signature
Project Manager: Melissa Felter	

Figure



SOURCE:

Map created with TOPO! ® ©2001 National Geographic (www.nationalgeographic.com/topo)

0 2000' 4000'

SCALE: 1" = 2000'

Williamsburg Works Former MGP Site Borough of Brooklyn, New York	GEI Consultants	SITE LOCATION MAP
nationalgrid	Project 093060	October 2022 Fig. 1

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Appendix A

Map to Hospital

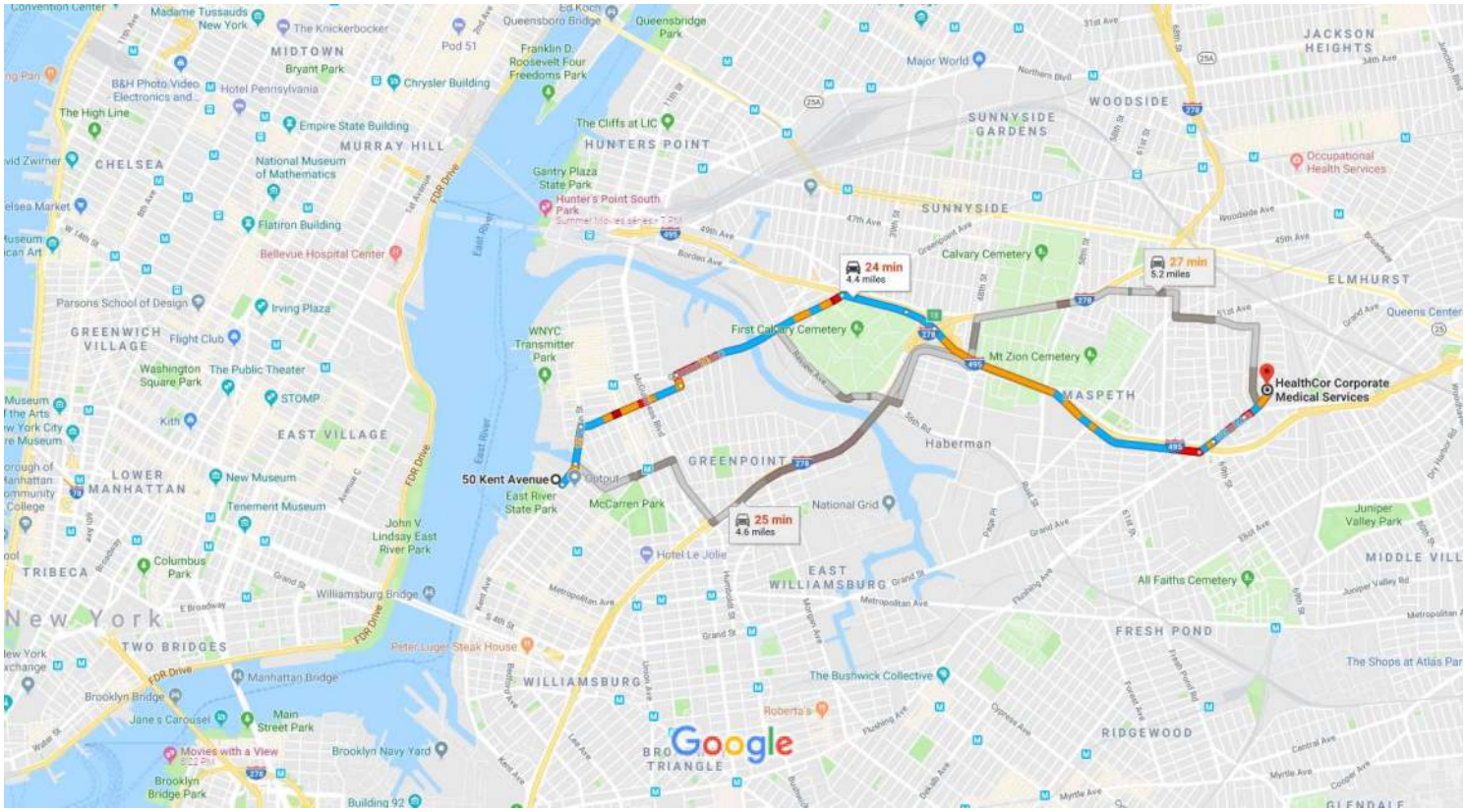
(Included if cell phone service is not reliable at or around project site)

Scan this QR code or click the link for access to Google Maps.

Google Maps

50 Kent Avenue, Brooklyn, NY to HealthCor Corporate Medical Services

Drive 4.4 miles, 24 min



Map data ©2018 Google 2000 ft

50 Kent Ave
Brooklyn, NY 11249

Take Franklin St to Calyer St

2 min (0.3 mi)

1. Head northeast on Kent Ave toward N 12th St

0.1 mi

2. Continue onto Franklin St

0.2 mi

Follow Calyer St to Greenpoint Ave

4 min (0.6 mi)

3. Turn right onto Calyer St

0.6 mi

4. Turn left onto Moultrie St

322 ft

Continue on Greenpoint Ave. Take Exit 18 and Borden Ave to Grand Ave in Queens

14 min (3.5 mi)

5. Turn right onto Greenpoint Ave

0.6 mi

6. Slight right to stay on Greenpoint Ave

0.4 mi

7. Turn right onto the Interstate 495 E ramp to Long Island Expressway/Eastern Long Island

0.3 mi

8. Use the 2nd from the left lane to follow signs for I-278 E/La Guardia/Airport/Bronx/I-495 Alt/Maurice Ave

0.2 mi

9. Keep left at the fork to continue on Exit 18, follow signs for Maurice Ave and merge onto Borden Ave
   Pass by McDonald's (on the right in 1.0 mi)

1.5 mi

10. Turn left onto Grand Ave

463 ft

11. Continue straight to stay on Grand Ave
    Pass by Iavarone Bros. (on the right)

0.2 mi

12. Continue straight to stay on Grand Ave
    Destination will be on the left

0.2 mi

HealthCor Corporate Medical Services

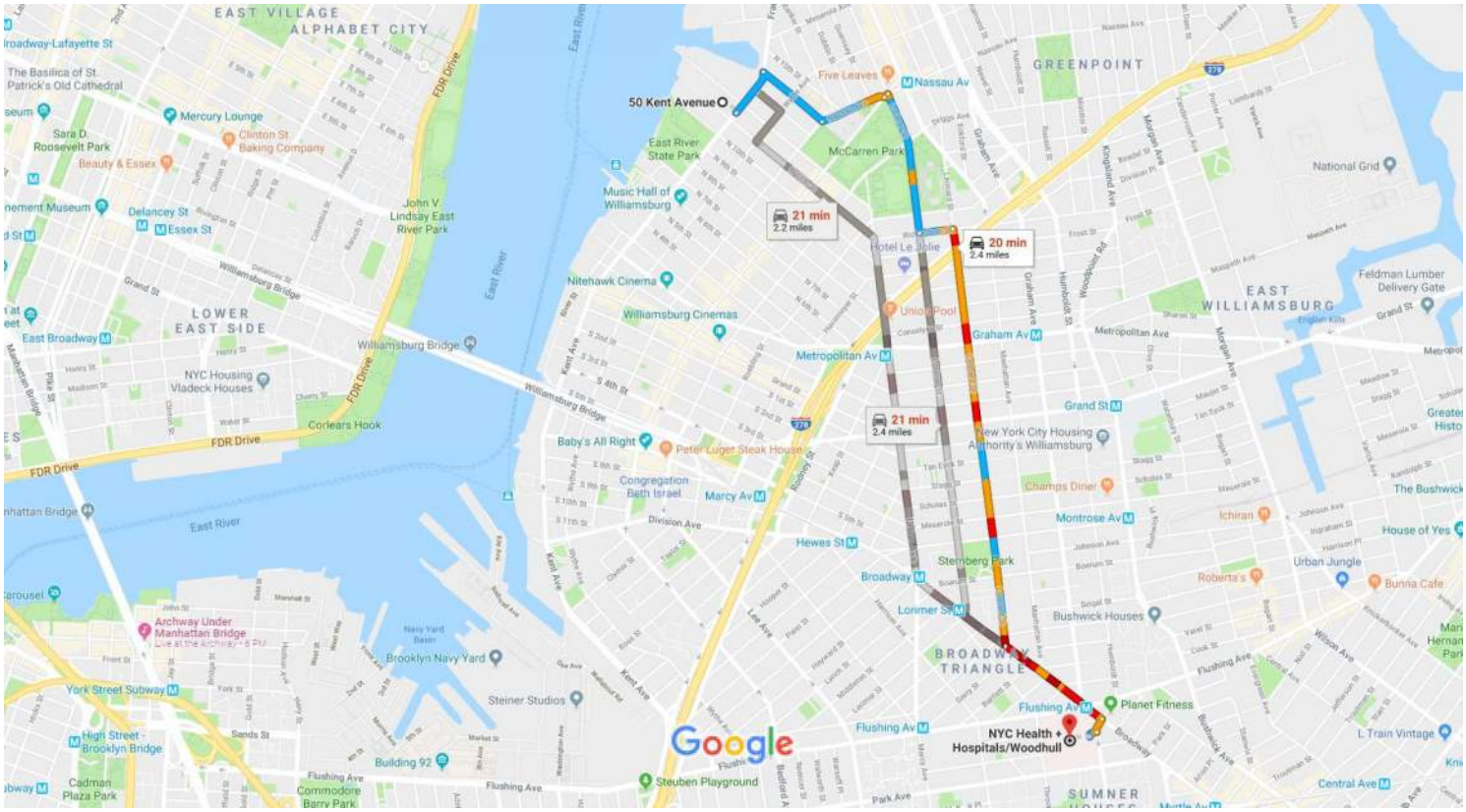
73-01 Grand Ave, Maspeth, NY 11378

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

Google Maps

50 Kent Avenue, Brooklyn, NY to NYC Health + Hospitals/Woodhull

Drive 2.4 miles, 20 min



Map data ©2018 Google 1000 ft

50 Kent Ave
Brooklyn, NY 11249

1. Head northeast on Kent Ave toward N 12th St — 32 s (0.1 mi)

Take Lorimer St and Leonard St to Broadway

13 min (1.9 mi)

2. Turn right onto N 14th St — 0.2 mi
3. N 14th St turns left and becomes Nassau Ave — 0.2 mi
4. Turn left onto Bedford Ave — 59 ft
5. Turn right onto Lorimer St — 0.4 mi
6. Turn left onto Richardson St — 459 ft
7. Turn right at the 1st cross street onto Leonard St — 1.1 mi

Drive

3 min (0.3 mi)

8. Turn left onto Broadway
   Pass by McDonald's (on the right)

0.3 mi

9. Turn right onto Marcus Garvey Blvd/Sumner Ave

197 ft

10. Turn right
    Destination will be on the right

27 s (135 ft)

NYC Health + Hospitals/Woodhull

760 Broadway, Brooklyn, NY 11206

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

Appendix B

Job Hazard Analyses

Job Hazard Analysis

Task	Drilling Oversight		
Revision Date	6/27/22	**Client Name**	National Grid
Project Name	Williamsburg MGP Site	**Project Number**	093060
Tools/Equipment Used	Hand tools, camera		
Task Specific Training	GEI Annual Safety Training (Field or HAZWOPER), First Aid/CPR		
Minimum PPE Required	☒ Hard Hat ☒Safety Glasses ☒Safety-Toed Boots ☒ Reflective Vest ☒Hearing Protection ☐ Personal Flotation Device (PFD) ☐ Face Shield ☐ Chaps ☐ Tyvek clothing/boots ☐ Flame Resistant Clothing ☒ Gloves Nitrile ☐Respirator ☐Other		

JHA Prepared By:	**Date:**	**Approved by:**	**Date:**

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
1. Mobilize on site	Slips/trips/falls, stuck by, crushing hazards	Hazard Identification HS-026	• Wear PPE that properly fits, is in good condition, and is appropriate for the activities and hazards. • Maintain good visibility of the work area. • Avoid walking on uneven, steeply sloped, or debris ridden ground surfaces. • Plan tasks prior to preforming them including an activity hazard analysis. • Keep trafficked areas free from slip/trip/fall hazards. • Wear shoes with traction. • Avoid traversing steep areas in slippery conditions. • Do not carry heavy objects to work areas, on steeply sloped areas, or where steep areas must be traversed to reach work areas.

[1] Use the hierarchy of controls to determine applicable hazard controls for the task in order of most effective to least effective: Elimination (physically remove the hazard), Substitution (replace the hazard), Engineering Controls (Isolate the team from the hazard), Administrative Controls (change the way people work), PPE (personal protective equipment).

Job Hazard Analysis
Task: Drilling Oversight
Project: Williamsburg MGP Site
Date: 6/27/22

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
2. Utility survey	Shock, Explosion, Fire	Utility Markout HS-014	• Ensure that all utilities have been properly marked prior to beginning work. • If a utility strike occurs, call the appropriate authorities immediately. Clear the area and do not delay.
3. Observe contractor activities	Struck by/crushing hazards	Working Around Heavy Equipment HS-018	• Identify yourself and your work location to heavy equipment operators, so they may incorporate you into their operations. • Coordinate hand signals with operators. • Confirm equipment inspection has been completed. • Stay Alert! Pay attention to equipment backup alarms and swing radii. • Position yourself in a safe location. • Confirm adequate clearance from overhead utilities. • Notify the contractor immediately if any problems arise. • Do not stand or sit under suspended loads or near any pressurized equipment lines. • Do not operate cellular telephones in the vicinity of heavy equipment operation.
4. Waste characterization	Contaminant contact	Hazardous Substance Management HS-009	• Wear proper PPE during sampling including nitrile gloves and safety glasses. • Dispose of gloves after use and wash hands. • Wear work gloves over nitrile gloves. • Keep trafficked areas free from slip/trip/fall hazards.
5. Demobilize from site	Personal/material security, slips/trips/falls	Hazard Identification HS-026	• Confirm all materials are secured/labeled, including drums and any equipment left on site. • Confirm that any open trenches/pits are properly marked or barricaded. • Clean all equipment/tools prior to leaving. • Secure any gates/locks. • Notify project manager (or designee) you are leaving the site.

Job Hazard Analysis

Task	Driving – Site Mobilization		
Revision Date	6/27/22	**Client Name**	National Grid
Project Name	Williamsburg MGP Site	**Project Number**	093060
Tools/Equipment Used	None		
Task Specific Training	GEI Annual Safety Training (Field or HAZWOPER), First Aid/CPR		
Minimum PPE Required	☐ Hard Hat ☐Safety Glasses ☐Safety-Toed Boots ☐ Reflective Vest ☐Hearing Protection ☐ Personal Flotation Device (PFD) ☐ Face Shield ☐ Chaps ☐ Tyvek clothing/boots ☐ Flame Resistant Clothing ☐ Gloves Nitrile ☐Respirator ☐Other		

JHA Prepared By: Melissa Felter	Date: 6/27/22	Approved by:	Date:

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
1. Inspect Vehicle	Slips/trips/falls	Hazard Identification HS-026, Driver Safety HS-004	• Walk around vehicle to inspect for any vehicle safety issues or hazards that could be within the travel path. • Adjust mirrors and seats prior to driving. • Becoming familiar with dashboard, center console, and steering controls. • Locate the turn signals, windshield wipers, lights, emergency flashers, and the heating, air conditioning, and defrost controls. • Use a spotter if needed when backing up.
2. Driving	Struck by/crushing hazards	Driver Safety SOP HS-004	• Employees must wear their safety belt while in a moving vehicle. • Employees will follow safe driving behaviors, which include limiting distractions such as manipulating radios or other equipment that may cause a distraction. Employees will not exceed the posted speed limit and will maintain a safe distance between other vehicles. • Use defensive driving techniques. • Avoid driving during hazardous weather conditions. • Driving distance and time after a 12-hour shift will not exceed 30 miles or 30 minutes (whichever is greater). • Vehicle accidents will be reported in accordance with GEI's

[1] Use the hierarchy of controls to determine applicable hazard controls for the task in order of most effective to least effective: Elimination (physically remove the hazard), Substitution (replace the hazard), Engineering Controls (Isolate the team from the hazard), Administrative Controls (change the way people work), PPE (personal protective equipment).

			accident reporting procedures.
3. Parking Vehicle	Struck by, crushing hazards, security	Driver Safety SOP HS-004	• Be aware of surrounding conditions. Park in designated areas or a safe area away from heavy equipment. • Position the vehicle in a manner which reduces or eliminates the need to operate the vehicle in reverse. Choose an easy-exit parking space, like pull-through or where no one else is parked. • Don't crowd neighboring vehicles; be sure to park your vehicle in the middle of your space. • Secure equipment and supplies in the trunk or where they cannot be seen. Or take items with you if they cannot be hidden. • If at night, park in well lit areas.
4. Site Entry	Slips/trips/falls, struck by, crushing	Working Around Heavy Equipment HS-018, Hazard Identification HS-026	• Don appropriate PPE prior to walking on site. • Identify yourself and your work location to heavy equipment operators, so they may incorporate you into their operations. • Stay Alert! Pay attention to equipment backup alarms and swing radii. • Avoid distractions like using cell phones while traversing the site.
5. Backing Up Vehicle	Struck by, crushing	Driver Safety HS-004	• Before entering your vehicle do a walk-around. Check for fences, poles, drop-offs, buildings, etc. • Know your clearances. While performing your walk-around also check for obstructions, low hanging eaves and tree limbs, wires, and any other potential clearance-related obstacles. • Use a spotter. Do not allow the spotter to be positioned directly behind your vehicle or walk backwards behind you while giving instructions. They should be off to the driver's side where you can see them in your side mirror.

Job Hazard Analysis

Task	**Excavation Oversight**		
Revision Date	6/27/22	**Client Name**	National Grid
Project Name	Williamsburg MGP Site	**Project Number**	093060
Tools/Equipment Used	Field book, phone camera		
Task Specific Training	GEI Annual Safety Training (Field or HAZWOPER), First Aid/CPR		
Minimum PPE Required	☒ Hard Hat ☒Safety Glasses ☒Safety-Toed Boots ☒ Refective Vest ☒Hearing Protection ☐ Personal Flotation Device (PFD) ☐ Face Shield ☐ Chaps ☐ Tyvek clothing/boots ☐ Flame Resistant Clothing ☐ Gloves ☐Respirator ☐Other		

JHA Prepared By:	**Date:**	**Approved by:**	**Date:**

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
1. Mobilize on site	Heavy lifting, strains/sprains, slip/trips/falls, pinch points, struck by, crushing hazards	Working Around Heavy Equipment HS-018, Manual Lifting HS-025, Hazard Identification HS-026 GEI Ergonomic Program, GEI Personal Protective Equipment Program	• Don appropriate PPE that properly fits, is in good condition, and is suitable for the activities and hazards. • Check in with appropriate heavy equipment operator personnel as applicable. • Maintain good visibility of the work area. • Avoid walking on uneven, steeply sloped, or debris ridden ground surfaces. • Plan tasks prior to preforming them including an activity hazard analysis. • Keep trafficked areas free from slip/trip/fall hazards. • Avoid traversing steep areas in slippery conditions. • Do not carry heavy objects to work areas, on steeply sloped areas, or where steep areas must be traversed to reach work areas. • Use the buddy system when necessary

[1] Use the hierarchy of controls to determine applicable hazard controls for the task in order of most effective to least effective: Elimination (physically remove the hazard), Substitution (replace the hazard), Engineering Controls (Isolate the team from the hazard), Administrative Controls (change the way people work), PPE (personal protective equipment).

Job Hazard Analysis
Task Name: Excavation Observation
Project: Williamsburg MGP Site
Date: 6/27/22

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
2.Conducting project activities around/near heavy equipment operations	Slip/trips/falls, pinch points, struck by, crushing hazards, unstable or non-secured load, noise exposure	Noise Exposure HS-012, Traffic Hazards HS-016, Working Around Heavy Equipment HS-018, Hazard Identification HS-026 GEI Ergonomic Program, GEI Personal Protective Equipment Program,	• Wear hardhat, high visibility safety vest, steel-toed, steel-shank boots or EH-rated safety boots with coposie toe and shank, safety glasses, nitrile/neoprene gloves, and earplugs. • Identify yourself and your work location to heavy equipment operators so they may incorporate you into their operations. • Coordinate hand signals with operators and field staff. • Approach heavy equipment from the front so operator can see you • Stay alert! Pay attention to equipment backup alarms and swing radii. • Wear high visibility safety reflective vest when working near equipment and/or motor vehicle traffic. • Position yourself in a safe location when filling out logs or talking with contractor or other field staff. • Notify the contractor immediately if any problems arise. • Do not stand or sit under suspeneded loads or near any pressurized equipment lines. • Do not sit and stand near heavy equipment that is when materials are being unloaded, loaded, etc. • If a task requires inspection of materials, this should be done after they are securely stored. • Do not operate cellular telephones in the vicinity of heavy equipment operation.
3. Demobilize from site	Personal/material security, slips/trips/falls	Hazard Identification HS-026	• Confirm all materials are secured/labeled, including drums and any equipment left on site. • Confirm that any open trenches/pits are properly marked or barricaded. • Clean all equipment/tools prior to leaving. • Secure any gates/locks. • Notify project manager (or designee) you are leaving the site.

Job Hazard Analysis

Task	Groundwater Monitoring Well Gauging		
Revision Date	6/27/22	Client Name	National Grid
Project Name	Williamsburg MGP Site	Project Number	093060
Tools/Equipment Used	Hand tools, water interface meter		
Task Specific Training	GEI Annual Safety Training (Field or HAZWOPER), First Aid/CPR		
Minimum PPE Required	☐ Hard Hat ☒Safety Glasses ☒Safety-Toed Boots ☒ Reflective Vest ☐Hearing Protection ☐ Personal Flotation Device (PFD) ☐ Face Shield ☐ Chaps ☐ Tyvek clothing/boots ☐ Flame Resistant Clothing ☒ Gloves Nitrile/Cut resistant ☐Respirator ☐Other		

JHA Prepared By: Melissa Felter	Date: 6/27/22	Approved by:	Date:

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
1. Carry Equipment and Set-up	Heavy lifting, Cuts/Scrapes, Slips/Trips/Falls, Pinch points	Non-Powered Hand Tools HS-008a Manual Lifting HS-025 Ergonomic Program	• User proper lifting techniques. • Keep trafficked areas free from slip/trip/fall hazards. • Wear the proper type of glove to protect hands against sharp edges and skin/soft tissue injuries • Wear appropriate footwear • Be aware of hard to grip and hold items that may force your hand or wrist into awkward, stressful positions • Take breaks when carrying items frequently and/or for long distances • Do not overreach when picking up or placing items. • Use the buddy system when necessary
2. Open Monitoring Well	Cuts/Scrapes, Insect Bites	Non-Powered Hand Tools HS-008a Manual Lifting HS-025 Ergonomic Program	• Keep trafficked areas free from slip/trip/fall hazards. • Wear the proper type of glove to protect hands against sharp edges and skin/soft tissue injuries • Use proper tools to open monitoring wells • Open casings slowly in case insects inhabit the area. • If insect nest is inside casing, open protective casing and see if insects will leave the nest. Once free of insects, proceed with work. If not, contact project manager if problem persists. • If severely allergic to insects, have appropriate epinephrine on hand.

[1] Use the hierarchy of controls to determine applicable hazard controls for the task in order of most effective to least effective. Elimination (physically remove the hazard), Substitution (replace the hazard), Engineering Controls (Isolate the team from the hazard), Administrative Controls (change the way people work), PPE (personal protective equipment).

			• Remain calm and still if a single stinging insect is flying around. (Swatting at an insect may cause it to sting.) • If you are attacked by several stinging insects at once, run to get away from them. (Bees release a chemical when they sting, which may attract other bees.) • Follow incident reporting procedures if first aid is needed.
3. Deploy Interface Meter	Awkward position, contaminant exposure	Hazard Identification HS– 026 Ergonomic Program	• Wear Nitrile/neoprene gloves and dispose of gloves after use and wash hands. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep control of the reel when deploying the probe. Avoid letting the probe drop quickly into the well. • Reel the probe up slowly to avoid splashes from contaminated groundwater or sediment. • Keep trafficked areas free from slip/trip/fall hazards.
4. Equipment Decontamination	Contaminant Contact, Cuts or Abrasions, Slips/Trips/Falls	Hazard Identification HS–026 Ergonomic Program	• Wear nitrile gloves and glasses to provide eye protection from splashing. • Wash hands immediately after use. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep trafficked areas free from slip/trip/fall hazards.
5. Equipment De-Mob	Heavy lifting, Cuts/Scrapes, Slips/Trips/Falls, Pinch points	Non-Powered Hand Tools HS-008a Manual Lifting HS-025 Ergonomic Program	• User proper lifting techniques. • Keep trafficked areas free from slip/trip/fall hazards. • Wear the proper type of glove to protect hands against sharp edges and skin/soft tissue injuries • Wear appropriate footwear • Be aware of hard to grip and hold items that may force your hand or wrist into awkward, stressful positions • Take breaks when carrying items frequently and/or for long distances • Do not overreach when picking up or placing items. • Use the buddy system when necessary

Job Hazard Analysis

Task	Groundwater Sampling – (Low Flow)		
Revision Date	6/27/22	**Client Name**	National Grid
Project Name	Williamsburg MGP Site	**Project Number**	093060
Tools/Equipment Used	Hand tools, interface meter, pump, water quality meter		
Task Specific Training	GEI Annual Safety Training (Field or HAZWOPER), First Aid/CPR		
Minimum PPE Required	☐ Hard Hat ☒Safety Glasses ☒Safety-Toed Boots ☒ Reflective Vest ☐Hearing Protection ☐ Personal Flotation Device (PFD) ☐ Face Shield ☐ Chaps ☐ Tyvek clothing/boots ☐ Flame Resistant Clothing ☒ Gloves Nitrile/Cut resistant ☐Respirator ☐Other		

JHA Prepared By:	Date:	Approved by:	Date:

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
1. Carry Equipment and Set-up	Heavy lifting, Cuts/Scrapes, Slips/Trips/Falls, Pinch points	Non-Powered Hand Tools HS-008a Manual Lifting HS-025 Ergonomic Program	• User proper lifting techniques. • Keep trafficked areas free from slip/trip/fall hazards. • Wear the proper type of glove to protect hands against sharp edges and skin/soft tissue injuries • Wear appropriate footwear • Be aware of hard to grip and hold items that may force your hand or wrist into awkward, stressful positions • Take breaks when carrying items frequently and/or for long distances • Do not overreach when picking up or placing items. • Use the buddy system when necessary
2. Cut Tubing/String	Cuts/Scrapes, pinch points	Non-Powered Hand Tools HS-008a	• Keep free hand out of the way. • Secure work if cutting through thick material. • Use only sharp blades; dull blades require more force that results in less knife control. • Pull the knife through the object and away from your body; pulling motions are easier to manage. • Do not use knife as a pry tool. • Wear leather or kevlar gloves when using knives or blades, or when removing sharp objects caught or dangling in sampling gear.

[1] Use the hierarchy of controls to determine applicable hazard controls for the task in order of most effective to least effective: Elimination (physically remove the hazard), Substitution (replace the hazard), Engineering Controls (Isolate the team from the hazard), Administrative Controls (change the way people work), PPE (personal protective equipment).

3. Collect GW Reading/Samples	Awkward position, contaminant exposure	Hazard Identification HS– 026 Benzene Awareness Program Ergonomic Program	• Wear Nitrile/neoprene gloves and dispose of gloves after use and wash hands. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep trafficked areas free from slip/trip/fall hazards.
4. Drum Purge Water	Contaminant Contact, Cuts or Abrasions Heavy Lifting , Slips/Trips/Falls	Container Management HS–003 Manual Lifting HS–025 Ergonomic Program	• Wear proper PPE during sampling including nitrile gloves and safety glasses and face shield as appropriate. • Use proper dollies or drum moving tools. • Use applicable tools to open/close drum lids. • Do not handle drums with bulging sides. • Dispose of gloves after use and wash hands. • Wear work gloves over nitrile gloves. • Use proper lifting techniques. • Ask fellow worker for help. • Keep trafficked areas free from slip/trip/fall hazards.
5. Equipment Decontamination	Contaminant Contact, Cuts or Abrasions, Slips/Trips/Falls	Hazard Identification HS–026 Benzene Awareness Program Ergonomic Program	• Wear nitrile gloves and glasses to provide eye protection from splashing. • Wash hands immediately after use. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep trafficked areas free from slip/trip/fall hazards.
6. Equipment De-Mob	Heavy lifting, Cuts/Scrapes, Slips/Trips/Falls, Pinch points	Non-Powered Hand Tools HS-008a Manual Lifting HS-025 Ergonomic Program	• User proper lifting techniques. • Keep trafficked areas free from slip/trip/fall hazards. • Wear the proper type of glove to protect hands against sharp edges and skin/soft tissue injuries • Wear appropriate footwear • Be aware of hard to grip and hold items that may force your hand or wrist into awkward, stressful positions • Take breaks when carrying items frequently and/or for long distances • Do not overreach when picking up or placing items. • Use the buddy system when necessary

Job Hazard Analysis

Task	**Site Surveying**		
Revision Date	6/27/22	**Client Name**	National Grid
Project Name	Williamsburg MGP Site	**Project Number**	093060
Tools/Equipment Used	None		
Task Specific Training	Annual Safety Training (Field or Hazwoper), First Aid/CPR		
Minimum PPE Required	☐ Hard Hat ☐Safety Glasses ☒Safety-Toed Boots ☒ Reflective Vest ☐Hearing Protection ☐ Personal Flotation Device (PFD) ☐ Face Shield ☐ Chaps ☐ Tyvek clothing/boots ☐ Flame Resistant Clothing ☐ Gloves Enter Type(s) - e.g., Nitrile, Cut Resistant, Latex ☐Respirator Enter Type/Cartridges - (e.g., Half-face, P-100) ☐Other		

JHA Prepared By: Melissa Felter	**Date: 6/27/22**	**Approved by:**	**Date:**

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
1.Clothing Treatment - Permethrin	Chemical Exposure	Biological Hazards HS-001 (Permethrin Guidance)	• Read application instructions thoroughly and apply according to the directions. Do not over-treat products. • Permethrin treatments are for meant only for fabrics, do not apply directly to the skin. • Apply product to clothing and gear outdoors in a well-ventilated area protected from wind. • Hang treated clothing outdoors and allow for them to dry completely before wearing. • Do not spray directly on clothing that you are wearing. • Do not wear clothing or use gear that is not completely dry. • Wash treated clothing separate from other garments. • Retreat clothing and gear after six washings or six weeks of exposure to sun and air.

[1] Use the hierarchy of controls to determine applicable hazard controls for the task in order of most effective to least effective: Elimination (physically remove the hazard), Substitution (replace the hazard), Engineering Controls (Isolate the team from the hazard), Administrative Controls (change the way people work), PPE (personal protective equipment).

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
2.Carrying Equipment/Site Setup	Heavy lifting, strains/sprains, slip/trips/falls, pinch points	Non-Powered Hand Tools HAS-008a, Manual Lifting HS-025, GEI Ergonomic Program	• Use proper lifting techniques • Check route for clearance of trip hazards • Wear appropriate footwear and gloves to protect hands against sharp edges and soft tissue injuries • Be aware of hard to grip and hold items that may force your hand or wrist into awkward, stressful positions • Take breaks when carrying items frequently and/or for long distances • Do not overreach when picking up or placing items • Use the buddy system when necessary
3. Site Walk/Survey	Slip/trips/falls, repetition, heat stress, cold stress, biological hazards	Biological Hazards HS-001, Inclement Weather HS-010, Manual Lifting HS-025, Hazard Identification HS-026, GEI Cold Stress Program, GEI Heat Stress Program, GEI Ergonomic Program	• Wear steel-toed boots and high visibility reflective vest when traversing work areas • Avoid walking on uneven, steeply sloped or debris ridden ground surfaces • Discuss action plan prior to severe weather • Apply insect repellent and poisonous plant barrier cream prior to the start of any field work and as needed throughout the workday • Use the buddy system and have a check in plan with project team and/or project manager • Bring adequate hydration for the workday (water, fluids with electrolytes) • Apply sunscreen regularly or wear a hat and long sleeve to reduce sun exposure • Plan an area to take breaks with natural shade or provided by pop up structure • Bring backpack to carry your fluids, snacks, first aid kits, etc. for larger project sites
4.Demobilize from Site	Personal/material security, slips/trips/falls	Hazard Identification HS-026	• Confirm all materials are secured/labeled, including drums and any equipment left on site. • Confirm that any open trenches/pits are properly marked or barricaded. • Clean all equipment/tools prior to leaving. • Secure any gates/locks. • Notify project manager (or designee) you are leaving the site.

Job Hazard Analysis

Task	**Soil Sampling – Drill Rig**		
Revision Date	6/27/22	**Client Name**	National Grid
Project Name	Williamsburg MGP Site	**Project Number**	093060
Tools/Equipment Used	Hand tools, CAMP equipment, PID, camera		
Task Specific Training	GEI Annual Safety Training (Field or HAZWOPER), First Aid/CPR		
Minimum PPE Required	☒ Hard Hat ☒Safety Glasses ☒Safety-Toed Boots ☒ Reflective Vest ☒Hearing Protection ☐ Personal Flotation Device (PFD) ☐ Face Shield ☐ Chaps ☐ Tyvek clothing/boots ☐ Flame Resistant Clothing ☒ Gloves Nitrile ☐Respirator ☐Other		

JHA Prepared By:	**Date:**	**Approved by:**	**Date:**

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
1. Mobilize On Site/Equipment Setup	Slips/trips/falls, stuck by, crushing hazards	Hazard Identification HS-026	• Wear PPE that properly fits, is in good condition, and is appropriate for the activities and hazards. • Maintain good visibility of the work area. • Avoid walking on uneven, steeply sloped, or debris ridden ground surfaces. • Plan tasks prior to preforming them including an activity hazard analysis. • Keep trafficked areas free from slip/trip/fall hazards. • Wear shoes with traction. • Avoid traversing steep areas in slippery conditions. • Do not carry heavy objects to work areas, on steeply sloped areas, or where steep areas must be traversed to reach work areas.

[1] Use the hierarchy of controls to determine applicable hazard controls for the task in order of most effective to least effective: Elimination (physically remove the hazard), Substitution (replace the hazard), Engineering Controls (Isolate the team from the hazard), Administrative Controls (change the way people work), PPE (personal protective equipment).

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
2. Utility survey	Shock, Explosion, Fire	Utility Markout HS-014	• Ensure that all utilities have been properly marked prior to beginning work. • If a utility strike occurs, call the appropriate authorities immediately. Clear the area and do not delay.
3. Observe contractor activities	Struck by/crushing hazards	Working Around Heavy Equipment HS-018	• Identify yourself and your work location to heavy equipment operators, so they may incorporate you into their operations. • Coordinate hand signals with operators. • Confirm equipment inspection has been completed. • Stay Alert! Pay attention to equipment backup alarms and swing radii. • Position yourself in a safe location. • Confirm adequate clearance from overhead utilities. • Notify the contractor immediately if any problems arise. • Do not stand or sit under suspended loads or near any pressurized equipment lines. • Do not operate cellular telephones in the vicinity of heavy equipment operation.
4. Cutting cores	Cuts and lacerations	Hazardous Substance Management HS-009/ Non Powered Hand Tools HS-008a	• Use care when cutting cores. Use mechanical shears, electric knife or self-retracting safety blade when handling cores. • Eliminate hazard by having the drillers open the cores for you. • When using cutting tools, follow the safety precautions listed below: • Keep free hand out of the way. • Secure work if cutting through thick material. • Use only sharp blades; dull blades require more force that results in less knife control. • Pull the knife through the object and away from your body; pulling motions are easier to manage. • Do not put the knife in your pocket. • Wear leather or Kevlar® gloves when using knives or blades, or when removing sharp objects caught or dangling in sampling gear.

Job Hazard Analysis
Task: Soil Sampling – Drill Rig
Project: Williamsburg MGP Site
Date: 6/27/22

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
5. Sample Soil	Contaminant Exposure, Cuts/Scrapes, Repetition, Slips/Trips/Falls	Hazard Identification HS-026/Container Management HS-003	• Wear hardhat; high visibility reflective safety vest; steel-toed, steel-shank boots or composite toe and shank; safety glasses; Nitrile/neoprene gloves; and earplugs as necessary. • Dispose of gloves after use and wash hands. • Wear work gloves over nitrile gloves. • Excavation entry will be allowed only with proper sloping or shoring. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep trafficked areas free from slip/trip/fall hazards.
6. Drum Soil Cuttings	Contaminant Contact, Cuts or Abrasions Heavy Lifting , Slips/Trips/Falls	Container Management HS–003 Manual Lifting HS–025 Ergonomic Program	• Wear proper PPE during sampling including nitrile gloves and safety glasses and face shield as appropriate. • Use proper dollies or drum moving tools. • Use applicable tools to open/close drum lids. • Do not handle drums with bulging sides. • Dispose of gloves after use and wash hands. • Wear work gloves over nitrile gloves. • Use proper lifting techniques. • Ask fellow worker for help. • Keep trafficked areas free from slip/trip/fall hazards.
7. Equipment Decontamination	Contaminant Contact, Cuts or Abrasions, Slips/Trips/Falls	Hazard Identification HS–026 Benzene Awareness Program Ergonomic Program	• Wear nitrile gloves and glasses to provide eye protection from splashing. • Wash hands immediately after use. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep trafficked areas free from slip/trip/fall hazards.
8. Demobilize from site	Personal/material security, slips/trips/falls	Hazard Identification HS-026	• Confirm all materials are secured/labeled, including drums and any equipment left on site. • Confirm that any open trenches/pits are properly marked or barricaded. • Clean all equipment/tools prior to leaving. • Secure any gates/locks. • Notify project manager (or designee) you are leaving the site.

Job Hazard Analysis

Task	Soil Vapor Sampling		
Revision Date	6/27/22	**Client Name**	National Grid
Project Name	Williamsburg MGP Site	**Project Number**	093060
Tools/Equipment Used	Hand tools, pump		
Task Specific Training	GEI Annual Safety Training (Field or HAZWOPER), First Aid/CPR		
Minimum PPE Required	☐ Hard Hat ☒Safety Glasses ☒Safety-Toed Boots ☒ Reflective Vest ☐Hearing Protection ☐ Personal Flotation Device (PFD) ☐ Face Shield ☐ Chaps ☐ Tyvek clothing/boots ☐ Flame Resistant Clothing ☒ Gloves Nitrile/Cut resistant ☐Respirator ☐Other		

JHA Prepared By:	Date:	Approved by:	Date:

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
1. Carry Equipment and Set-up	Heavy lifting, Cuts/Scrapes, Slips/Trips/Falls, Pinch points	Non-Powered Hand Tools HS-008a Manual Lifting HS-025 Ergonomic Program	• User proper lifting techniques. • Keep trafficked areas free from slip/trip/fall hazards. • Wear the proper type of glove to protect hands against sharp edges and skin/soft tissue injuries • Wear appropriate footwear • Be aware of hard to grip and hold items that may force your hand or wrist into awkward, stressful positions • Take breaks when carrying items frequently and/or for long distances • Do not overreach when picking up or placing items. • Use the buddy system when necessary
2. Cut Tubing	Cuts/Scrapes, pinch points	Non-Powered Hand Tools HS-008a	• Keep free hand out of the way. • Secure work if cutting through thick material. • Use only sharp blades; dull blades require more force that results in less knife control. • Pull the knife through the object and away from your body; pulling motions are easier to manage. • Do not use knife as pry bar. • Wear leather or kevlar gloves when using knives or blades, or when removing sharp objects caught or dangling in sampling gear.

[1] Use the hierarchy of controls to determine applicable hazard controls for the task in order of most effective to least effective: Elimination (physically remove the hazard), Substitution (replace the hazard), Engineering Controls (Isolate the team from the hazard), Administrative Controls (change the way people work), PPE (personal protective equipment).

3. Collect Samples	Awkward position	Hazard Identification HS– 026 Ergonomic Program	• Wear Nitrile/neoprene gloves and dispose of gloves after use and wash hands. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep trafficked areas free from slip/trip/fall hazards.
4. Equipment De-Mob	Heavy lifting, Cuts/Scrapes, Slips/Trips/Falls, Pinch points	Non-Powered Hand Tools HS-008a Manual Lifting HS-025 Ergonomic Program	• User proper lifting techniques. • Keep trafficked areas free from slip/trip/fall hazards. • Wear the proper type of glove to protect hands against sharp edges and skin/soft tissue injuries • Wear appropriate footwear • Be aware of hard to grip and hold items that may force your hand or wrist into awkward, stressful positions • Take breaks when carrying items frequently and/or for long distances • Do not overreach when picking up or placing items. • Use the buddy system when necessary

Job Hazard Analysis

Task	**NAPL Gauging and Recovery**		
Revision Date	October 5, 2022	**Client Name**	National Grid
Project Name	Williamsburg Works MGP Site	**Project Number**	093060
Tools/Equipment Used	Pump, generator, compressor, interface probe, tubing cutter, bailer, string, scissors		
Task Specific Training	GEI Annual Safety Training (HAZWOPER), First Aid/CPR		
Minimum PPE Required	☐ Hard Hat ☒Safety Glasses ☒Safety-Toed Boots ☒ Reflective Vest ☒Hearing Protection ☐ Personal Flotation Device (PFD) ☒ Face Shield ☐ Chaps ☒ Tyvek clothing/boots ☐ Flame Resistant Clothing ☒ Gloves Nitrile/Cut resistant ☐Respirator ☐Other		
JHA Prepared By: Melissa Felter	**Date: 10/5/2022**	**Approved by: Lesley Gastwirth**	**Date: 10/6/2022**

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
1. Carry Equipment and Set-up	Heavy lifting, Cuts/Scrapes, Slips/Trips/Falls, Pinch points	Non-Powered Hand Tools HS-008a Manual Lifting HS-025 Ergonomic Program	• User proper lifting techniques. • Keep trafficked areas free from slip/trip/fall hazards. • Wear the proper type of glove to protect hands against sharp edges and skin/soft tissue injuries • Wear appropriate footwear • Be aware of hard to grip and hold items that may force your hand or wrist into awkward, stressful positions • Take breaks when carrying items frequently and/or for long distances • Do not overreach when picking up or placing items. • Use the buddy system when necessary
2. Cut Tubing/String	Cuts/Scrapes, pinch points	Non-Powered Hand Tools HS-008a	• Keep free hand out of the way. • Secure work if cutting through thick material. • Use only sharp blades; dull blades require more force that results in less knife control.

[1] Use the hierarchy of controls to determine applicable hazard controls for the task in order of most effective to least effective: Elimination (physically remove the hazard), Substitution (replace the hazard), Engineering Controls (Isolate the team from the hazard), Administrative Controls (change the way people work), PPE (personal protective equipment).

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
			• Pull the knife through the object and away from your body; pulling motions are easier to manage. • Do not put the knife in your pocket. • Wear leather or Kevlar gloves when using knives or blades, or when removing sharp objects caught or dangling in sampling gear.
3. Set up pump, generator and compressor, if needed.	Heavy Lifting, Slips/Trips/Falls	Manual Lifting HS–025 Ergonomic Program	• Check air compressor hoses before use. • Position the generator downwind of the work area. • Keep trafficked areas free from slip/trip/fall hazards.
4. Fuel generator	Heavy Lifting, Slips/Trips/Falls	Manual Lifting HS–025 Ergonomic Program	• Turn off the generator and allow to cool at least 15-minutes before refueling. • Gasoline used to refill the generator will be stored in an OSHA-approved portable fuel container (safety can).
5. Secure string to bailer and lower bailer down well to collect NAPL	Contaminant Contact, Awkward position, Slips/Trips/Falls, Heavy lifting	Benzene Awareness Program Ergonomic Program	• Wear proper PPE during sampling including nitrile gloves, Tyvek or Tyvek apron with sleeves, and safety glasses and face shield as appropriate. • Keep trafficked areas free from slip/trip/fall hazards. • Be aware of hard to grip and hold items that may force your hand or wrist into awkward, stressful positions • Take breaks when carrying items frequently and/or for long distances • Do not overreach when picking up or placing items. • Use the buddy system when necessary
6. Drum Purged NAPL	Contaminant Contact, Cuts or Abrasions Heavy Lifting , Slips/Trips/Falls	Container Management HS–003 Manual Lifting HS–025 Ergonomic Program Benzene Awareness Program	• Wear proper PPE during sampling including nitrile gloves, Tyvek or Tyvek apron with sleeves , and safety glasses and face shield as appropriate. • Use proper dollies or drum moving tools. • Use applicable tools to open/close drum lids. • Do not handle drums with bulging sides. • Dispose of gloves after use and wash hands. • Wear work gloves over nitrile gloves. • Use proper lifting techniques. • Ask fellow worker for help. • Keep trafficked areas free from slip/trip/fall hazards.
7. Equipment Decontamination	Contaminant Contact, Cuts or Abrasions, Slips/Trips/Falls	Hazard Identification HS–026 Benzene Awareness Program Ergonomic Program	• Wear nitrile gloves and glasses to provide eye protection from splashing. • Wash hands immediately after use. • Take regular breaks and do not work in unusual positions for long

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
			periods of time. • Keep trafficked areas free from slip/trip/fall hazards.
8. Equipment De-Mob	Heavy lifting, Cuts/Scrapes, Slips/Trips/Falls, Pinch points	Non-Powered Hand Tools HS-008a Manual Lifting HS-025 Ergonomic Program	• User proper lifting techniques. • Keep trafficked areas free from slip/trip/fall hazards. • Wear the proper type of glove to protect hands against sharp edges and skin/soft tissue injuries • Wear appropriate footwear • Be aware of hard to grip and hold items that may force your hand or wrist into awkward, stressful positions • Take breaks when carrying items frequently and/or for long distances • Do not overreach when picking up or placing items. • Use the buddy system when necessary

Appendix C

Safety Data Sheets

HOVENSA



NFPA 704 (Section 16)

MATERIAL SAFETY DATA SHEET

Benzene **MSDS No. 0166**

1. CHEMICAL PRODUCT and COMPANY INFORMATION (rev. Jan-99)

HOVENSA L.L.C.
1 Estate Hope
Christiansted, VI 00820-5652

EMERGENCY TELEPHONE NUMBER (24 hrs): **CHEMTREC (800) 424-9300**
COMPANY CONTACT (business hours): **Safety Department (340) 692-3000**

SYNONYMS: Benzol; Coal Naphtha; coal tar naphtha; Cyclohexatriene; Phenyl hydride
See Section 16 for Abbreviations and Acronyms.

2. COMPOSITION and INFORMATION ON INGREDIENTS (rev. Apr-98)

INGREDIENT NAME	EXPOSURE LIMITS		CONCENTRATION PERCENT BY WEIGHT
Benzene CAS NUMBER: 71-43-2	OSHA PEL-TWA/STEL: ACGIH TLV-TWA: US Coast Guard:	1 / 5 ppm 0.5 / 2.5 ppm, A1, skin same as OSHA	100

3. HAZARDS IDENTIFICATION (rev. Apr-98; Tox-98)

EMERGENCY OVERVIEW
DANGER!
FLAMMABLE - BLOOD TOXIN AND CARCINOGEN - ABSORBED THROUGH THE SKIN - CENTRAL NERVOUS SYSTEM - HARMFUL OR FATAL IF SWALLOWED - ASPIRATION HAZARD

High fire hazard. Keep away from heat, spark, open flame, and other ignition sources.

If ingested, do NOT induce vomiting, as this may cause chemical pneumonia (fluid in the lungs). Contact may cause eye, skin and mucous membrane irritation. Harmful if absorbed through the skin. Avoid prolonged breathing of vapors or mists. Inhalation may cause irritation, anesthetic effects (dizziness, nausea, headache, intoxication), and respiratory system effects.

Long-term exposure may cause blood disease, including anemia and leukemia.

EYES
Moderate to severe irritant. Contact with liquid or vapor may cause irritation.

SKIN
Moderate to severe irritant. May cause skin irritation with prolonged or repeated contact. Practically non-toxic if absorbed following acute (single) exposure. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are exposed repeatedly.

INGESTION
The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest, and death may occur.

INHALATION
Excessive exposure may cause irritation to the nose, throat, lungs and respiratory tract. Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death.

Effects to the blood (including decreased platelet and white blood cell counts), cardiovascular system, nervous system, retina, lungs, gastrointestinal system, spleen, and kidneys have been reported from large, acute (short) and repeated or prolonged exposures.

CHRONIC EFFECTS and CARCINOGENICITY
Benzene is a regulated human carcinogen. Benzene has the potential to cause bone marrow depression, aplastic anemia (low red blood cell count) and other blood diseases, including leukemia, after repeated and prolonged exposure. Benzene can cause liver and kidney toxicity.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE
Irritation from skin exposure may aggravate existing open wounds, skin disorders, and dermatitis (rash). Pre-existing chronic respiratory disease, liver or kidney dysfunction, or blood, cardiovascular and central nervous system disorders may be aggravated by exposure.

4. FIRST AID MEASURES (rev. Apr-98)

EYES
In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min. Hold eyelids open to ensure adequate flushing. Seek medical attention.

SKIN
Remove contaminated clothing. Wash contaminated areas thoroughly with soap and water or waterless hand cleanser. Obtain medical attention if irritation or redness develops.

INGESTION
DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

INHALATION
Remove person to fresh air. If person is not breathing, ensure an open airway and provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

NOTE TO PHYSICIAN
OSHA and US Coast Guard require that a person exposed to benzene in an emergency have a urine sample taken at the end of the shift and have a urine phenol test performed within 72 hours. For results equal to or greater than 75 ml/L of urine, employees must have a complete blood count every month for three months after the emergency exposure. See OSHA 29 CFR 1910.1028 or USCG 49 CFR 193.

5. FIRE FIGHTING MEASURES (rev. Jan-99)

FLAMMABLE PROPERTIES:

FLASH POINT:	12 ^{o}F (-11°C)
AUTOIGNITION TEMPERATURE:	928 ^{o}F (498 ^{o}C)
OSHA/NFPA FLAMMABILITY CLASS:	1B (flammable liquid)
LOWER EXPLOSIVE LIMIT (%):	1.3%
UPPER EXPLOSIVE LIMIT (%):	7.9%

FIRE AND EXPLOSION HAZARDS
Vapors may be ignited rapidly when exposed to heat, spark, open flame or other source of ignition. Flowing product may be ignited by self-generated static electricity. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back. Runoff to sewer may cause fire or explosion hazard.

EXTINGUISHING MEDIA
SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO2, water spray, fire fighting foam, or Halon.

LARGE FIRES: Water spray, fog or fire fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

FIRE FIGHTING INSTRUCTIONS

Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment.

Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing.

Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam.

See Section 16 for the NFPA 704 Hazard Rating.

6. ACCIDENTAL RELEASE MEASURES (rev. Apr-98)

ACTIVATE FACILITY SPILL CONTINGENCY or EMERGENCY PLAN.

Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to confirm spill areas. Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.

Carefully contain and stop the source of the spill, if safe to do so. Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of fire fighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection.

Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal - caution, flammable vapors may accumulate in closed containers. Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

7. HANDLING and STORAGE (rev. Apr-98)

HANDLING PRECAUTIONS

Handle as a flammable liquid. Keep away from heat, sparks, and open flame! Electrical equipment should be approved for classified area. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion.

Special slow load procedures for "switch loading" must be followed to avoid the static ignition hazard that can exist when higher flash point material (such as fuel oil) is loaded into tanks previously containing low flash point products (such as this product) - see API Publication 2003, "Protection Against Ignitions Arising Out Of Static, Lightning and Stray Currents.

STORAGE PRECAUTIONS

Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". Avoid storage near incompatible materials. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks".

WORK/HYGIENIC PRACTICES

Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use as a cleaning solvent on the skin. Do not use solvents or harsh abrasive skin cleaners for washing this product from exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer. Consider the need to discard contaminated leather shoes and gloves.

8. EXPOSURE CONTROLS and PERSONAL PROTECTION (rev. Apr-98)

ENGINEERING CONTROLS

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

EYE/FACE PROTECTION

Safety glasses or goggles are recommended where there is a possibility of splashing or spraying.

SKIN PROTECTION

Gloves constructed of Viton are recommended for heavy exposure; Viton, nitrile, PVC, or neoprene for intermittent exposure. Chemical protective clothing such as DuPont Barricade ® or equivalent recommended based on degree of exposure.

Note: The resistance of specific material may vary from product to product as well as with degree of exposure. Consult manufacturer specifications for further information.

RESPIRATORY PROTECTION

A NIOSH/MSHA-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited. Refer to OSHA 29 CFR 1910.134, ANSI Z88.2-1992, NIOSH Respirator Decision Logic, and the manufacturer for additional guidance on respiratory protection selection and limitations.

Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.

9. PHYSICAL and CHEMICAL PROPERTIES (rev. Mar-95)

APPEARANCE

A clear, water-like liquid

ODOR

A sweet, aromatic odor.

ODOR THRESHOLD

4.7 ppm

BASIC PHYSICAL PROPERTIES

BOILING RANGE:	176 ^{o}F (80 ^{o}C)
VAPOR PRESSURE:	74.6 mm Hg @ 68 ^{o}F (20 ^{o}C)
VAPOR DENSITY (air = 1):	2.8
SPECIFIC GRAVITY (H_2O = 1):	0.87
EVAPORATION RATE:	High
PERCENT VOLATILES:	100 %
SOLUBILITY (H_2O):	Insoluble to slightly soluble

10. STABILITY and REACTIVITY (rev. Mar-95)

STABILITY: Stable. Hazardous polymerization will not occur.

CONDITIONS TO AVOID and INCOMPATIBLE MATERIALS

Material is stable under normal conditions. Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources

HAZARDOUS DECOMPOSITION PRODUCTS

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke). Contact with nitric and sulfuric acids will form nitrocresols that can decompose violently.

11. TOXICOLOGICAL PROPERTIES (rev. Apr-98; Tox-98)

ACUTE TOXICITY

Acute Dermal LD50 (rabbits): > 9.4 ml/kg Acute Oral LD50 (mouse): 4.7 g/kg
Acute inhalation LC50: 10,000 ppm (rat; 7 hours) Eye irritation (rabbit): mild to moderate
Primary dermal irritation (rabbits): mild to moderate

CHRONIC EFFECTS AND CARCINOGENICITY

Carcinogenicity: OSHA: YES IARC: (1) NTP: YES ACGIH: (A1)

Numerous epidemiological (human) and animal studies have reported an increased incidence or a causal relationship between leukemia and benzene exposure.

Mutagenicity: positive

12. ECOLOGICAL INFORMATION (rev. Apr-98)

Keep out of sewers, drainage areas and waterways. Report spills and releases, as applicable, under Federal and State regulations.

13. DISPOSAL CONSIDERATIONS (rev. Apr-98)

Consult federal, state and local waste regulations to determine appropriate disposal options.

14. TRANSPORTATION INFORMATION (rev. Apr-98)

DOT PROPER SHIPPING NAME:	Benzene
DOT HAZARD CLASS and PACKING GROUP:	3, PG II
DOT IDENTIFICATION NUMBER:	UN 1114
DOT SHIPPING LABEL:	FLAMMABLE LIQUID

15. REGULATORY INFORMATION (rev. Apr-98)

U.S. FEDERAL, STATE, and LOCAL REGULATORY INFORMATION

This product and its constituents listed herein are on the EPA TSCA Inventory. Any spill or uncontrolled release of this product, including any substantial threat of release, may be subject to federal, state and/or local reporting requirements. This product and/or its constituents may also be subject to other federal, state, or local regulations; consult those regulations applicable to your facility/operation.

CLEAN WATER ACT (OIL SPILLS)

Any spill or release of this product to "navigable waters" (essentially any surface water, including certain wetlands) or adjoining shorelines sufficient to cause a visible sheen or deposit of a sludge or emulsion must be reported immediately to the National Response Center (1-800-424-8802) or, if not practical, the U.S. Coast Guard with follow-up to the National Response Center, as required by U.S. Federal Law. Also contact appropriate state and local regulatory agencies as required.

CERCLA SECTION 103 and SARA SECTION 304 (RELEASE TO THE ENVIRONMENT)

Benzene is a CERCLA Section 103 "hazardous substance" subject to CERCLA and SARA Section 304 reporting requirements.

Reportable Quantity: 10 pounds

SARA SECTION 311/312 - HAZARD CLASSES

ACUTE HEALTH	CHRONIC HEALTH	FIRE	SUDDEN RELEASE OF PRESSURE	REACTIVE
X	X	X	--	--

SARA SECTION 313 - SUPPLIER NOTIFICATION

This product contains the following toxic chemicals subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372:

INGREDIENT NAME (CAS NUMBER)	CONCENTRATION WT. PERCENT
Benzene (71-43-2)	100

CANADIAN REGULATORY INFORMATION (WHMIS)

Class B, Division 2 (Flammable Liquid)

Class D, Division 2A (Very toxic by other means) and Class D, Division 2B (Toxic by other means)

16. OTHER INFORMATION (rev. Apr-98)

NFPA® HAZARD RATING	HEALTH:	2	Moderate
	FIRE:	3	Serious
	REACTIVITY:	0	Minimal
HMIS® HAZARD RATING	HEALTH:	3 *	Serious
	FIRE:	3	Serious
	REACTIVITY:	0	Minimal
			* Chronic

SUPERSEDES MSDS DATED: 04/23/98

ABBREVIATIONS:

AP = Approximately < = Less than > = Greater than

N/A = Not Applicable N/D = Not Determined ppm = parts per million

ACRONYMS:

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute (212) 642-4900
API	American Petroleum Institute (202) 682-8000
CERCLA	Comprehensive Emergency Response, Compensation, and Liability Act
DOT	U.S. Department of Transportation [General Info: (800) 467-4922]
EPA	U.S. Environmental Protection Agency
HMIS	Hazardous Materials Information System
IARC	International Agency For Research On Cancer
MSHA	Mine Safety and Health Administration
NFPA	National Fire Protection Association (617) 770-3000
NIOSH	National Institute of Occupational Safety and Health
NOIC	Notice of Intended Change (proposed change to ACGIH TLV)
NTP	National Toxicology Program
OPA	Oil Pollution Act of 1990
OSHA	U.S. Occupational Safety & Health Administration
PEL	Permissible Exposure Limit (OSHA)
RCRA	Resource Conservation and Recovery Act
REL	Recommended Exposure Limit (NIOSH)
SARA	Superfund Amendments and Reauthorization Act of 1986 Title III
SCBA	Self-Contained Breathing Apparatus
SPCC	Spill Prevention, Control, and Countermeasures
STEL	Short-Term Exposure Limit (generally 15 minutes)
TLV	Threshold Limit Value (ACGIH)
TSCA	Toxic Substances Control Act
TWA	Time Weighted Average (8 hr.)
WEEL	Workplace Environmental Exposure Level (AIHA)
WHMIS	Workplace Hazardous Materials Information System (Canada)

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES

Information presented herein has been compiled from sources considered to be dependable, and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgment.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

Material Safety Data Sheet

HYDROGEN SULFIDE

August 31, 1995

PHILLIPS 66 COMPANY
A Division of Phillips Petroleum Company
Bartlesville, Oklahoma 74004

PHONE NUMBERS
Emergency: (918) 661-8118
General MSDS Information: (918) 661-8327
For Additional MSDSs: (918) 661-5952

A. Product Identification

Synonyms: Sulfuretted Hydrogen; Hepatic Gas; Hydrosulfuric Acid
Chemical Name: Hydrogen Sulfide
Chemical Family: Inorganic Acid
Chemical Formula: H2S
CAS Reg. No.: 7783-06-4
Product No.: Not Established

Product and/or Components Entered on EPA's TSCA Inventory: YES

This product is in U.S. commerce, and is listed in the Toxic Substances Control Act (TSCA) Inventory of Chemicals; hence, it may be subject to applicable TSCA provisions and restrictions.

B. Hazardous Components

Ingredients	CAS Number	% By Wt.	OSHA PEL	ACGIH TLV
Hydrogen Sulfide	7783-06-4	100	10 ppm	10 ppm@

@ Short term exposure limit is 15 ppm.

C. Personal Protection Information

Ventilation: Use adequate ventilation to control exposure below recommended levels.

Respiratory Protection: For concentrations exceeding the recommended exposure level, use NIOSH/MSHA approved air purifying respirator. If conditions immediately dangerous to life or health (IDLH) exist, use NIOSH/MSHA approved self-contained breathing apparatus (SCBA) equipment.

Eye Protection: For splash protection use chemical goggles and face shield.

Skin Protection: Gloves and coveralls of rubber or neoprene construction if liquid contact could occur. Avoid

unnecessary skin contamination with material.

NOTE: Personal protection information shown in Section C is based upon general information as to normal uses and conditions. Where special or unusual uses or conditions exist, it is suggested that the expert assistance of an industrial hygienist or other qualified professional be sought.

D. Handling and Storage Precautions

Proper personal protective equipment must be used when handling this chemical.

Do not get liquefied gas into eyes, on skin, or on clothing. May cause freeze burns upon direct contact. Do not breathe vapor, mist, fume or dust. May be harmful. Launder contaminated clothing before reuse. Use only with adequate ventilation. Wash thoroughly after handling.

Keep away from heat, sparks, and flames. Secure container to prevent damage. Store in a well-ventilated area. Store in tightly closed container. Bond and ground during transfer. Do not puncture or incinerate container.

Handle cylinders with care. Protect cylinders from physical damage. Containers should not be subjected to temperatures above 125F. Do not heat cylinders by any means to increase the product discharge rate. Use a check valve or trap in the discharge line to prevent backflows into the cylinders. All electrical equipment should be non-sparking or explosion proof. Test atmosphere periodically for H2S. Do not rely on sense of smell for H2S release. Use product in a closed system.

E. Reactivity Data

Stability:	Stable
Conditions to Avoid:	Heat, flame, or other sources of ignition.
Incompatibility (Materials to Avoid):	Concentrated nitric acid, sulfuric acid, and other strong oxidizers. Vapors will combust spontaneously when mixed with chlorine, nitrogen trifluoride, or oxygen trifluoride vapors. Distinct hydrogen sulfide odor can be masked by high concentrations of vapors or gas of other chemicals.
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid:	Not Applicable
Hazardous Decomposition Products:	Sulfur Oxides formed when burned.

F. Health Hazard Data

Recommended Exposure Limits:

See Section B.

Acute Effects of Overexposure:

Eye: May be irritating to eyes at levels near the permissible exposure limit. Liquid may cause freeze burns.

Skin: Gas not expected to be irritating to skin. Liquid may cause freeze burns, irritation, reddening or swelling.

Inhalation: Toxic by inhalation. Release of liquefied product may create atmospheres which can rapidly exceed lethal levels. Acute low level exposure that exceeds the permissible exposure limit will result in irritation of the nose and throat, headache, dizziness, nausea, and nervousness.

Ingestion: Liquid may cause freeze burns and death.

Subchronic and Chronic Effects of Overexposure:

Humans breathing up to 8 ppm of hydrogen sulfide over a two month period experienced nausea, headache, shortness of breath, sleep disturbance, eye and throat irritation.

Other Health Effects:

The odor of hydrogen sulfide may not be recognized after prolonged inhalation due to paralysis of the sense of smell. Effects from inhaling the fumes may lead to chronic bronchitis, respiratory irritation, increased loss of pulmonary function, and tearing of the eyes.

Health Hazard Categories:

	Animal	Human		Animal	Human
Known Carcinogen	___	___	Toxic	_X_	_X_
Suspect Carcinogen	___	___	Corrosive	___	___
Mutagen	___	___	Irritant	___	___
Teratogen	___	___	Target Organ Toxin	_X_	_X_
Allergic Sensitizer	___	___	Specify - Skin & Eye Hazard - Freeze burns;		
Highly Toxic	___	___	Lung Hazard-Irritant; Nerve Toxin		

First Aid and Emergency Procedures:

NOTE: For freeze burns, immediately flush effected area with tap water for at least fifteen minutes, seek immediate medical attention.

Eye: Flush eyes with running water for at least fifteen minutes. If irritation or adverse symptoms develop, seek medical attention.

Skin: Wash skin with soap and water for at least fifteen minutes. If irritation or adverse symptoms develop, seek medical attention.

Inhalation: Immediately remove from exposure. If breathing is difficult, give oxygen. If breathing ceases, administer artificial respiration followed by oxygen. Seek immediate medical attention.

Ingestion: If illness or adverse symptoms develop, seek medical attention.

Prompt medical attention is mandatory in all cases of overexposure to hydrogen sulfide. Rescue personnel should be equipped with NIOSH/MSHA approved self-contained breathing apparatus (SCBA). Rescue personnel should recognize the hazards of overexposure due to olfactory fatigue. The use of rescue equipment which might contain ignition sources or cause static discharges should be avoided.

Nitrite treatment as medical therapy has been used in persons overexposed to hydrogen sulfide, but the benefits of this treatment are still considered by some to be of questionable usefulness.

Therapy can only be undertaken by qualified emergency medical personnel.

Treatment should be initiated with inhalation of amyl nitrite for fifteen to thirty seconds of each minute until 10 ml of a 3% solution of sodium nitrite can be injected intravenously at a rate of 2.5 to 5 ml per minute. Sodium nitrite injections may be repeated if necessary.

G. Physical Data

Appearance:	Colorless Gas or Liquefied Gas
Odor:	Repulsive (rotten egg) Odor
Boiling Point:	-75F (-60C)
Vapor Pressure:	394.0 psia @ 100F (37.8C)
Vapor Density (Air = 1):	1.176 @ 60F (15.6C)(Calculated)
Solubility in Water:	Slight
Specific Gravity (H2O = 1):	0.79 @ 60F (15.6C) Saturation Pressure
Percent Volatile by Volume:	100
Evaporation Rate (Ethyl Ether = 1):	>1
Viscosity:	Not Applicable

H. Fire and Explosion Data

Flash Point (Method Used):	Flammable Gas
Flammable Limits (% by Volume in Air):	LEL - 4 UEL - 44
Fire Extinguishing Media:	Dry chemical, foam or carbon dioxide (CO2)
Special Fire Fighting Procedures:	Shut off source, if possible. Water for or spray may be used to cool exposed containers and equipment. Use NIOSH/MSHA approved self-contained breathing apparatus. Wear protective equipment and/or garments described in Section C.
Fire and Explosion Hazards:	Sulfur oxides formed when burned. Vapors are heavier than air and may travel to an ignition source and flashback. Autoignition temperature is 500F (260C).

I. Spill, Leak and Disposal Procedures

Precautions Required if Material is Released or Spilled:
Evacuate area of all unnecessary personnel. Wear protective equipment and/or garments described in Section C if exposure conditions warrant. Shut off source. Ventilate confined area.

Waste Disposal (Insure Conformity with all Applicable Disposal Regulations):
Incinerate or place in permitted waste management facility.

J. DOT Transportation

Shipping Name:	Hydrogen sulfide, liquefied
Hazard Class:	2.3 (Poisonous gas)
ID Number:	UN 1053

```
         Packing Group: Not applicable
               Marking: Hydrogen Sulfide, liquefied, UN1053, RQ* Inhalation
                        hazard
                 Label: Poison gas and Flammable gas
               Placard: Poisonous gas/1053
Hazardous Substance/RQ: Hydrogen sulfide/100#
  Shipping Description: Hydrogen sulfide, liquefied, 2.3 (Poisonous gas),
                        UN 1053, RQ*, Poison - Inhalation Hazard Zone B
  Packaging References: 49 CFR 173.304, 173.314, 173.315
```

* Enter the letters "RQ" as shown only if the hazardous substance is present in a quantity, in one package, which equals or exceeds the reportable quantity (RQ) shown for the hazardous substance.

K. RCRA Classification - Unadulterated Product as a Waste

Ignitable (D001); Hydrogen Sulfide (U135)

Prior to disposal, consult your environmental contact to determine if the TCLP (Toxicity Characteristic Leaching Procedure, EPA Test Method 1311) is required. Reference 40 CFR Part 261.

L. Protection Required for Work on Contaminated Equipment

Contact immediate supervisor for specific instructions before work is initiated. Wear protective equipment and/or garments described in Section C if exposure conditions warrant. If repair of user's equipment is required, purge equipment with an inert gas prior to repairing.

M. Hazard Classification

_X_ This product meets the following hazard definition(s) as defined by the Occupational Safety and Health Hazard Communication Standard (29 CFR Section 1910.1200):

___ Combustible Liquid	___ Flammable Aerosol	___ Oxidizer
_X_ Compressed Gas	___ Explosive	___ Pyrophoric
_X_ Flammable Gas	_X_ Health Hazard (Section F)	___ Unstable
___ Flammable Liquid	___ Organic Peroxide	___ Water Reactive
___ Flammable Solid		

___ Based on information presently available, this product does not meet any of the hazard definitions of 29 CFR Section 1910.1200.

N. Additional Comments

As of the preparation date, this product did not contain a chemical or chemicals subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

```
NFPA 704 Hazard Codes - - - - - - - - Signals

                                      Least - 0
   Health      : 3                    Slight - 1
   Flammability: 4                    Moderate - 2
```

Reactivity : 0	High - 3
Special Haz.: -	Extreme - 4

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Material Safety Data Sheet
Phenol Liquid

Section 1 - Chemical Product and Company Identification

MSDS Name: Phenol Liquid
Catalog Numbers: A88I-500, A931I-1, A931I-200, A931I-4, A931I-500, S801181, S801181MF
Synonyms: Phenylic acid
Company Identification:
Fisher Scientific
1 Reagent Lane
Fair Lawn, NJ 07410
For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
108-95-2	Phenol	89	203-632-7
7732-18-5	Water	11	231-791-2

Hazard Symbols: T
Risk Phrases: 34 24/25

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: colorless liquid. Flash Point: 175 deg F. **Danger!** Corrosive. **Combustible liquid and vapor.** Toxic. Harmful if swallowed, inhaled, or absorbed through the skin. May cause severe respiratory and digestive tract irritation with possible burns. Causes severe eye and skin burns. May cause liver and kidney damage. May cause reproductive and fetal effects. Eye contact may result in permanent eye damage. May cause central nervous system effects.
Target Organs: Kidneys, central nervous system, liver.

Potential Health Effects

Eye: Contact with liquid or vapor causes severe burns and possible irreversible eye damage.
Skin: Causes severe skin irritation. Harmful if absorbed through the skin. Direct skin contact results in white, wrinkled discoloration, followed by severe burns. Phenol solutions may be absorbed through the skin ra pidly to cause systemic poisoning and possible death.
Ingestion: Symptoms may include: headache, excitement, fatigue, nausea, vomiting, stupor, and coma. May cause central nervous system depression, characterized by excitement, followed by headache, dizziness, drowsiness, and nausea. Advanced stages may cause collapse, unconsciousness, coma and possible death due to respiratory failure. Causes digestive tract burns with immediate pain, swelling of the throat, convulsions, and possible coma.
Inhalation: Causes severe irritation of upper respiratory tract with coughing, burns, breathing difficulty, and possible coma. May be fatal if exposed to high concentrations. May also cause pallor, loss of appetite, nausea, vomiting, diarrhea, weakness, darkened urine, headache, sweating, convulsions, cyanosis (bluish skin due to deficient oxygenation of the blood), unconsciousness, fatigue, pulmonary edema & coma.
Chronic: Chronic inhalation and ingestion may cause effects similar to those of acute inhalation and ingestion. May cause liver and kidney damage. May cause fetal effects. Repeated skin contact may cause dermatitis with dark pigmentation of the skin.

Section 4 - First Aid Measures

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately.
Skin: Get medical aid immediately. Immediately flush skin with plenty of water for at least 15 minutes

while removing contaminated clothing and shoes. Discard contaminated clothing in a manner which limits further exposure. SPEEDY ACTION IS CRITICAL! Destroy contaminated shoes.
Ingestion: Do NOT induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.
Inhalation: Get medical aid immediately. Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information: Vapors may form an explosive mixture with air. Use water spray to keep fire-exposed containers cool. Wear appropriate protective clothing to prevent contact with skin and eyes. Wear a self-contained breathing apparatus (SCBA) to prevent contact with thermal decomposition products.
Extinguishing Media: For small fires, use dry chemical, carbon dioxide, water spray or alcohol-resistant foam.
Flash Point: 175e deg F (79.44 deg C)
Autoignition Temperature: 1319 deg F (715.00 deg C)
Explosion Limits, Lower:1.8
Upper: 8.6
NFPA Rating: (estimated) Health: 4; Flammability: 2; Instability: 0

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Absorb spill with inert material (e.g. vermiculite, sand or earth), then place in suitable container. Avoid runoff into storm sewers and ditches which lead to waterways. Clean up spills immediately, observing precautions in the Protective Equipment section. Use water spray to disperse the gas/vapor. Remove all sources of ignition. Provide ventilation.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Do not get in eyes, on skin, or on clothing. Empty containers retain product residue, (liquid and/or vapor), and can be dangerous. Do not ingest or inhale. Use only in a chemical fume hood. Wash clothing before reuse. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose empty containers to heat, sparks or open flames.
Storage: Keep away from heat and flame. Keep away from sources of ignition. Keep from contact with oxidizing materials. Store in a cool, dry, well-ventilated area away from incompatible substances.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Phenol	5 ppm TWA; skin - potential for cutaneous absorption	5 ppm TWA; 19 mg/m3 TWA 250 ppm IDLH	5 ppm TWA; 19 mg/m3 TWA
Water	none listed	none listed	none listed

OSHA Vacated PELs: Phenol: 5 ppm TWA; 19 mg/m3 TWA Water: No OSHA Vacated PELs are listed for this chemical.
Personal Protective Equipment
Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin: Wear neoprene gloves, apron, and/or clothing. Selection of specific glove materials should be based on your conditions of use in your application in consultation with your Safety Officer and manufacturer's glove recommendations.
Clothing: Wear appropriate protective clothing to prevent skin exposure.
Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Always use a NIOSH or European Standard EN 149 approved respirator when necessary.

Section 9 - Physical and Chemical Properties

Physical State: Liquid
Appearance: colorless

Odor: sweetish odor
pH: 6 aqueous solution.
Vapor Pressure: .35 mm Hg @25C
Vapor Density: 3.2
Evaporation Rate:<0.01 (butyl acetate=1)
Viscosity: 1.51 cp@80C
Boiling Point: 360 deg F
Freezing/Melting Point:109 deg F
Decomposition Temperature: Not available.
Solubility: 6.75% in water
Specific Gravity/Density:1.0576
Molecular Formula:H6H6O
Molecular Weight:28.0834

Section 10 - Stability and Reactivity

Chemical Stability: Stable.
Conditions to Avoid: Temperatures above recommended temperatures.
Incompatibilities with Other Materials: Incompatible with strong oxidizing agents, alkalies, nitric acid, calcium hypochlorite, and halogens, Mixture with nitrobenzene and aluminum chloride may violently explode. Coagulates colodion and proteins. Hot liquid phenol will attack aluminum, magnesium, lead, and zinc metals. Mixtures with nitrobenzene and aluminum chloride may violently explode.
Hazardous Decomposition Products: Carbon monoxide, carbon dioxide.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 108-95-2: SJ3325000
CAS# 7732-18-5: ZC0110000
LD50/LC50:
CAS# 108-95-2:
Draize test, rabbit, eye: 5 mg Severe;
Draize test, rabbit, skin: 500 mg/24H Severe;
Draize test, rabbit, skin: 100 mg Mild;
Inhalation, mouse: LC50 = 177 mg/m3;
Inhalation, rat: LC50 = 316 mg/m3;
Oral, mouse: LD50 = 270 mg/kg;
Oral, rat: LD50 = 317 mg/kg;
Skin, rabbit: LD50 = 630 mg/kg;
Skin, rat: LD50 = 669 mg/kg;
CAS# 7732-18-5:
Oral, rat: LD50 = >90 mL/kg;
Carcinogenicity:
CAS# 108-95-2:
ACGIH: A4 - Not Classifiable as a Human Carcinogen
IARC: IARC Group 3 - not classifiable CAS# 7732-18-5: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
Epidemiology: The IARC has determined that there is inadequate evidence fo r carcinogenicity of phenol in humans and experiment aal animals.
Teratogenicity: No information available.
Reproductive Effects: No information available.
Neurotoxicity: No information available.
Mutagenicity: No information available.
Other Studies: Rabbit skin irritation: severe. Rabbit eye irritation: sever e.

Section 12 - Ecological Information

Ecotoxicity: Daphnia: EC50=4.0mg/l; 96hour; ia: EC50=12.0mg/l; 48 hour; No data
Environmental: Will not be expected to significantly bioconcentrate in aquatic organisms.
Physical: In water, phenol will not be expected to significantly hydrolyze.
Other: 96-hour LC50=11 mg/l in Gammarus fasciatus. 48-hour LC=11.2 mg/l in Leuciscus idus.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.

RCRA P-Series: None listed.

RCRA U-Series: CAS# 108-95-2: waste number U188.

Section 14 - Transport Information

	US DOT	IATA	RID/ADR	IMO	Canada TDG
Shipping Name:	PHENOL SOLUTIONS				PHENOL SOLUTION
Hazard Class:	6.1				6.1(9.2)
UN Number:	UN2821				UN2821
Packing Group:	II				II

Section 15 - Regulatory Information

US FEDERAL

TSCA

CAS# 108-95-2 is listed on the TSCA inventory.

CAS# 7732-18-5 is listed on the TSCA inventory.

Health & Safety Reporting List

CAS# 108-95-2: Effective Date: 6/1/87; Sunset Date: 6/1/97

Chemical Test Rules

None of the chemicals in this product are under a Chemical Test Rule.

Section 12b

None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

SARA

CERCLA Hazardous Substances and corresponding RQs

CAS# 108-95-2: 1000 lb final RQ; 454 kg final RQ

SARA Section 302 Extremely Hazardous Substances

CAS# 108-95-2: 500 lb TPQ (lower threshold); 10,000 lb TPQ (upper thre shold)

SARA Codes

CAS # 108-95-2: acute, chronic, flammable.

Section 313

This material contains Phenol (CAS# 108-95-2, 89%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.

Clean Air Act:

CAS# 108-95-2 is listed as a hazardous air pollutant (HAP). This material does not contain any Class 1 Ozone depletors. This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

CAS# 108-95-2 is listed as a Hazardous Substance under the CWA. CAS# 108-95-2 is listed as a Priority Pollutant under the Clean Water Act. CAS# 108-95-2 is listed as a Toxic Pollutant under the Clean Water Act.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

CAS# 108-95-2 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.

CAS# 7732-18-5 is not present on state lists from CA, PA, MN, MA, FL, or NJ.

California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols:

T

Risk Phrases:

R 34 Causes burns.

R 24/25 Toxic in contact with skin and if swallowed.

Safety Phrases:

S 28 After contact with skin, wash immediately with...
S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

WGK (Water Danger/Protection)
CAS# 108-95-2: 2
CAS# 7732-18-5: No information available.

Canada - DSL/NDSL
CAS# 108-95-2 is listed on Canada's DSL List.
CAS# 7732-18-5 is listed on Canada's DSL List.

Canada - WHMIS
This product has a WHMIS classification of B3, D1A, E.

Canadian Ingredient Disclosure List
CAS# 108-95-2 is listed on the Canadian Ingredient Disclosure List.

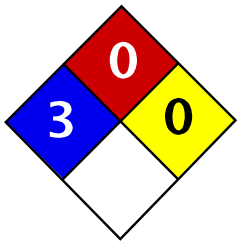
Exposure Limits
CAS# 108-95-2: OEL-ARAB Republic of Egypt:TWA 5 ppm (19 mg/m3);Skin OEL-AUSTRALIA:TWA 5 ppm (19 mg/m3);Skin OEL-BELGIUM:TWA 5 ppm (19 mg/m3);Skin OEL-CZECHOSLOVAKIA:TWA 20 mg/m3;STEL 40 mg/m3 OEL-DENMARK:TWA 5 ppm (19 mg/m3);Skin OEL-FINLAND:TWA 5 ppm (19 mg/m3);STEL 10 ppm (38 mg/m3);Skin OEL-FRANCE:TWA 5 ppm (19 mg/m3);Skin OEL-GERMANY:TWA 5 ppm (19 mg/m3);Skin OEL-HUNGARY:TWA 4 mg/m3;STEL 8 mg/m3;Skin OEL-JAPAN:TWA 5 ppm (19 mg/m3);Skin OEL-THE NETHERLANDS:TWA 5 ppm (19 mg/m3);Skin OEL-THE PHILIPPINES:TWA 5 ppm (10 mg/m3);Skin OEL-POLAND:TWA 10 ppm OEL-RUSSIA:TWA 5 ppm;STEL 0.3 mg/m3;Skin OEL-SWEDEN:TWA 1 ppm (4 mg/m3);STEL 2 ppm (8 mg/m3);Skin OEL-SWITZERLAND:TWA 5 ppm (19 mg/m3);STEL 10 ppm (38 mg/m3);Skin OEL-THAILAND:TWA 5 ppm (19 mg/m3) OEL-TURKEY:TWA 5 ppm (19 mg/m3);Skin OEL-UNITED KINGDOM:TWA 5 ppm (19 mg/m3);STEL 10 ppm;Skin OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV

Section 16 - Additional Information

MSDS Creation Date: 6/01/1999
Revision #5 Date: 10/08/2003

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.





Health	3
Fire	1
Reactivity	0
Personal Protection	J

Material Safety Data Sheet
Sodium Cyanide MSDS

Section 1: Chemical Product and Company Identification

Product Name: Sodium Cyanide

Catalog Codes: SLS2314, SLS3736

CAS#: 143-33-9

RTECS: VZ7525000

TSCA: TSCA 8(b) inventory: Sodium Cyanide

CI#: Not available.

Synonym:

Chemical Name: Sodium Cyanide

Chemical Formula: NaCN

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Sodium Cyanide	143-33-9	100

Toxicological Data on Ingredients: Sodium Cyanide: ORAL (LD50): Acute: 6.44 mg/kg [Rat]. DERMAL (LD50): Acute: 10.4 mg/kg [Rabbit].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Hazardous in case of skin contact (permeator). Corrosive to eyes and skin. The amount of tissue damage depends on length of contact. Eye contact can result in corneal damage or blindness. Skin contact can produce inflammation and blistering. Inhalation of dust will produce irritation to gastro-intestinal or respiratory tract, characterized by burning, sneezing and coughing. Severe over-exposure can produce lung damage, choking, unconsciousness or death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.

The substance may be toxic to skin, eyes, central nervous system (CNS).
Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure of the eyes to a low level of dust can produce eye irritation. Repeated skin exposure can produce local skin destruction, or dermatitis. Repeated inhalation of dust can produce varying degree of respiratory irritation or lung damage. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances: Slightly flammable to flammable in presence of acids, of moisture.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder.

LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards:
Dangerous on contact with acids, acid fumes, water or stream. It will produce toxic and flammable vapors of CN-H and sodium oxide.
Contact with acids and acid salts causes immediate formation of toxic and flammable hydrogen cyanide gas.
When heated to decomposition it emits toxic fumes hydgrogen cyanide and oxides of nitrogen

Special Remarks on Explosion Hazards: Fusion mixtures of metal cyanides with metal chlorates, perchlorated or nitrates causes a violent explosion

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Corrosive solid. Poisonous solid.
Stop leak if without risk. Do not get water inside container. Do not touch spilled material. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep container dry. Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe dust. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, acids, moisture.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 24°C (75.2°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Synthetic apron. Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor and dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
STEL: 5 (mg/m3) from ACGIH (TLV) [United States] SKIN
CEIL: 4.7 from NIOSH
CEIL: 5 (mg/m3) from NIOSHConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Granular solid. Flakes solid.)

Odor:
Faint almond-like odor.
Odorless when perfectly dry. Emits odor of hydrogen cyanide when damp.

Taste: Not available.

Molecular Weight: 49.01 g/mole

Color: White.

pH (1% soln/water): Not available.

Boiling Point: 1496°C (2724.8°F)

Melting Point: 563°C (1045.4°F)

Critical Temperature: Not available.

Specific Gravity: 1.595 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Vapor Density of Hydrogen Cyanide gas: 0.941

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility:
Soluble in cold water.
Slightly soluble in Ethanol

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Excess heat, moisture, incompatibles.

Incompatibility with various substances: Reactive with oxidizing agents, acids, moisture.

Corrosivity:
Corrosive in presence of aluminum.
Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Violent reaction with fluorine gas, magnesium, nitrates, nitric acid.
Dangerous on contact with acids, acid fumes, water or stream. It wil produce toxic and flammable vapors of CN-H and sodium oxide.
Cyanide may react with CO2 in ordinary air to form toxic hydrogen cyanide gas.
Strong oxidizers such as acids, acid salts, chlorates, and nitrates.
Contact with acids and acid salts causes immediate formation of toxic and flammable hydrogen cyanide gas.

Special Remarks on Corrosivity: Corrosive to aluminum

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
Acute oral toxicity (LD50): 6.44 mg/kg [Rat].
Acute dermal toxicity (LD50): 10.4 mg/kg [Rabbit].

Chronic Effects on Humans: May cause damage to the following organs: skin, eyes, central nervous system (CNS).

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant), of ingestion, of inhalation.
Hazardous in case of skin contact (permeator).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: May cause adverse reproductive effects (maternal and paternal fertility) based on animal data.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health effects:
Skin: May cause itching and irritation. May be fatal if absorbed through injured skin with symtpoms similar to those noted for inhalation and ingestion.
Eyes: May cause eye irritation and eye damage.
Inhalation: May cause respiratory tract irritation. May be fatal if inhaled. The substance inhibits cellular respiration causing metabolic asphyxiation. May cause headache, weakness, dizziness, labored breathing, nausea, vomiting. May be followed by cardiovascular effects, unconciousness, convulsions, coma, and death
Ingestion: May be fatal if swallowed. May cause gastrointestinal tract irritation with nausea, vomiting. May affect behavior and nervous systems(seizures, convulsions, change in motor activity, headache, dizziness, confusion, weakness stupor, aniexity, agitation, tremors), cardiovascular system, respiration (hyperventilation, pulmonary edema, breathing difficulty, respiratory failure), cardiovascular system (palpitations, rapid heart beat, hypertension, hypotension). Massive doses by produce sudden loss of conciousness and prompt death from respiratory arrest. Smaller but still lethal doses
on the breath or vomitus.
Chronic Potential Health Effects:
Central Nervous system effects (headaches, vertigo, insomnia, memory loss, tremors, fatigue), fatigue, metabolic effects (poor appetite), cardiovascular effects (chest discomfort, palpitations), nerve damage to the eyes, or dermatitis, respiratory tract irritation, eye irritation, or death can occur.
may prolong the illness for 1 or more hours. A bitter almond odor may be noted

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Sodium cyanide UNNA: 1689 PG: I

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut carcinogen reporting list.: Sodium Cyanide
Illinois chemical safety act: Sodium Cyanide
New York release reporting list: Sodium Cyanide
Rhode Island RTK hazardous substances: Sodium Cyanide
Pennsylvania RTK: Sodium Cyanide
Minnesota: Sodium Cyanide
Massachusetts RTK: Sodium Cyanide
Massachusetts spill list: Sodium Cyanide
New Jersey: Sodium Cyanide
New Jersey spill list: Sodium Cyanide
Louisiana RTK reporting list: Sodium Cyanide
Louisiana spill reporting: Sodium Cyanide
California Director's List of Hazardous Substances: Sodium Cyanide
TSCA 8(b) inventory: Sodium Cyanide
TSCA 4(a) final test rules: Sodium Cyanide
TSCA 8(a) PAIR: Sodium Cyanide
TSCA 8(d) H and S data reporting: Sodium Cyanide
TSCA 12(b) one time export: Sodium Cyanide
SARA 302/304/311/312 extremely hazardous substances: Sodium Cyanide
CERCLA: Hazardous substances.: Sodium Cyanide: 10 lbs. (4.536 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-6: Reactive and very flammable material.
CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC).
CLASS E: Corrosive solid.

DSCL (EEC):
R27/28- Very toxic in contact with skin and if swallowed.
R41- Risk of serious damage to eyes.
S1/2- Keep locked up and out of the reach of children.
S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S28- After contact with skin, wash immediately

with plenty of water
S36/37- Wear suitable protective clothing and gloves.
S39- Wear eye/face protection.
S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
S46- If swallowed, seek medical advice immediately and show this container or label.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 1

Reactivity: 0

Personal Protection: j

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Synthetic apron.
Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/11/2005 01:58 PM

Last Updated: 11/06/2008 12:00 PM

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SPI Supplies Division
Structure Probe, Inc.
P.O. Box 656 West Chester, PA 19381-0656 USA
Phone: 1-(610)-436-5400 Fax: 1-(610)-436-5755
E-mail: spi3spi@2spi.com
WWW: http://www.2spi.com
Manufacturer's CAGE: 1P573

Material Safety Data Sheet

SPI #02701-AB, 02701A-AB Chrysotile "B" and SPI#02740-AB, 02740A-AB Chrysolile "B" Asbestos Standards

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Section 1: Identification

```
Date Effective.......... May 30, 2007
                         (most recent revision)

Chemical family..... Hydrous silicates of magnesia

Emergencies
Contacting CHEMTREC:

24 Hour Emergency Use Only #'s......
Worldwide phone: 1-(703)-527-3887
Worldwide FAX:   1-(703)-741-6090
Toll-free phone: 1-(800)-424-9300 USA only

Product or Trade Name....  Chrysotile asbestos fiber

Emergency Overview:
Chrysotile asbestos is a known human carcinogen.
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Section 2: Composition

Name	CAS #	EC#	Approximate Weight %
Chrysotile	12001-29-5	650-013-006	>99.99%

Confirmed carcinogen by ACGIH, IARC, OSHA AND NTP.

Section 3: Hazard Identification

Potential Health Effects:
Acute: Overexposure to breathing asbestos may cause asbestosis, pulmonary fibrosis, mesothelioma, other lung disorders or cancer. Handling of materials and smoking or eating prior to washing could be hazardous. Medical examination and x-rays are required to determine signs & symptoms of exposure.

Routes of exposure: Inhalation, Skin contact, Ingestion

Medical Conditions Aggravated by Exposure:
Pulmonary disease

Occupational Exposure Limits:

TLV: 0.1 fiber/cc (as TWA)
A1 (ACGIH 1998. For fibers longer than 5Âµm with an aspect ratio equal to or greater than 3:1 as determined at 400-450X magnification by the membrane filter method).

Incompatibilies:
Strong oxidizers, strong acids, and bases

Route of entry: Inhalation, Skin contact, Ingestion
Target organs: Lungs

Symptoms:
There are not acute signs or symptoms associated with asbestos. Diseases associated with over exposure are chronic, generally taking from 10 to 40 years to become apparent.

Section 4: First Aid Measures

Eyes: In case of contact, immediately flush eyes with copious amounts of flowing water for at least 15 minutes, retracting eye lids often. Get medical attention immediately. Contact lenses should not be worn when working with this product.

Skin: Wash skin thoroughly with mild soap and water. Flush with copious amounts of water for 15 minutes.

Inhalation: Move the exposed person to fresh air at once. Support breathing. If symptoms persist contact physician.

Ingestion: Get medical aid immediately.

Section 5: Fire Fighting Measures

Flammability classification: Not classified.
Heat resistant up to 500°C; is completely decomposed at a temperature of 1000°C.

Flash Point/Method: Not known

Auto-Ignition Temperature: Not determined

Flammable Limits: Lower: Not applicable
Upper: Not applicable

Extinguishing Media: Water, Foam, Dry Chemical

Unusual Fire Hazards: Toxic gases and asbestos particulate may be Released in a fire.

Firefighting procedures/instructions:
Use NIOSH approved self-contained breathing apparatus and full protective equipment.
Properties that could increase fire or explosion hazard:
Combustibility of this material results from paraffin lubrication.

Section 6: Accidental Release Measures

Use HEPA vacuum wet methods when feasible. Use appropriate personal protection for clean-up personnel.

Section 7: Handling and Storage

Storage and handling:
Store in well-sealed container in cool, dry area.

Section 8: Exposure Controls and Personal Protection

ANSI approved eye wash and deluge shower should be available in the work area.

Personal Protective Equipment (PPE):

Eye/Face Protection: ANSI 87.1 approved chemical safety glasses with side shield.

Protective gloves: Rubber gloves
Protective clothing: Wear protective clothing to prevent skin contact. Do NOT take working clothes home.

Respiratory Protection:
Wear NIOSH approved respirator in accordance with 29CFR1910.1001.

Other: Wash prior to eating, drinking, or smoking. Avoid ingestion or breathing of dust.

Section 9: Physical and Chemical Properties

Appearance: white or gray fibrous solid
Color: white or gray
pH: Not applicable
Odor: None
Vapor Pressure: Not applicable
Vapor Density (Air=1): Not available
Boiling Point/Range: Not available
Melting Point/Range: Decomposes above 500°C
Specific Gravity: 2.2 to 2.6 g/cc
Solubility in water: None
Softening Point: Not determined
Molecular Formula: $Mg_3Si_2H_4O_6/Mg_3(Si_2O_5)(OH)4$
Molecular Weight: 277
%Volatile by Volume: Not determined
Evaporation Rate (n-butyl acetate = 1): Not available
Viscosity: Not available

Section 10: Stability and Reactivity

Chemical Stability: The product is stable under normal use conditions.

Conditions to Avoid:
Prevent dispersion of dust. Avoid all contact. Avoid airborne concentrations at or above OSHA PEL.

Incompatibility (materials to avoid):
Strong oxidizers, strong acids, and bases.

Hazardous Products of Decomposition:
None known

Reactions with Air and Water:
Avoid airborne concentrations at or above OSHA PEL.

Section 11: Toxicological Information

RTECS# CI3478500

Section 12: Ecological Information

None available

Section 13: Disposal Considerations

Bury waste is solid landfill as required in 29CFR1910.1001. Comply with applicable OSHA, Federal, State and Local regulations.

Section 14: Transport Information

Proper Shipping Name: White asbestos (chrysotile)

DOT Hazard Class: 9

UN/NA ID: UN2590

Packing Group: III

Labels: 9

Marine Pollutant: No information

DOT Status: Not Regulated

Section 15: Regulatory Information

United States:

TSCA
This product is listed under the TSCA Inventory.

CERCLA:
This product has an RQ of 1 pound under CERCLA.

SARA:
Section 313
This product is listed under SARA Section 313.

California Prop. 65:
Asbestos a known carcinogen under California Prop. 65.

US Statements:
Confirmed carcinogen. Target organs: Lung

European/International Regulations:
European Labeling in Accordance with EC Directives

Hazard Symbols: T Toxic
Risk Phrases:
R23 Toxic by Inhalation
R45 May cause cancer
R48 Danger of serious damage to health by prolonged exposure
R49 May cause cancer by inhalation

Safety Phrases:
S53 Avoid exposure â€“ obtain special instructions before use
S45 In case of accident, or if you feel unwell, seek medical advice immediately (show the label where possible.)

Canada

This product has a WHMIS classification of D2B.

DSL/NDSL
This product is listed on the DSL List and is not listed on the NDSL List.

Section 16: Other Information

If this product should be used in ways that are outside of the intended applications in scanning electron microscope laboratories, and if it is going to be formulated into some other system, so that it becomes just another component of that other system, read the MSDS sheets for the other components before blending as the resulting mixture may have the hazards of all of its parts.

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Wednesday December 03, 2008

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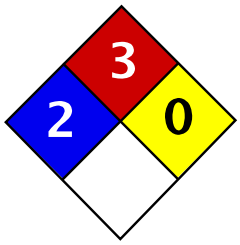

Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Ethylbenzene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Ethylbenzene

Catalog Codes: SLE2044

CAS#: 100-41-4

RTECS: DA0700000

TSCA: TSCA 8(b) inventory: Ethylbenzene

CI#: Not available.

Synonym: Ethyl Benzene; Ethylbenzol; Phenylethane

Chemical Name: Ethylbenzene

Chemical Formula: C8H10

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Ethylbenzene	100-41-4	100

Toxicological Data on Ingredients: Ethylbenzene: ORAL (LD50): Acute: 3500 mg/kg [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant, permeator).

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (irritant, sensitizer).
CARCINOGENIC EFFECTS: Classified 2B (Possible for human.) by IARC.
MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance may be toxic to central nervous system (CNS).
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. WARM water MUST be used. Get medical attention.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 432°C (809.6°F)

Flash Points:
CLOSED CUP: 15°C (59°F). (Tagliabue.) OPEN CUP: 26.667°C (80°F) (Cleveland) (CHRIS, 2001)
CLOSED CUP: 12.8 C (55 F) (Bingham et al, 2001; NIOSH, 2001)
CLOSED CUP: 21 C (70 F) (NFPA)

Flammable Limits: LOWER: 0.8% - 1.6%UPPER: 6.7% - 7%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Highly flammable in presence of open flames and sparks, of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.
Slightly explosive in presence of heat.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards:
Vapor may travel considerable distance to source of ignition and flash back. Vapors may form explosive mixtures with air. When heated to decomposition it emits acrid smoke and irritating fumes.

Special Remarks on Explosion Hazards: Vapors may form explosive mixtures in air.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid.
Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Avoid contact with eyes. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame). Sensitive to light. Store in light-resistant containers.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 100 STEL: 125 (ppm) from OSHA (PEL) [United States]
TWA: 435 STEL: 545 from OSHA (PEL) [United States]
TWA: 435 STEL: 545 (mg/m3) from NIOSH [United States]
TWA: 100 STEL: 125 (ppm) from NIOSH [United States]
TWA: 100 STEL: 125 (ppm) from ACGIH (TLV) [United States]
TWA: 100 STEL: 125 (ppm) [United Kingdom (UK)]
TWA: 100 STEL: 125 (ppm) [Belgium]
TWA: 100 STEL: 125 (ppm) [Finland]
TWA: 50 (ppm) [Norway]
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Sweetish. Gasoline-like. Aromatic.

Taste: Not available.

Molecular Weight: 106.16 g/mole

Color: Colorless.

pH (1% soln/water): Not available.

Boiling Point: 136°C (276.8°F)

Melting Point: -94.9 (-138.8°F)

Critical Temperature: 617.15°C (1142.9°F)

Specific Gravity: 0.867 (Water = 1)

Vapor Pressure: 0.9 kPa (@ 20°C)

Vapor Density: 3.66 (Air = 1)

Volatility: 100% (v/v).

Odor Threshold: 140 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.1

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility:
Easily soluble in diethyl ether.
Very slightly soluble in cold water or practically insoluble in water.
Soluble in all proportions in Ethyl alcohol.
Soluble in Carbon tetrachloride, Benzene.
Insoluble in Ammonia.
Slightly soluble in Chloroform.
Solubility in Water: 169 mg/l @ 25 deg. C.; 0.014 g/100 ml @ 15 deg. C.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ingnition sources (flames, sparks, static), incompatible materials, light

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Not considered to be corrosive for metals and glass.

Special Remarks on Reactivity:
Can react vigorously with oxidizing materials.
Sensitive to light.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Inhalation.

Toxicity to Animals: Acute oral toxicity (LD50): 3500 mg/kg [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 2B (Possible for human.) by IARC.
MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast.
May cause damage to the following organs: central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of ingestion, of inhalation.
Slightly hazardous in case of skin contact (irritant, permeator).

Special Remarks on Toxicity to Animals:
Lethal Dose/Conc 50% Kill:
LD50 [Rabbit] - Route: Skin; Dose: 17800 ul/kg
Lowest Published Lethal Dose/Conc:
LDL[Rat] - Route: Inhalation (vapor); Dose: 4000 ppm/4 H

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects and birth defects (teratogenic) based on animal test data.
May cause cancer based on animals data. IARC evidence for carcinogenicity in animals is sufficient. IARC evidence of carcinogenicity in humans inadequate.
May affect genetic material (mutagenic).

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: Can cause mild skin irritation. It can be absorbed through intact skin.
Eyes: Contact with vapor or liquid can cause severe eye irritation depending on concentration. It may also cause conjunctivitis. At a vapor exposure level of 85 - 200 ppm , it is mildly and transiently irritating to the eyes; 1000 ppm causes further irritation and tearing; 2000 ppm results in immediate and severe irritation and tearing; 5,000 ppm is intolerable (ACGIH, 1991; Clayton and Clayton, 1994). Standard draize test for eye irritation using 500 mg resulted in severe irritation (RTECS)
Inhalation: Exposure to high concentrations can cause nasal, mucous membrane and respiratory tract irritation and can also result in chest constriction and, trouble breathing, respiratory failure, and even death. It can also affect behavior/Central Nervous System. The effective dose for CNS depression in experimental animals was 10,000 ppm (ACGIH, 1991). Symptoms of CNS depression include headache, nausea, weakness, dizziness, vertigo, irritability, fatigue, lightheadedness, sleepiness, tremor, loss of coordination, judgement and conciousness, coma, and death. It can also cause pulmonary edema. Inhalation of 85 ppm can produce fatigue, insomnia, headache, and mild irritation of the respiratory tract (Haley & Berndt, 1987).
Ingestion: Do not drink, pipet or siphon by mouth. May cause gastroinestinal/digestive tract irritation with Abdominal pain, nausea, vomiting. Ethylbenzene is a pulmonary aspiration hazard. Pulmonary aspiration of even small amounts of the liquid may cause fatal pneumonitis. It may also affect behavior/central nervous system with

Section 12: Ecological Information

Ecotoxicity:
Ecotoxicity in water (LC50): 14 mg/l 96 hours [Fish (Trout)] (static). 12.1 mg/l 96 hours [Fish (Fathead Minnow)] (flow-through)]. 150 mg/l 96 hours [Fish (Blue Gill/Sunfish)] (static). 275 mg/l 96 hours [Fish (Sheepshead Minnow)]. 42.3 mg/l 96 hours [Fish (Fathead Minnow)](soft water). 87.6mg/l 96 hours [Shrimp].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Ethylbenzene UNNA: 1175 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Ethylbenzene
Illinois toxic substances disclosure to employee act: Ethylbenzene
Illinois chemical safety act: Ethylbenzene
New York release reporting list: Ethylbenzene
Rhode Island RTK hazardous substances: Ethylbenzene
Pennsylvania RTK: Ethylbenzene
Minnesota: Ethylbenzene
Massachusetts RTK: Ethylbenzene
Massachusetts spill list: Ethylbenzene
New Jersey: Ethylbenzene
New Jersey spill list: Ethylbenzene
Louisiana spill reporting: Ethylbenzene
California Director's List of Hazardous Substances: Ethylbenzene
TSCA 8(b) inventory: Ethylbenzene
TSCA 4(a) proposed test rules: Ethylbenzene
TSCA 8(d) H and S data reporting: Ethylbenzene: Effective Date: 6/19/87; Sunset Date: 6/19/97
SARA 313 toxic chemical notification and release reporting: Ethylbenzene

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F).
CLASS D-2A: Material causing other toxic effects (VERY TOXIC).
CLASSE D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R11- Highly flammable.
R20- Harmful by inhalation.
S16- Keep away from sources of ignition - No smoking.
S24/25- Avoid contact with skin and eyes.
S29- Do not empty into drains.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References:
-Manufacturer's Material Safety Data Sheet.
-Fire Protection Guide to Hazardous Materials, 13th ed., National Fire Protection Association (NFPA)
-Registry of Toxic Effects of Chemical Substances (RTECS)
-Chemical Hazard Response Information System (CHRIS)
-Hazardous Substance Data Bank (HSDB)
-New Jersey Hazardous Substance Fact Sheet
-Ariel Global View
-Reprotext System

Other Special Considerations: Not available.

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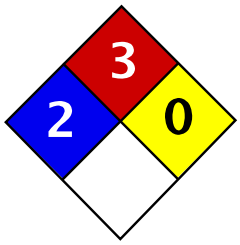

Health	2
Fire	3
Reactivity	0
Personal Protection	J

Material Safety Data Sheet
m-Xylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: m-Xylene

Catalog Codes: SLX1066

CAS#: 108-38-3

RTECS: ZE2275000

TSCA: TSCA 8(b) inventory: m-Xylene

CI#: Not applicable.

Synonym: m-Methyltoluene

Chemical Name: 1,3-Dimethylbenzene

Chemical Formula: C6H4(CH3)2

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
{m-}Xylene	108-38-3	100

Toxicological Data on Ingredients: m-Xylene: ORAL (LD50): Acute: 5000 mg/kg [Rat.]. DERMAL (LD50): Acute: 14100 mg/kg [Rabbit.].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant). Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant).
Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation.
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to blood, kidneys, the nervous system, liver.
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation: Not available.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 527°C (980.6°F)

Flash Points: CLOSED CUP: 25°C (77°F). OPEN CUP: 28.9°C (84°F) (Cleveland).

Flammable Limits: LOWER: 1.1% UPPER: 7%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Highly flammable in presence of open flames and sparks, of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable liquid, insoluble in water.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards:
Explosive in the form of vapor when exposed to heat or flame. Vapor may travel considerable distance to source of ignition and flash back. When heated to decomposition it emits acrid smoke and irritating fumes.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid, insoluble in water.

Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes Keep away from incompatibles such as oxidizing agents.

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. A refrigerated room would be preferable for materials with a flash point lower than 37.8°C (100°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection: Splash goggles. Lab coat. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Boots. Gloves. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 100 STEL: 150 (ppm) from ACGIH (TLV)
TWA: 434 STEL: 651 (mg/m3) from ACGIHConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid. (Liquid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 106.17 g/mole

Color: Colorless.

pH (1% soln/water): Not applicable.

Boiling Point: 139.3°C (282.7°F)

Melting Point: -47.87°C (-54.2°F)

Critical Temperature: Not available.

Specific Gravity: 0.86 (Water = 1)

Vapor Pressure: 6 mm of Hg (@ 20°C)

Vapor Density: 3.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.62 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether.

Solubility:
Easily soluble in methanol, diethyl ether.
Insoluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Eye contact.

Toxicity to Animals:
Acute oral toxicity (LD50): 5000 mg/kg [Rat.].
Acute dermal toxicity (LD50): 14100 mg/kg [Rabbit.].

Chronic Effects on Humans: The substance is toxic to blood, kidneys, the nervous system, liver.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant).
Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
0347 Animal: embryotoxic, foetotoxic, passes through the placental barrier.
0900 Detected in maternal milk in human.
Narcotic effect; may cause nervous system disturbances.

Special Remarks on other Toxic Effects on Humans: Material is irritating to mucous membranes and upper respiratory tract.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Class 3: Flammable liquid.

Identification: : Xylene : UN1307 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: m-Xylene
Massachusetts RTK: m-Xylene
TSCA 8(b) inventory: m-Xylene
SARA 313 toxic chemical notification and release reporting: m-Xylene
CERCLA: Hazardous substances.: m-Xylene

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F).
CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R10- Flammable.
R38- Irritating to skin.
R41- Risk of serious damage to eyes.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: j

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References:
-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.
-Material safety data sheet emitted by: la Commission de la SantÃ© et de la SÃ©curitÃ© du Travail du QuÃ©bec.
-SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984.
-The Sigma-Aldrich Library of Chemical Safety Data, Edition II.
-Guide de la loi et du rÃ¨glement sur le transport des marchandises dangeureuses au canada. Centre de conformitÃ© internatinal LtÃ©e. 1986.

Other Special Considerations: Not available.

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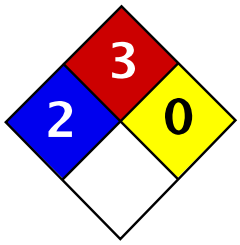

Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Toluene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Toluene

Catalog Codes: SLT2857, SLT3277

CAS#: 108-88-3

RTECS: XS5250000

TSCA: TSCA 8(b) inventory: Toluene

CI#: Not available.

Synonym: Toluol, Tolu-Sol; Methylbenzene; Methacide; Phenylmethane; Methylbenzol

Chemical Name: Toluene

Chemical Formula: C6-H5-CH3 or C7-H8

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Toluene	108-88-3	100

Toxicological Data on Ingredients: Toluene: ORAL (LD50): Acute: 636 mg/kg [Rat]. DERMAL (LD50): Acute: 14100 mg/kg [Rabbit]. VAPOR (LC50): Acute: 49000 mg/m 4 hours [Rat]. 440 ppm 24 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance may be toxic to blood, kidneys, the nervous system, liver, brain, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 480°C (896°F)

Flash Points: CLOSED CUP: 4.4444°C (40°F). (Setaflash) OPEN CUP: 16°C (60.8°F).

Flammable Limits: LOWER: 1.1% UPPER: 7.1%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Flammable in presence of open flames and sparks, of heat.
Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable liquid, insoluble in water.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray or fog.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards:
Toluene forms explosive reaction with 1,3-dichloro-5,5-dimethyl-2,4-imidazolididione; dinitrogen tetraoxide;

concentrated nitric acid, sulfuric acid + nitric acid; N_2O_4; $AgClO_4$; BrF_3; Uranium hexafluoride; sulfur dichloride. Also forms an explosive mixture with tetranitromethane.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Toxic flammable liquid, insoluble or very slightly soluble in water.
Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 200 STEL: 500 CEIL: 300 (ppm) from OSHA (PEL) [United States]
TWA: 50 (ppm) from ACGIH (TLV) [United States] SKIN
TWA: 100 STEL: 150 from NIOSH [United States]
TWA: 375 STEL: 560 (mg/m^3) from NIOSH [United States]
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Sweet, pungent, Benzene-like.

Taste: Not available.

Molecular Weight: 92.14 g/mole

Color: Colorless.

pH (1% soln/water): Not applicable.

Boiling Point: 110.6°C (231.1°F)

Melting Point: -95°C (-139°F)

Critical Temperature: 318.6°C (605.5°F)

Specific Gravity: 0.8636 (Water = 1)

Vapor Pressure: 3.8 kPa (@ 25°C)

Vapor Density: 3.1 (Air = 1)

Volatility: Not available.

Odor Threshold: 1.6 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 2.7

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether, acetone.

Solubility:
Soluble in diethyl ether, acetone.
Practically insoluble in cold water.
Soluble in ethanol, benzene, chloroform, glacial acetic acid, carbon disulfide.
Solubility in water: 0.561 g/l @ 25 deg. C.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources (flames, sparks, static), incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Incompatible with strong oxidizers, silver perchlorate, sodium difluoride, Tetranitromethane, Uranium Hexafluoride.
Frozen Bromine Trifluoride reacts violently with Toluene at -80 deg. C.
Reacts chemically with nitrogen oxides, or halogens to form nitrotoluene, nitrobenzene, and nitrophenol and halogenated products, respectively.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.
Acute oral toxicity (LD50): 636 mg/kg [Rat].
Acute dermal toxicity (LD50): 14100 mg/kg [Rabbit].
Acute toxicity of the vapor (LC50): 440 24 hours [Mouse].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC.
May cause damage to the following organs: blood, kidneys, the nervous system, liver, brain, central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of skin contact (irritant), of ingestion, of inhalation.
Slightly hazardous in case of skin contact (permeator).

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Dose:
LDL [Human] - Route: Oral; Dose: 50 mg/kg
LCL [Rabbit] - Route: Inhalation; Dose: 55000 ppm/40min

Special Remarks on Chronic Effects on Humans:
Detected in maternal milk in human. Passes through the placental barrier in human. Embryotoxic and/or foetotoxic in animal. May cause adverse reproductive effects and birth defects (teratogenic). May affect genetic material (mutagenic)

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: Causes mild to moderate skin irritation. It can be absorbed to some extent through the skin.
Eyes: Cauess mild to moderate eye irritation with a burning sensation. Splash contact with eyes also causes conjunctivitis, blepharospasm, corneal edema, corneal abraisons. This usually resolves in 2 days.
Inhalation: Inhalation of vapor may cause respiratory tract irritation causing coughing and wheezing, and nasal discharge. Inhalation of high concentrations may affect behavior and cause central nervous system effects characterized by nausea, headache, dizziness, tremors, restlessness, lightheadedness, exhilaration, memory loss, insomnia, impaired reaction time, drowsiness, ataxia, hallucinations, somnolence, muscle contraction or spasticity, unconsciousness and coma. Inhalation of high concentration of vapor may also affect the cardiovascular system (rapid heart beat, heart palpitations, increased or decreased blood pressure, dysrhythmia,), respiration (acute pulmonary edema, respiratory depression, apnea, asphyxia), cause vision disturbances and dilated pupils, and cause loss of appetite.
Ingestion: Aspiration hazard. Aspiration of Toluene into the lungs may cause chemical pneumonitis. May cause irritation of the digestive tract with nausea, vomiting, pain. May have effects similar to that of acute inhalation.
Chronic Potential Health Effects:
Inhalation and Ingestion: Prolonged or repeated exposure via inhalation may cause central nervous system and cardiovascular symptoms similar to that of acute inhalation and ingestion as well liver damage/failure, kidney damage/failure (with hematuria, proteinuria, oliguria, renal tubular acidosis), brain damage, weight loss, blood (pigmented or nucleated red blood cells, changes in white blood cell count), bone marrow changes, electrolyte imbalances (Hypokalemia, Hypophostatemia), severe, muscle weakness and Rhabdomyolysis.
Skin: Repeated or prolonged skin contact may cause defatting dermatitis.

Section 12: Ecological Information

Ecotoxicity:
Ecotoxicity in water (LC50): 313 mg/l 48 hours [Daphnia (daphnia)]. 17 mg/l 24 hours [Fish (Blue Gill)]. 13 mg/l 96 hours [Fish (Blue Gill)]. 56 mg/l 24 hours [Fish (Fathead minnow)]. 34 mg/l 96 hours [Fish (Fathead minnow)]. 56.8 ppm any hours [Fish (Goldfish)].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may

arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Toluene UNNA: 1294 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Toluene
California prop. 65 (no significant risk level): Toluene: 7 mg/day (value)
California prop. 65 (acceptable daily intake level): Toluene: 7 mg/day (value)
California prop. 65: This product contains the following ingredients for which the State of California has found to cause birth defects which would require a warning under the statute: Toluene
Connecticut hazardous material survey.: Toluene
Illinois toxic substances disclosure to employee act: Toluene
Illinois chemical safety act: Toluene
New York release reporting list: Toluene
Rhode Island RTK hazardous substances: Toluene
Pennsylvania RTK: Toluene
Florida: Toluene
Minnesota: Toluene
Michigan critical material: Toluene
Massachusetts RTK: Toluene
Massachusetts spill list: Toluene
New Jersey: Toluene
New Jersey spill list: Toluene
Louisiana spill reporting: Toluene
California Director's List of Hazardous Substances.: Toluene
TSCA 8(b) inventory: Toluene
TSCA 8(d) H and S data reporting: Toluene: Effective date: 10/04/82; Sunset Date: 10/0/92
SARA 313 toxic chemical notification and release reporting: Toluene
CERCLA: Hazardous substances.: Toluene: 1000 lbs. (453.6 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F).
CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R11- Highly flammable.
R20- Harmful by inhalation.
S16- Keep away from sources of ignition - No smoking.
S25- Avoid contact with eyes.
S29- Do not empty into drains.
S33- Take precautionary measures against static discharges.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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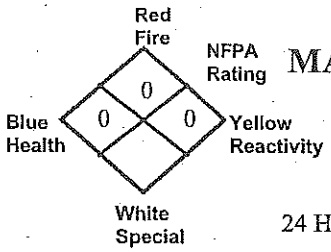
S-70112

Alconox ®



MATERIAL SAFETY DATA SHEET

Alconox, Inc.
30 Glenn Street
White Plains, NY 10603

24 Hour Emergency Number – Chem-Tel (800) 255-3924

I. IDENTIFICATION

Product Name (as appears on label)	ALCONOX
CAS Registry Number:	Not Applicable
Effective Date:	January 1, 2001
Chemical Family:	Anionic Powdered Detergent
Manufacturer Catalog Numbers for sizes	1104, 1125, 1150, 1101, 1103 and 1112

II. HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

There are no hazardous ingredients in ALCONOX as defined by the OSHA Standard and Hazardous Substance List 29 CFR 1910 Subpart Z.

III. PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point (F):	Not Applicable
Vapor Pressure (mm Hg):	Not Applicable
Vapor Density (AIR=1):	Not Applicable
Specific Gravity (Water=1):	Not Applicable
Melting Point:	Not Applicable
Evaporation Rate (Butyl Acetate=1):	Not Applicable
Solubility in Water:	Appreciable-Soluble to 10% at ambient conditions
Appearance:	White powder interspersed with cream colored flakes.
pH:	9.5 (1%)

IV. FIRE AND EXPLOSION DATA

Flash Point (Method Used):	None
Flammable Limits:	LEL: No Data UEL: No Data
Extinguishing Media:	Water, dry chemical, CO_2, foam
Special Fire fighting Procedures:	Self-contained positive pressure breathing apparatus and protective clothing should be worn when fighting fires involving chemicals.
Unusual Fire and Explosion Hazards:	None

V. REACTIVITY DATA

Stability:	Stable
Hazardous Polymerization:	Will not occur
Incompatibility (Materials to Avoid):	None
Hazardous Decomposition or Byproducts:	May release CO_2 on burning

VI. HEALTH HAZARD DATA

Route(s) of Entry:	Inhalation? Yes Skin? No Ingestion? Yes
Health Hazards (Acute and Chronic):	Inhalation of powder may prove locally irritating to mucous membranes. Ingestion may cause discomfort and/or diarrhea. Eye contact may prove irritating.
Carcinogenicity:	NTP? No IARC Monographs? No OSHA Regulated? No
Signs and Symptoms of Exposure:	Exposure may irritate mucous membranes. May cause sneezing.
Medical Conditions Generally Aggravated by Exposure:	Not established. Unnecessary exposure to this product or any industrial chemical should be avoided. Respiratory conditions may be aggravated by powder.
Emergency and First Aid Procedures:	Eyes: Immediately flush eyes with water for at least 15 minutes. Call a physician. Skin: Flush with plenty of water. Ingestion: Drink large quantities of water or milk. Do not induce vomiting. If vomiting occurs administer fluids. See a physician for discomfort.

VII. PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken if Material is Released or Spilled:	Material foams profusely. Recover as much as possible and flush remainder to sewer. Material is biodegradable.
Waste Disposal Method:	Small quantities may be disposed of in sewer. Large quantities should be disposed of in accordance with local ordinances for detergent products.
Precautions to be Taken in Storing and Handling:	Material should be stored in a dry area to prevent caking.
Other Precautions:	No special requirements other than the good industrial hygiene and safety practices employed with any industrial chemical.

VIII. CONTROL MEASURES

Respiratory Protection (Specify Type):	Dust mask - Recommended
Ventilation:	Local Exhaust-Normal Special-Not Required Mechanical-Not Required Other-Not Required
Protective Gloves:	Impervious gloves are useful but not required.
Eye Protection:	Goggles are recommended when handling solutions.
Other Protective Clothing or Equipment:	None
Work/Hygienic Practices:	No special practices required

THE INFORMATION HEREIN IS GIVEN IN GOOD FAITH BUT NO WARRANTY IS EXPRESSED OR IMPLIED.

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**** MATERIAL SAFETY DATA SHEET ****

Methanol
14280

**** SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION ****

MSDS Name: Methanol
Catalog Numbers:
, S75959, S75965, S75965A, S75965HPLC, S75965SPEC, A408-1, A408-4, A408SK-4 A411-20, A411-4, A412-1, A412-20, A412-200, A412-200LC, A412-4, A412-4LC, A412-500, A412-500LC, A412CU1300, A413FB115, A412FB19, A412FB200, A412FB50, A412J500, A412P-4, A412P-4LC, A412POP19, A412POP200, A412POP50, A412POPB19, A412POPB200, A412POPB50, A412RE115, A412RE19, A412RE200, A412RE50, A412RS115, A412RS200, A412RS28, A412RS50, A412SK-4, A412SS-115, A412SS-19, A412SS-200, A413-20, A413-200, A413-4, A413-500, A433F-1GAL, A433P-4, A433P1GAL, A433S-20, A433S-200, A433S-4, A434-20, A450-4, A452-1, A452-4, A452-4LC, A452J1, A452NB219, A452POP19, A452POP200, A452POP28, A452POP50, A452POPN19, A452RS-115, A452RS-19, A452RS-200, A452RS-28, A452RS-50, A452SK-1, A452SK-4, A452SS-115, A452SS-19, A452SS-200, A452SS-50, A453-1, A453-1LC, A453-500, A453J1, A454-1, A454-1LC, A454-4, A454-4LC, A454POP19, A454POP200, A454POP50, A454RS-115, A454RS-19, A454RS-200, A454RS-28, A454RS-50, A454SS-19, A454SS-28, A454SS-50, A455-1, A455POP19, A455POP200, A455POP50, A455SS19, A455SS200, A455SS50, A457-4, A935-4, A935FB200, A935POPB200, A935RB200, A936-1, A936-4, A947-4, A947-4LC, A947POP19, A947POP200, A947POP50, A947RS-115, A947RS-200, A947RS-28, A947SS-115, A947SS-19, A947SS-200, A947SS-28, A947SS-50, BP1105-1, BP1105-4, BP1105POP19, BP1105POP20, BP1105POP50, BP1105RS19, BP1105SS19, BP1105SS28, BP1105SS50, BP2618100, HC400 1GAL, NC9633361, NC9766429, NC9780216, NC9905242, NC9941388, NC9942270, NC9964975, NC9979250, SC95-1, SW2-1, TIA9474, TIA947P200L .
Synonyms:
Carbinol; Methyl alcohol; Methyl hydroxide; Monohydroxymethane; Wood alcohol; Wood naptha; Wood spirits; Columbian spirits; Methanol.
Company Identification: Fisher Scientific
1 Reagent Lane
Fairlawn, NJ 07410
For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

**** SECTION 2 - COMPOSITION, INFORMATION ON INGREDIENTS ****

CAS#	Chemical Name	%	EINECS#
67-56-1	Methanol	>99.0	200-659-6

Hazard Symbols: T F
Risk Phrases: 11 23/24/25 39/23/24/25

**** SECTION 3 - HAZARDS IDENTIFICATION ****

EMERGENCY OVERVIEW
Appearance: clear, colorless liquid. Flash Point: 11 deg C.
Danger! Flammable liquid and vapor. Causes respiratory tract irritation. May cause central nervous system depression. Poison! Cannot be made non-poisonous. Causes eye and skin irritation. May be fatal or cause blindness if swallowed. Harmful if swallowed, inhaled, or absorbed through the skin. Vapor harmful.
Target Organs: Eyes, nervous system, optic nerve.

Potential Health Effects
Eye:
Methanol is a mild to moderate eye irritant. Inhalation, ingestion or skin absorption of methanol can cause significant disturbances in vision, including blindness.
Skin:
Causes moderate skin irritation. Harmful if absorbed through the skin. Prolonged and/or repeated contact may cause defatting of the skin and dermatitis. Methanol can be absorbed through the skin, producing systemic effects that include visual disturbances.
Ingestion:
Harmful if swallowed. May be fatal or cause blindness if swallowed. Aspiration hazard. May cause systemic toxicity with acidosis. May cause central nervous system depression, characterized by excitement, followed by headache, dizziness, drowsiness, and nausea. Advanced stages may cause collapse, unconsciousness, coma and possible death due to respiratory failure.
Inhalation:
Methanol is toxic and can very readily form extremely high vapor concentrations at room temperature. Inhalation is the most common route of occupational exposure. At first, methanol causes CNS depression with nausea, headache, vomiting, dizziness and incoordination. A time period with no obvious symptoms follows (typically 8-24 hrs). This latent period is followed by metabolic acidosis and severe visual effects which may include reduced reactivity and/or increased sensitivity to light, blurred, double

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and/or snowy vision, and blindness. Depending on the severity of exposure and the promptness of treatment, survivors may recover completely or may have permanent blindness, vision disturbances and/or nervous system effects.
Chronic:
Prolonged or repeated skin contact may cause dermatitis. Chronic exposure may cause effects similar to those of acute exposure. Methanol is only very slowly eliminated from the body. Because of this slow elimination, methanol should be regarded as a cumulative poison. Though a single exposure may cause no effect, daily exposures may result in the accumulation of a harmful amount. Methanol has produced fetotoxicity in rats and teratogenicity in mice exposed by inhalation to high concentrations that did not produce significant maternal toxicity.

**** SECTION 4 - FIRST AID MEASURES ****

Eyes:
In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical aid.
Skin:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid immediately. Wash clothing before reuse.
Ingestion:
Potential for aspiration if swallowed. Get medical aid immediately. Do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person.
Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.
Notes to Physician:
Effects may be delayed.
Antidote:
Ethanol may inhibit methanol metabolism.

**** SECTION 5 - FIRE FIGHTING MEASURES ****

General Information:
Containers can build up pressure if exposed to heat and/or fire. As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. Use water spray to keep fire-exposed containers cool. Water may be ineffective. Material is lighter than water and a fire may be spread by the use of water. Flammable liquid and vapor. Vapors are heavier than air and may travel to a source of ignition and flash back. Vapors can spread along the ground and collect in low or confined areas.
Extinguishing Media:
For small fires, use dry chemical, carbon dioxide, water spray or alcohol-resistant foam. Water may be ineffective. For large fires, use water spray, fog or alcohol-resistant foam. Do NOT use straight streams of water.
Autoignition Temperature:464 deg C (867.20 deg F)
Flash Point: 11 deg C (51.80 deg F)
Explosion Limits, lower:6.0 vol %
Explosion Limits, upper:36.00 vol %
NFPA Rating: (estimated) Health: 1; Flammability: 3; Instability: 0

**** SECTION 6 - ACCIDENTAL RELEASE MEASURES ****

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks:
Absorb spill with inert material (e.g. vermiculite, sand or earth), then place in suitable container. Use water spray to disperse the gas/vapor. Remove all sources of ignition. Provide ventilation. A vapor suppressing foam may be used to reduce vapors. Water spray may reduce vapor but may not prevent ignition in closed spaces.

**** SECTION 7 - HANDLING and STORAGE ****

Handling:
Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Ground and bond containers when transferring material. Avoid contact with eyes, skin, and clothing. Empty containers retain product residue, (liquid and/or vapor), and can be dangerous. Keep container tightly closed. Do not ingest or inhale. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose empty containers to heat, sparks or open flames. Use only with adequate ventilation. Keep away from heat, sparks and flame. Avoid use in confined spaces. Avoid breathing vapor or mist.
Storage:
Keep away from heat, sparks, and flame. Keep away from sources of ignition. Store in a cool, dry, well-ventilated area away from incompatible substances. Flammables-area. Keep containers tightly closed.

**** SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION ****

Engineering Controls:
Use explosion-proof ventilation equipment. Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Methanol	200 ppm; 250 ppm STEL; skin - potential for cutaneous absorption	200 ppm TWA; 260 mg/m3 TWA 6000 ppm IDLH	200 ppm TWA; 260 mg/m3 TWA

OSHA Vacated PELs:
Methanol:
200 ppm TWA; 260 mg/m3 TWA

Personal Protective Equipment

Eyes:
Wear chemical goggles.
Skin:
Wear appropriate protective gloves to prevent skin exposure.
Clothing:
Wear appropriate protective clothing to prevent skin exposure.
Respirators:
A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant a respirator's use.

**** SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES ****

Physical State:	Liquid
Color:	clear, colorless
Odor:	alcohol-like - weak odor
pH:	Not available.
Vapor Pressure:	127 mm Hg @ 25 deg C
Vapor Density:	1.11 (Air=1)
Evaporation Rate:	5.2 (Ether=1)
Viscosity:	0.55 cP 20 deg C
Boiling Point:	64.7 deg C @ 760 mm Hg
Freezing/Melting Point:	-98 deg C
Decomposition Temperature:	Not available.
Solubility in water:	miscible
Specific Gravity/Density:	.7910 g/cm3 @ 20&C
Molecular Formula:	CH4O
Molecular Weight:	32.04

**** SECTION 10 - STABILITY AND REACTIVITY ****

Chemical Stability:
Stable under normal temperatures and pressures.
Conditions to Avoid:
High temperatures, ignition sources, confined spaces.
Incompatibilities with Other Materials:
Strong oxidizing agents, strong acids, powdered aluminum, powdered magnesium.
Hazardous Decomposition Products:
Carbon monoxide, irritating and toxic fumes and gases, carbon dioxide, formaldehyde.
Hazardous Polymerization: Will not occur.

**** SECTION 11 - TOXICOLOGICAL INFORMATION ****

RTECS#:
CAS# 67-56-1: PC1400000
LD50/LC50:
CAS# 67-56-1: Draize test, rabbit, eye: 40 mg Moderate; Draize test, rabbit, eye: 100 mg/24H Moderate; Draize test, rabbit, skin: 20 mg/24H Moderate; Inhalation, rabbit: LC50 = 81000 mg/m3/14H; Inhalation, rat: LC50 = 64000 ppm/4H; Oral, mouse: LD50 = 7300 mg/kg; Oral, rabbit: LD50 = 14200 mg/kg; Oral, rat: LD50 = 5600 mg/kg; Skin, rabbit: LD50 = 15800 mg/kg.
Human LDLo Oral: 143 mg/kg.
Inhalation; 300 ppm caused visual field changes & headache.
LDLo Skin: 393 mg/kg.
experimental animals than humans, because most animal species metabolize methanol differently. Non-primate species do not ordinarily show symptoms of metabolic acidosis or the visual effects

which have been observed in primates and humans.
Carcinogenicity:
Methanol -
Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
Epidemiology:
No data available.
Teratogenicity:
There is no human information available. Methanol is considered to be a potential developmental hazard based on animal data. In animal experiments, methanol has caused fetotoxic or teratogenic effects without maternal toxicity.
Reproductive Effects:
See actual entry in RTECS for complete information.
Neurotoxicity:
ACGIH cites neuropathy, vision and CNS under TLV basis.
Mutagenicity:
See actual entry in RTECS for complete information.
Other Studies:
No data available.

**** SECTION 12 - ECOLOGICAL INFORMATION ****

Ecotoxicity:
Fish: Fathead Minnow: 29.4 g/L; 96 Hr; LC50 (unspecified)Fish: Goldfish: 250 ppm; 11 Hr; resulted in deathFish: Rainbow trout: 8000 mg/L; 48 Hr; LC50 (unspecified)Fish: Rainbow trout: LC50 = 13-68 mg/L; 96 Hr.; 12 degrees CFish: Fathead Minnow: LC50 = 29400 mg/L; 96 Hr.; 25 degrees C, pH 7.63Fish: Rainbow trout: LC50 = 8000 mg/L; 48 Hr.; UnspecifiedBacteria: Phytobacterium phosphoreum: EC50 = 51,000-320,000 mg/L; 30 minutes; Microtox test

**** SECTION 13 - DISPOSAL CONSIDERATIONS ****

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste.
US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series: CAS# 67-56-1: waste number U154 (Ignitable waste).

**** SECTION 14 - TRANSPORT INFORMATION ****

US DOT
Shipping Name: METHANOL
Hazard Class: 3
UN Number: UN1230
Packing Group: II
Canadian TDG
Shipping Name: METHANOL
Hazard Class: 3.61
UN Number: UN1230
Other Information: FLASHPOINT 11 C

**** SECTION 15 - REGULATORY INFORMATION ****

US FEDERAL
TSCA
CAS# 67-56-1 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
SARA
CERCLA Hazardous Substances and corresponding RQs
CAS# 67-56-1: 5000 lb final RQ; 2270 kg final RQ
SARA Section 302 Extremely Hazardous Substances
None of the chemicals in this product have a TPQ.
SARA Codes
CAS # 67-56-1: acute, flammable.
Section 313
This material contains Methanol (CAS# 67-56-1, 99.0%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 372.
Clean Air Act:
CAS# 67-56-1 is listed as a hazardous air pollutant (HAP).
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
None of the chemicals in this product are listed as Hazardous Substances under the CWA.
None of the chemicals in this product are listed as Priority Pollutants under the CWA.

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None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

Methanol can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.

California No Significant Risk Level:

None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols: T F

Risk Phrases:

R 11 Highly flammable.
R 23/24/25 Toxic by inhalation, in contact with skin and if swallowed.
R 39/23/24/25 Toxic : danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed.

Safety Phrases:

S 7 Keep container tightly closed.
S 16 Keep away from sources of ignition - No smoking.
S 36/37 Wear suitable protective clothing and gloves.
S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

WGK (Water Danger/Protection)

CAS# 67-56-1: 1

United Kingdom Occupational Exposure Limits

CAS# 67-56-1: OES-United Kingdom, TWA 200 ppm TWA; 266 mg/m3 TWA
CAS# 67-56-1: OES-United Kingdom, STEL 250 ppm STEL; 333 mg/m3 STEL

United Kingdom Maximum Exposure Limits

Canada

CAS# 67-56-1 is listed on Canada's DSL List.
This product has a WHMIS classification of B2, D1B, D2B.
CAS# 67-56-1 is listed on Canada's Ingredient Disclosure List.

Exposure Limits

CAS# 67-56-1: OEL-ARAB Republic of Egypt:TWA 200 ppm (260 mg/m3);Skin

**** SECTION 16 - ADDITIONAL INFORMATION ****

MSDS Creation Date: 7/21/1999 Revision #11 Date: 10/21/2002

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no way shall the company be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if the company has been advised of the possibility of such damages.

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**** MATERIAL SAFETY DATA SHEET ****

Nitric Acid
16550

**** SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION ****

MSDS Name: Nitric Acid
Catalog Numbers:
, S71972, S71972MF, S75623-2, S75623-3, S76523, A198C-212, A198C4X-212, A200-212, A200-500, A200-612GAL, A200C-212, A200C4X-212, A200C4X2001, A200C4X2122, A200C4X212L, A200J500, A200S-212, A200S-500, A200S4X-212, A200S4X212L, A200SI-212, A467-1, A467-2, A467-250, A467-500, A483-212, A509-212, A509-500, A509SK-212, S719721, S71972IMF, S71972SC
Synonyms:
Azotic Acid; Engravers Nitrate; Hydrogen Nitrate.
Company Identification: Fisher Scientific
1 Reagent Lane
Fairlawn, NJ 07410
For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

**** SECTION 2 - COMPOSITION, INFORMATION ON INGREDIENTS ****

CAS#	Chemical Name	%	EINECS#
7697-37-2	Nitric acid	69-71	231-714-2
7732-18-5	Water	29-31	231-791-2

Hazard Symbols: O C
Risk Phrases: 35 8

**** SECTION 3 - HAZARDS IDENTIFICATION ****

EMERGENCY OVERVIEW

Appearance: clear to yellow liquid.
Danger! Strong oxidizer. Contact with other material may cause a fire. Corrosive. Causes eye and skin burns. Causes digestive and respiratory tract burns. Check internal container upon receipt. Bottles should be vented periodically to relieve pressure.
Target Organs: Eyes, skin, mucous membranes.

Potential Health Effects

Eye:
Causes severe eye burns. May cause irreversible eye injury. May cause chemical conjunctivitis and corneal damage.

Skin:
Causes skin burns. May cause deep, penetrating ulcers of the skin. May cause skin rash (in milder cases), and cold and clammy skin with cyanosis or pale color.

Ingestion:
May cause severe and permanent damage to the digestive tract. Causes gastrointestinal tract burns. May cause perforation of the digestive tract. May cause systemic effects.

Inhalation:
Effects may be delayed. Causes chemical burns to the respiratory tract. Inhalation may be fatal as a result of spasm, inflammation, edema of the larynx and bronchi, chemical pneumonitis and pulmonary edema. Aspiration may lead to pulmonary edema. May cause systemic effects. May cause acute pulmonary edema, asphyxia, chemical pneumonitis, and upper airway obstruction caused by edema.

Chronic:
Repeated inhalation may cause chronic bronchitis. Repeated exposure may cause erosion of teeth. Effects may be delayed.

**** SECTION 4 - FIRST AID MEASURES ****

Eyes:
Get medical aid immediately. Do NOT allow victim to rub or keep eyes closed. Extensive irrigation with water is required (at least 30 minutes).

Skin:
Get medical aid immediately. Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Destroy contaminated shoes.

Ingestion:
Do NOT induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.

Inhalation:
Get medical aid immediately. Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Do NOT use mouth-to-mouth resuscitation. If breathing has ceased apply artificial respiration

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using oxygen and a suitable mechanical device such as a bag and a mask.
Notes to Physician:
Treat symptomatically and supportively.

**** SECTION 5 - FIRE FIGHTING MEASURES ****

General Information:
As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Strong oxidizer. Contact with combustible materials may cause a fire. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. Use water spray to keep fire-exposed containers cool. Substance is noncombustible. Use water with caution and in flooding amounts.
Extinguishing Media:
Substance is noncombustible; use agent most appropriate to extinguish surrounding fire. Contact professional fire-fighters immediately.
Autoignition Temperature:Not available.
Flash Point: Not available.
Explosion Limits, lower:Not available.
Explosion Limits, upper:Not available.
NFPA Rating: (estimated) Health: 4; Flammability: 0; Instability: 0; Specia

**** SECTION 6 - ACCIDENTAL RELEASE MEASURES ****

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks:
Absorb spill with inert material (e.g. vermiculite, sand or earth), then place in suitable container. Avoid runoff into storm sewers and ditches which lead to waterways. Clean up spills immediately, observing precautions in the Protective Equipment section. Neutralize spill with sodium bicarbonate. Provide ventilation. A vapor suppressing foam may be used to reduce vapors.

**** SECTION 7 - HANDLING and STORAGE ****

Handling:
Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use only in a well-ventilated area. Do not breathe dust, vapor, mist, or gas. Keep container tightly closed. Avoid contact with clothing and other combustible materials. Do not get on skin or in eyes. Avoid ingestion and inhalation. Discard contaminated shoes.
Storage:
Keep away from heat, sparks, and flame. Do not store near combustible materials. Keep container closed when not in use. Store in a cool, dry, well-ventilated area away from incompatible substances. Bottles should be vented periodically in order to overcome pressure buildup.

**** SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION ****

Engineering Controls:
Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate ventilation to keep airborne concentrations low.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Nitric acid	2 ppm; 4 ppm STEL	2 ppm TWA; 5 mg/m3 TWA 25 ppm IDLH	2 ppm TWA; 5 mg/m3 TWA
Water	none listed	none listed	none listed

OSHA Vacated PELs:
Nitric acid:
2 ppm TWA; 5 mg/m3 TWA
Water:
No OSHA Vacated PELs are listed for this chemical.

Personal Protective Equipment

Eyes:
Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin:
Wear appropriate gloves to prevent skin exposure.

Clothing:
Wear a chemical apron. Wear appropriate clothing to prevent skin exposure.

Respirators:
Wear a NIOSH/MSHA or European Standard EN 149 approved full-facepiece airline respirator in the positive pressure mode with emergency escape provisions.

**** SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES ****

Physical State:	Liquid
Color:	clear to yellow
Odor:	strong odor - acrid odor
pH:	1.0
Vapor Pressure:	6.8 mm Hg
Vapor Density:	Not available.
Evaporation Rate:	Not available.
Viscosity:	Not available.
Boiling Point:	186.8 deg F
Freezing/Melting Point:	-43.6 deg F
Decomposition Temperature:	Not available.
Solubility in water:	Soluble in water.
Specific Gravity/Density:	1.50
Molecular Formula:	HNO3
Molecular Weight:	63.0119

**** SECTION 10 - STABILITY AND REACTIVITY ****

Chemical Stability:
Stable. Decomposes when in contact with air, light, or organic matter.
Conditions to Avoid:
High temperatures, incompatible materials, ignition sources, moisture, combustible materials, reducing agents.
Incompatibilities with Other Materials:
Reducing agents, combustible materials, strong bases, alcohols, aldehydes, cyanides, metals, Incompatible with many substances..
Hazardous Decomposition Products:
Nitrogen oxides.
Hazardous Polymerization: Has not been reported.

**** SECTION 11 - TOXICOLOGICAL INFORMATION ****

RTECS#:
CAS# 7697-37-2: QU5775000 QU5900000
CAS# 7732-18-5: ZC0110000
LD50/LC50:
CAS# 7697-37-2: Inhalation, rat: LC50 = 260 mg/m3/30M; Inhalation, rat: LC50 = 130 mg/m3/4H; Inhalation, rat: LC50 = 67 ppm(NO2)/4H.
CAS# 7732-18-5: Oral, rat: LD50 = >90 mL/kg.
Carcinogenicity:
Nitric acid -
Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
Water -
Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
Epidemiology:
No information found.
Teratogenicity:
No information found.
Reproductive Effects:
No information found.
Neurotoxicity:
No information found.
Mutagenicity:
No information found.
Other Studies:
See actual entry in RTECS for complete information.

**** SECTION 12 - ECOLOGICAL INFORMATION ****

Other
No information available.

**** SECTION 13 - DISPOSAL CONSIDERATIONS ****

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste.
US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series: None listed.

**** SECTION 14 - TRANSPORT INFORMATION ****

US DOT
Shipping Name: NITRIC ACID
Hazard Class: 8
UN Number: UN2031
Packing Group: II

Canadian TDG
Shipping Name: NITRIC ACID
Hazard Class: 8(9.2)
UN Number: UN2031

**** SECTION 15 - REGULATORY INFORMATION ****

US FEDERAL
TSCA
CAS# 7697-37-2 is listed on the TSCA inventory.
CAS# 7732-18-5 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
SARA
CERCLA Hazardous Substances and corresponding RQs
CAS# 7697-37-2: 1000 lb final RQ; 454 kg final RQ
SARA Section 302 Extremely Hazardous Substances
CAS# 7697-37-2: 1,000 lb TPQ
SARA Codes
CAS # 7697-37-2: acute, chronic, flammable.
Section 313
This material contains Nitric acid (CAS# 7697-37-2, 69 71%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 372.
Clean Air Act:
This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
CAS# 7697-37-2 is listed as a Hazardous Substance under the CWA.
None of the chemicals in this product are listed as Priority Pollutants under the CWA.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.
OSHA:
None of the chemicals in this product are considered highly hazardous by OSHA.
STATE
Nitric acid can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.
Water is not present on state lists from CA, PA, MN, MA, FL, or NJ.
California No Significant Risk Level:
None of the chemicals in this product are listed.
European/International Regulations
European Labeling in Accordance with EC Directives
Hazard Symbols: O C
Risk Phrases:
R 35 Causes severe burns.
R 8 Contact with combustible material may cause fire.
Safety Phrases:
S23B Do not breathe fumes.
S 26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S 36 Wear suitable protective clothing.
S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
WGK (Water Danger/Protection)
CAS# 7697-37-2: 1
CAS# 7732-18-5: No information available.
United Kingdom Occupational Exposure Limits
CAS# 7697-37-2: OES-United Kingdom, TWA 2 ppm TWA; 5.2 mg/m3 TWA
CAS# 7697-37-2: OES-United Kingdom, STEL 4 ppm STEL; 10 mg/m3 STEL
CAS# 7697-37-2: OES-United Kingdom, STEL 4 ppm STEL; 10 mg/m3 STEL

United Kingdom Maximum Exposure Limits

Canada
CAS# 7697-37-2 is listed on Canada's DSL List.
CAS# 7732-18-5 is listed on Canada's DSL List.
This product has a WHMIS classification of C, D1A, E.
CAS# 7697-37-2 is listed on Canada's Ingredient Disclosure List.
CAS# 7732-18-5 is not listed on Canada's Ingredient Disclosure List.
Exposure Limits
CAS# 7697-37-2: OEL-ARAB Republic of Egypt:TWA 2 ppm (5 mg/m3)
OEL-AUSTRALIA:TWA 2 ppm (5 mg/m3);STEL 4 ppm (10 mg/m3)
OEL-BELGIUM:TWA 2 ppm (5.2 mg/m3);STEL 4 ppm (10 mg/m3)
OEL-CZECHOSLOVAKIA:TWA 2.5 mg/m3;STEL 5 mg/m3
OEL-DENMARK:TWA 2 ppm (5 mg/m3)
OEL-FINLAND:TWA 2 ppm (5 mg/m3);STEL 5 ppm (13 mg/m3);Skin
OEL-FRANCE:TWA 2 ppm (5 mg/m3);STEL 4 ppm (10 mg/m3)
OEL-GERMANY:TWA 10 ppm (25 mg/m3)

DATE: 01/27/04 ACCT: 905868001
INDEX: H40230547 CAT NO: A200500 PO NBR: 07796

OEL-HUNGARY:STEL 5 mg/m3
OEL-JAPAN:TWA 2 ppm (5.2 mg/m3)
OEL-THE PHILIPPINES:TWA 2 ppm (5 mg/m3)
OEL-POLAND:TWA 10 mg/m3
OEL-RUSSIA:TWA 2 ppm;STEL 2 mg/m3;Skin
OEL-SWEDEN:TWA 2 ppm (5 mg/m3);STEL 5 ppm (13 mg/m3)
OEL-SWITZERLAND:TWA 2 ppm (5 mg/m3);STEL 4 ppm (1 mg/m3)
OEL-THAILAND:TWA 2 ppm (5 mg/m3)
OEL-TURKEY:TWA 2 ppm (5 mg/m3)
OEL-UNITED KINGDOM:TWA 2 ppm (5 mg/m3);STEL 4 ppm (10 mg/m3)
OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV
OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV

**** SECTION 16 - ADDITIONAL INFORMATION ****

MSDS Creation Date: 9/30/1998 Revision #10 Date: 4/01/2003

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no way shall the company be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if the company has been advised of the possibility of such damages.

MATERIAL SAFETY DATA SHEET: CRYSTAL SIMPLE GREEN®

I. PRODUCT & COMPANY INFORMATION

PRODUCT NAME: CRYSTAL SIMPLE GREEN®

OTHER NAMES: CRYSTAL SIMPLE GREEN® - SPECIALIZED CLEANER / DEGREASER
SIMPLE GREEN SAFETY TOWELS (fluid only)

COMPANY NAME: SUNSHINE MAKERS, INC.
15922 Pacific Coast Highway
Huntington Harbour, CA 92649 USA
Telephone: 800-228-0709 • 562-795-6000
Fax: 562-592-3034
Website: www.simplegreen.com

Version No. 4006
Issue Date: January 2002

For 24-hour emergency, call Chem-Tel, Inc.: 800-255-3924

USE OF PRODUCT: A specialized cleaner and degreaser for use in the industrial and institutional workplace..

II. INGREDIENT INFORMATION

The only ingredient of Crystal Simple Green® with established exposure limits is undiluted 2-butoxyethanol (<6%) (Butyl Cellosolve; CAS No. 111-76-2): the OSHA PEL and ACGIH TLV is 25 ppm (skin). Note, however, that Butyl Cellosolve is only one of the raw material ingredients that undergo processing and dilution during the manufacture of Crystal Simple Green®. Upon completion of the manufacturing process, Crystal Simple Green® does not possess the occupational health risks associated with exposure to undiluted Butyl Cellosolve. Verification of this is contained in the independent test results detailed under "Toxicological Information" on Page 3 of this MSDS.

The Butyl Cellosolve in Crystal Simple Green® is part of a chemical category (glycol ethers) regulated by the Emergency Planning and Community Right-to-Know Act (SARA, Title III, section 313); therefore, a reporting requirement exists. Based upon chemical analysis, Crystal Simple Green® contains no known EPA priority pollutants, heavy metals, or chemicals listed under RCRA, CERCLA, or CWA. Analysis by TCLP (Toxicity Characteristic Leaching Procedure) according to RCRA revealed no toxic organic or inorganic constituents.

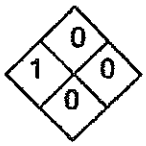
All components of Crystal Simple Green® are listed on the TSCA Chemical Substance Inventory.

III. HAZARDS IDENTIFICATION

UN Number: Not required
Dangerous Goods Class: Nonhazardous

Hazard Rating (NFPA/HMIS)

Health = 1* Reactivity = 0
Fire = 0 Special = 0



Rating Scale

0 = minimal 1 = slight
2 = moderate 3 = serious
4 = severe

*Mild eye irritant, non-mutagenic and non-carcinogenic. **None of the ingredients in Crystal Simple Green® are regulated or listed as potential cancer agents by Federal OSHA, NTP, or IARC.**

IV. FIRST AID MEASURES

SYMPTOMS OF OVEREXPOSURE AND FIRST AID TREATMENT

Eye contact: Reddening may develop. Immediately rinse the eye with large quantities of cool water; continue 10-15 minutes or until the material has been removed; be sure to remove contact lenses, if present, and to lift upper and lower lids during rinsing. Get medical attention if irritation persists.

Skin contact: Minimal effects, if any; rinse skin with water, rinse shoes and launder clothing before reuse. Reversible reddening may occur in some dermal-sensitive users; thoroughly rinse area and get medical attention if reaction persists.

Swallowing: Essentially non-toxic. Give several glasses of water to dilute; do not induce vomiting. If stomach upset occurs, consult physician.

Inhalation: Non-toxic. Exposures to concentrate-mist may cause mild irritation of nasal passages or throat; remove to fresh air. Get medical attention if irritation persists.

V. FIRE FIGHTING MEASURES

Crystal Simple Green® is stable, not flammable, and will not burn.

Flash Point/Auto-Ignition:	Not flammable.
Flammability Limits:	Not flammable.
Extinguishing Media:	Not flammable/nonexplosive. No special procedures required.
Special Fire Fighting Procedures:	None required.

VI. ACCIDENTAL RELEASE MEASURES

Recover usable material by convenient method; residual may be removed by wipe or wet mop. If necessary, unrecoverable material may be washed to drain with large quantities of water.

VII. HANDLING, STORAGE & TRANSPORT INFORMATION

No special precautions are required. **This product is non-hazardous for storage and transport according to the U.S. Department of Transportation Regulations.** Crystal Simple Green® requires no special labeling or placarding to meet U.S. Department of Transportation requirements.

UN Number:	Not required
Dangerous Goods Class:	Nonhazardous

VIII. EXPOSURE CONTROLS

Exposure Limits: The Crystal Simple Green® formulation presents no health hazards to the user when used according to label directions for its intended purposes. Mild skin and eye irritation is possible (please see Eye contact and Skin contact in Section IV.).

Ventilation: No special ventilation is required during use. Large-scale uses indoors should provide an increased rate of air exchange.

Human Health Effects or Risks from Exposure: Adverse effects on human health are not expected from Crystal Simple Green®, based upon twenty years of use of Simple Green without reported adverse health incidence in diverse population groups, including extensive use by inmates of U.S. Federal prisons in cleaning operations.

Crystal Simple Green® is a mild eye irritant; mucous membranes may become irritated by concentrate-mist.

Crystal Simple Green® is not likely to irritate the skin in the majority of users. Repeated daily application to the skin without rinsing, or continuous contact of Crystal Simple Green® on the skin may lead to temporary, but reversible, irritation.

Medical Conditions Aggravated by Exposure: No aggravation of existing medical conditions is expected; dermal-sensitive users may react to dermal contact by Crystal Simple Green®.

IX. PERSONAL PROTECTION

Precautionary Measures: No special requirements under normal use conditions.
Eye Protection: Caution, including reasonable eye protection, should always be used to avoid eye contact where splashing may occur.
Skin Protection: No special precautions required; rinse completely from skin after contact.
Respiratory Protection: No special precautions required except during large-scale spray applications where spray mist levels are high.
Work and Hygienic Practices: Wash or rinse hands before touching eyes or contact lenses. Follow standard hygienic practices for handling cleaning agents.

X. PHYSICAL AND CHEMICAL PROPERTIES

Appearance/odor::	Clear liquid	Vapor Pressure:	18 mm Hg @ 20 °C; 23.5 mm Hg @ 26 °C
Specific Gravity:	1.020	Vapor Density:	1.3 (air = 1)
pH of concentrate:	9.35	Density:	8.5 lbs./gallon
Evaporation:	>1 (butyl acetate = 1)		
Boiling Point:	100.6 °C (212 °F)		
Freezing Point:	-9 °C (16 °F) If product freezes, it will reconstitute without loss of efficacy when brought back to room temperature and agitated.		

VOC Composite Partial Pressure: 0 mm Hg @ 20 °C
Volatile Organic Compounds (VOCs): 0 g/L per ASTM Method D-2369. Per California AQMD's VOC test method, product must be diluted at least 2 parts of water to 1 part Crystal Simple Green® in order to meet SCAQMD Rule 1171 & Rule 1122 and BAAQMD Regulation 8-16 VOC requirements for solvent cleaning operations.
Water Solubility: Completely soluble in water.
Detection: Crystal Simple Green® has a characteristic odor that is not indicative of any hazardous situation.

XI. STABILITY AND REACTIVITY INFORMATION

Nonreactive. Crystal Simple Green® is stable, even under fire conditions, and will not react with water or oxidizers. Hazardous polymerization will not occur.

XII. TOXICOLOGICAL INFORMATION

The information and conclusions cited in this section are based on data and testing of Simple Green®. The data are directly applicable to Crystal Simple Green® because, except for the fragrance and dyes which have been removed, it contains the same ingredients as Simple Green®.

Nonhuman Toxicity

Acute Mortality Studies:
Oral LD_{50} (rat): >5.0 g/kg body weight // Dermal LD_{50} (rabbit): >2.0 g/kg body weight

Dermal Irritation: Only mild, but reversible, irritation was found in a standard 72-hr test on rabbits. A value of 0.2 (non-irritating) was found on a scale of 8.

Eye Irritation: With or without rinsing with water, the irritation scores in rabbits at 24 hours did not exceed 15 (mild irritant) on a scale of 110.

Subchronic dermal effects: No adverse effects, except reversible dermal irritation, were found in rabbits exposed to Simple Green® (up to 2.0 g/kg/day for 13 weeks) applied to the skin of 25 males and 25 females. Only female body weight gain was affected. Detailed microscopic examination of all major tissues showed no adverse changes.

Fertility Assessment by Continuous Breeding: The Simple Green® formulation had no adverse effect on fertility and reproduction in CD-1 mice with continuous administration for 18 weeks, and had no adverse effect on the reproductive performance of their offspring.

XIII. BIODEGRADABILITY AND ENVIRONMENTAL TOXICITY INFORMATION

Biodegradability:
Like Simple Green®, Crystal Simple Green® is readily decomposed by naturally occurring microorganisms. The biological oxygen demand (BOD), as a percentage of the chemical oxygen demand (COD), after 4, 7, and 11 days was 56%, 60%, and 70%, respectively. Per OECD Closed Bottle Test, Crystal Simple Green® meets OECD and EPA recommendations for ready biodegradability.

In a standard biodegradation test with soils from three different countries, Butyl Cellosolve reached 50% degradation in 6 to 23 days, depending upon soil type, and exceeded the rate of degradation for glucose, which was used as a control for comparison.

Environmental Toxicity Information:
Crystal Simple Green® is considered practically non-toxic per EPA's aquatic toxicity scale.

XIV. DISPOSAL CONSIDERATIONS

Crystal Simple Green® is fully water soluble and biodegradable and will not harm sewage-treatment microorganisms if disposal by sewer or drain is necessary. Dispose of in accordance with all applicable local, state, and federal laws.

XV. OTHER INFORMATION

Containers:	Crystal Simple Green® residues can be completely removed by rinsing with water; the container may be recycled or applied to other uses.
Contact Point:	Sunshine Makers, Inc., Research and Development Division: 562-795-6000.

***** NOTICE *****

All information appearing herein is based upon data obtained by the manufacturer and recognized technical sources. Judgments as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of this information, Sunshine Makers, Inc. or its distributors extends no warranties, makes no representations and assumes no responsibility as to the suitability of such information for application to purchaser's intended purposes or for consequences of its use.

Appendix D

Forms

GEI Consultants

Accident/Incident Report Form

Please complete this form and send it to your Branch Manager, HR and CHSO ***within 24 hours*** of the incident.

SECTION A — ACCIDENT/INCIDENT DETAILS

EMPLOYEE INFORMATION:

Name: _____

Home Address: _____
Street Address City State Zip Code

Contact Information: ( ) _____ ( ) _____
Primary Secondary

Date of Birth: _____

Date of Hire: _____

Branch: _____

Supervisor: _____

OTHER INJURED (IF APPLICABLE):

Name: _____

Home Address: _____
Street Address City State Zip Code

Contact Information: ( ) _____ ( ) _____
Primary Secondary

Date of Birth: _____

Date of Hire: _____

Branch: _____

Supervisor: _____

Date and Time Accident/Incident	Date and Time Reported
_____ /_____ /_____ Month Day Year	_____ /_____ /_____ Month Day Year
_____ A.M. _____ P.M.	_____ A.M. _____ P.M.

LOCATION OF INCIDENT/ACCIDENT

Project Name: _____

Client and Location: _____

or _____

Office Location: _____

INCIDENT TYPE: (Check All That Applies)

- ☐ **Personal Injury/Illness**
- ☐ **Vehicle Accident**
- ☐ **Property Damage**
- ☐ **Environmental Spill**
- ☐ **Other**

WITNESS INFORMATION

Name: _____

Contact Number: _____

Company: _____

WHAT HAPPENED TO THE INJURED PARTY: ☐First Aid Administered ☐Refused Treatment/Transport ☐Transported to Hospital ☐Returned to Work ☐ Went Home ☐ Went to Physician ☐ Unknown

Clinic/Hospital or Treating Physician: _____ Phone: _____
Name Street Address City State Zip Code

SECTION B — PERSONAL INJURY

Cause of Injury: _____

Part of Body Injured: _____ Multiple Injuries: ☐Y ☐N

Was PPE worn when injured? : ☐Y ☐N What PPE was worn? _____

WAS INJURY A RESULT OF THE USE A MOTOR VEHICLE: ☐ **YES** ☐ **NO** **(If yes, complete Section C)**

GEI Consultants

Accident/Incident Report Form

Please complete this form and send it to your Branch Manager, HR and CHSO ***within 24 hours*** of the incident.

SECTION C — AUTO ACCIDENT ONLY

DRIVER/VEHICLE INFORMATION

Name of Insured: _____

Department: _____

Driver's License Number: _____

DOB: ____/____/____ State: _____

Description of Vehicle: License Plate Number: _____

Make: _____ Model: _____ Year:_____ Color:_____

Owner: _____

Name of Other Driver: _____

Driver's License Number: _____

State: _____

Description of Vehicle: License Plate Number: _____

Make: _____ Model:_____ Year: _____ Color:_____

Insurance Carrier: _____

Policy Number: _____ Ph. Number:_____

SECTION D — PROPERTY DAMAGE OR CHEMICAL RELEASE ONLY

Type of Damage(s): _____

Cause of Damage(s): _____

Type of Chemical Released (if known): _____

Quantity of Chemical Released: _____

Spill Measures Employed: _____

SECTION E — NATURE OF ACCIDENT/INCIDENT AND EXTENT OF INJURIES/DAMAGES

(Please give a detailed description of what happened. Attach a sketch or picture if applicable)

_____

_____

_____

_____

_____

_____

_____

_____

_____

I hereby certify that the above information is true and correct to my understanding of this accident/incident.

_____ _____

Employee/Preparer's Name **Date and Time**

GEI Consultants

Daily Safety Briefing Log and Site Visitor Sign-In

Project Number:	**Project Name:**
[1]Date:	**Time:**
Briefing Conducted by:	**Signature:**

This sign-in log documents the tailgate briefing conducted in accordance with the site specific HASP. Personnel who perform work operations on site are required to attend each briefing and to acknowledge receipt of each briefing, daily.

TOPICS COVERED (check all those covered):

- ☐ General PPE Usage
- ☐ Hearing Conservation
- ☐ Respiratory Protection
- ☐ Personal Hygiene
- ☐ Exposure Guidelines
- ☐ Decon Procedures
- ☐ Confined Space
- ☐ Slips, Trips, Falls
- ☐ Heat Stress
- ☐ Cold Stresses
- ☐ Site Control
- ☐ Work Zones
- ☐ Lockout/Tagout
- ☐ Excavation Safety
- ☐ Confined Space
- ☐ Traffic Safety
- ☐ Changes to the HASP
- ☐ Initial Review of Hazard Evaluation
- ☐ Emergency Procedures (include route to hospital)
- ☐ Other (Specify):
- ☐ Other (Specify):

Daily Safety Topic Description:

Personnel Sign-in List

Printed Name	Signature	Company Name	Time-In	Time-Out

[1] This form is applicable for *only* 1 day of site activity.

NEAR MISS REPORT

A near miss is a potential hazard or incident that has not resulted in any personal injury. Unsafe working conditions, unsafe employee work habits, improper use of equipment, or use of malfunctioning equipment have the potential to cause work related injuries. It is everyone's responsibility to report and/or correct these potential accidents/incidents immediately. Please complete this form as a means to report these near-miss situations. Send a copy of the completed form to the Project Manager, Regional Health and Safety Officer and the Corporate Health and Safety Officer.

Location: _____ Site Name: _____

Date: _____ Time: _____ ☐ a.m. ☐ p.m.

Weather conditions, site operations taking place during near miss. _____

Please check all appropriate conditions:

☐ Unsafe Act ☐ Unsafe equipment

☐ Unsafe Condition ☐ Unsafe use of equipment

Description of incident or potential hazard: _____

Employees or sub-contractors involved if applicable._____

Employee Signature _____ Date _____

Print Name _____

NEAR MISS INVESTIGATION

Description of the near-miss condition: _____
Causes (primary & contributing) _____
Corrective action taken (Remove the hazard, replace, repair, or retrain in the proper procedures for the task) _____
Actions not yet taken_____

Signed: _____ Date Completed: _____

Print Name
Not completed for the following reason: _____Date:_____

GEI Consultants

Project Safety Briefing Form

Project Number:	**Project Name:**	
Date:	**Time:**	**Project Manager:**
Briefing Conducted by:		**Signature:**

This sign-in log documents the project specific-briefing conducted in accordance with the HASP and GEI H&S policy. GEI personnel who perform work on site are required to attend the Project briefing and to acknowledge it's receipt. Applicable health and safety SOPs are also required to be reviewed in this briefing and attached as an appendix to the HASP. Prior to the start of the project **or upon the start of a new on-site project team member**, this form must be completed. Please email this completed form to Health&SafetyCommittee@geiconsultants.com.

TOPICS COVERED (check all those covered):

☐	General PPE Usage	☐	Excavation Safety	☐	SOP:
☐	Hearing Conservation	☐	Confined Space	☐	SOP:
☐	Respiratory Protection	☐	Traffic Safety	☐	SOP:
☐	Personal Hygiene	☐	Changes to the HASP	☐	SOP:
☐	Exposure Guidelines	☐	Site Control	☐	SOP:
☐	Decon Procedures	☐	Work Zones	☐	SOP:
☐	Emergency Procedures (include route to hospital)	☐	Lockout/Tagout	☐	SOP:
☐	Confined Space	☐	Review of Hazard Evaluation	☐	SOP:
☐	Slips, Trips, Falls	☐	Other (Specify):	☐	SOP:
☐	Heat Stress	☐	Other (Specify):	☐	SOP:
☐	Cold Stress	☐	Other (Specify):	☐	SOP:

Personnel Sign-in List

Printed Name	Signature

Appendix E

GEI's Health and Safety SOPs and Programs

Applicable GEI H&S SOPs *(check all that apply)*		
☒ Biological Hazards – 001	☒ Inclement Weather – 010	☐ Aerial Lift – 020
✔ Bloodborne Pathogens – 002	☐ Ladders -011	☐ Mobile Equipment – 021
☒ Container Management – 003	☒ Noise Exposure -012	☐ Aquatic Ecological Survey & Electrofishing -022
☒ Driver Safety - 004	☐ Nuclear Density Gauge Operation -013	☐ Scaffolding - 023
☐ Electrical Safety - 005a	☒ Utility Markout-014	☐ Wilderness Safety - 024
☐ Lockout Tagout - 005b	☐ Respirator Fit Test Procedure-015	☒ Manual Lifting – 025
☒ Excavation Trenching - 006	☒ Traffic Hazards -016	✔ Hazard Identification - 026
☒ Non-Powered Hand Tools - 008a	☐ Water Safety – 017	☐ Confined Space Entry for Sanitary Sewers – 027
☐ Powered Hand Tools – 008b	☒ Working Around Heavy Equipment – 018	☐ Safe Trailer Use – 028
☒ Hazardous Substances Management -009	☐ Rail Safety -019	✔ COVID-19 Field Work Guidance

Scan this QR code with your smartphone to access all GEI H&S SOPs

Applicable GEI H&S Programs *(check all that apply)*		
☐ Asbestos Program	☒ DOT Driver Safety	☐ Hydrogen Sulfide
☐ Arsenic Safety	✔ Ergonomic	☐ Injury and Illness Prevention (California Only)
☒ Benzene Awareness	☐ Fall Protection	☐ Respiratory Protection Program
☐ Cadmium Awareness	✔ Hazard Communication	☐ Hydrogen Sulfide
☒ Cold Stress	☒ Hearing Conservation	✔ Fire Prevention
☐ Confined Space Entry	☒ Heat Illness Prevention	☐ Lead Compliance
☒ Crystalline Silica	☐ Hexavalent Chromium	

Scan this QR code with your smartphone to access all GEI Programs

STANDARD OPERATING PROCEDURES

SOP No. HS-001 Biological Hazards

1.1 Objective

The objective of this standard operating procedure (SOP) is to prevent or limit the potential for GEI personnel to encounter biological hazards during field activities.

1.2 General

This SOP is intended for use by employees engaged in work with the potential for contact with biological hazards such as animals, insects, plants, and sewage. The site-specific health and safety plan (HASP) should include a hazard assessment for the project that identifies the potential for encounters with biological hazards and the control methods to be implemented by GEI employees. These hazards should be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Health and Safety page of the GEI intranet.

1.2.1 Animals

During some site operations, animals such as stray or domesticated dogs or cats, raccoons, snakes, bears, rats, bats, etc. may be encountered. Employees should use discretion and attempt to avoid contact with animals. If these animals present a problem, efforts will be made to remove these animals from the site by contacting a licensed animal control technician.

1.2.1.1 Rabies

The rabies virus is transmitted through the bite of an infected animal or contact with saliva or brain/nervous system tissue of an infected animal. The rabies virus infects the central nervous system causing disease in the brain. The early symptoms of rabies in people are fever, headache, and general weakness or discomfort. As the disease progresses, more specific symptoms appear and may include insomnia, anxiety, confusion, slight or partial paralysis, excitation, hallucinations, agitation, hypersalivation (increase in saliva), difficulty swallowing, and hydrophobia (fear of water). Death usually occurs within days of the onset of these symptoms.

If you are bitten or think you may be exposed, wash any wounds immediately and thoroughly with soap and water. Then notify the Project Manager and Corporate Health and Safety Officer (CHSO) and go to the hospital emergency room. The doctor, possibly in consultation with the state or local health department, will decide if you need a rabies vaccination. Decisions to start vaccination will be based on your type of exposure and the animal you were exposed to, as well as laboratory and surveillance information for the

geographic area where the exposure occurred. An Accident Report Form should be completed and submitted per GEI's accident reporting procedures.

1.2.2 Insects

Insects, including bees, wasps, hornets, mosquitoes, ticks, spiders, etc may be present at a job site making the chance of a bite/sting possible. Some individuals may have a severe allergic reaction to an insect bite or sting that can result in a life threatening condition. Some insect bites can transmit diseases such as Lyme disease or a virus such as West Nile. The following is a list of preventive measures:

- Apply insect repellent prior to performing field work and as often as needed throughout the work shift
- Wear proper protective clothing (work boots, socks and light colored clothing)
- Wear shoes, long pants with bottoms tucked into boots or socks, and a long-sleeved shirt when outdoors for long periods of time, or when many insects are most active (between dawn and dusk).
- When walking in wooded areas, avoid contact with bushes, tall grass, or brush as much as possible
- Field personnel who may have insect allergies should have bee sting allergy medication on site and should provide this information to the Site Safety Officer (SSO) and the CHSO prior to commencing work.
- Field personnel should perform a self-check at the end of the day for ticks.

1.2.3 Tick-borne Diseases

Lyme disease is caused by infection from a deer tick that carries a spirochete. During the painless tick bite, the spirochete may be transmitted into the bloodstream often after feeding on the host for 12 to 24 hours. The ticks that cause the disease are often no bigger than a poppy seed or a comma in newsprint. The peak months for human infection are from May to September.

Symptoms appear in three stages. First symptoms usually appear from 2 days to a few weeks after a person is bitten by an infected tick. Symptoms usually consist of a ring-like red rash on the skin where the tick was attached. The rash is often bulls-eye like with red around the edges and clear in the center. The rash may be warm, itchy, tender, and/or "doughy." Unfortunately, this rash appears in only 60 to 80 percent of infected persons. An infected person also has flu-like symptoms of a stiff neck, chills, fever, sore throat, headache, fatigue and joint pain. These symptoms often disappear after a few weeks.

The second stage symptoms, which occur weeks to months later include meningitis, severe headache, drooping of the muscles on the face, called Bell's Palsy, encephalitis, numbness, withdrawal and lethargy. These symptoms may last for several weeks to several months. Third stage symptoms, which occur months or years later include arthritis, heart problems, and loss of memory. The third stage symptoms may mimic multiple sclerosis and Alzheimer's disease.

Personnel should check themselves when in areas that could harbor deer ticks, wear light color clothing and visually check themselves and their buddy when coming from wooded or vegetated areas. If a GEI employee has been bitten by a tick, the CHSO should be contacted immediately. An Accident Report form must be completed by the individual in compliance with the Accident Reporting procedure outlined in the Corporate Health and Safety Manual.



From left to right: The deer tick adult female, adult male, nymph, and larva on a centimeter scale.

The tick can be removed by pulling gently at the head with tweezers. If tweezers are not available, cover your fingers with tissue paper and use them to grasp the tick. It is important to grasp the tick as close to the site of attachment and use a firm steady pull to remove it. Wash hands immediately after with soap and water. The affected area should then be disinfected with an antiseptic wipe. All mouth parts must be removed from the skin. If the tick is removed by breaking off the mouth parts, an irritation or infection may occur. Also, the organism that is causing the disease can still enter the body through the skin. The employee will be offered the option for medical treatment by a physician, which typically involves antibiotics. If personnel feel sick or have signs similar to those above, they should notify the SSO and the CHSO immediately.

Treatment with antibiotics is effective and recovery is usually complete. In the first stage antibiotics are usually given orally. Second and third stage treatment, however is prolonged and recovery may take longer. Antibiotic treatment is usually provided intravenously for second and third stage Lyme disease.

The deer tick can also cause **Babesiosis**, an infection of the parasite Babesia Microti. Symptoms of Baesiosis may not be evident, but may also include fever, fatigue and

hemolytic anemia lasting from several days to several months. Babesiosis is most commonly diagnosed in the elderly or in individuals whose immune systems are compromised.

Ehrlichiosis is a tick-borne disease which can be caused by either of two different organisms. Human monocytic ehrlichiosis (HME) is caused by *Ehrlichia chaffeensis*, which is transmitted by the lone star tick (*Amblyomma americanum*). Human granulocytic anaplasmosis (HGA), previously known as human granulocytic ehrlichiosis (HGE), is caused by *Anaplasma phagocytophilia*, which is transmitted by the deer tick (*Ixodes scapularis*).

In New York State, most cases of ehrlichiosis have been reported on Long Island and in the Hudson Valley. Ehrlichiosis is transmitted by the bite of infected ticks, including the deer tick and the lone star tick. The symptoms of HME and HGE are the same and usually include fever, muscle aches, weakness and headache. Patients may also experience confusion, nausea, vomiting and joint pain. Unlike Lyme disease or Rocky Mountain spotted fever, a rash is not common. Infection usually produces mild to moderately severe illness, with high fever and headache, but may occasionally be life-threatening or even fatal. Symptoms appear one to three weeks after the bite of an infected tick. However, not every exposure results in infection.

Rocky Mountain spotted fever (RMSF) is a tick-borne disease caused by a rickettsia (a microbe that differs somewhat from bacteria and virus). Fewer than 50 cases are reported annually in New York State. In the eastern United States, children are infected most frequently, while in the western United States, disease incidence is highest among adult males. Disease incidence is directly related to exposure to tick-infested habitats or to infested pets. Most of the cases in New York State have occurred on Long Island. RMSF is characterized by a sudden onset of moderate to high fever (which can last for two or three weeks), severe headache, fatigue, deep muscle pain, chills and rash. The rash begins on the legs or arms, may include the soles of the feet or palms of the hands and may spread rapidly to the trunk or rest of the body. Symptoms usually appear within two weeks of the bite of an infected tick.

*(Information on Ehrlichiosis, Babesiosis, and Rocky Mountain Spotted Fever was derived from the New York State Department of Health).

1.2.4 West Nile Virus

West Nile Virus (WNV) is a mosquito-borne infection transmitted through the bite of an infected mosquito. The symptoms of WNV can be asymptomatic (no symptoms) or in more serious cases can lead to West Nile Fever. West Nile Fever can include fever, headache, tiredness, body ache, an occasional rash on the trunk of the body, and swollen lymph glands, In severe cases, people have developed West Nile Encephalitis or

Meningitis which symptoms include fever, headache, neck stiffness, tremors, coma and in some cases death. The incubation period for the disease is usually 2 to 15 days. The symptoms can range from a few days to several weeks. Most mosquitoes are not infected and the chance of infection from a mosquito bite of an on-site employee is very small.

The following precautions will be used to help reduce the risk of mosquito bites:

- Reduce mosquito-breeding areas by making sure wheelbarrows, buckets, and other containers are turned upside down when not used so that they do not collect standing water.
- Wear shoes, long pants with bottoms tucked into boots or socks, and a long-sleeved shirt when outdoors for long periods of time, or when many mosquitoes are most active (between dawn and dusk).
- Use mosquito repellant according to the manufacturer's directions when outdoors for long periods of time and when mosquitoes are most active.

Centers for Disease Control and Prevention (CDC) evaluation of information contained in peer-reviewed scientific literature and data available from the Environmental Protection Agency (EPA) has identified several EPA registered products that provide repellent activity sufficient to help people avoid the bites of disease carrying mosquitoes. Products containing these active ingredients typically provide reasonably long-lasting protection:

- **DEET** (Chemical Name: N,N-diethyl-m-toluamide or N,N-diethly-3-methyl-benzamide) 20 to 30 percent DEET
- **Picaridin** (KBR 3023, Chemical Name: 2-(2-hydroxyethyl)-1-piperidinecarboxylic acid 1-methylpropyl ester)
- **Oil of Lemon Eucalyptus** or **PMD** (Chemical Name: para-Menthane-3,8-diol) the synthesized version of oil of lemon eucalyptus
- **IR3535** (Chemical Name: 3-[N-Butyl-N-acetyl]-aminopropionic acid, ethyl ester)
- **Permethrin** (3-Phenoxybenzyl (1RS)-cis,trans-3-(2,2-dichlorovinyl) -2,2-dimethylcyclopropanecarboxylate) - Permethrin kills ticks and can be used on clothing (but not skin)

EPA characterizes the active ingredients DEET and Picaridin as "conventional repellents" and Oil of Lemon Eucalyptus, PMD, and IR3535 as "biopesticide repellents", which are derived from natural materials.

In general, higher concentrations of active ingredient provide longer duration of protection, regardless of the active ingredient, although concentrations above approximately 50 percent do not offer a marked increase in protection time. Products with less than 10 percent active ingredient may offer only limited protection, often from 1 to 2 hours. Products that offer sustained release or controlled release (micro-encapsulated) formulations, even with lower active ingredient concentrations, may provide longer protection times. Regardless of what product you use, if you start to get mosquito bites reapply the repellent according to the label instructions or remove yourself from the area with biting insects if possible.

Clothing and other products can be purchased pre-treated, or products can be treated using EPA-registered products. Permethrin is the only pesticide approved by the EPA for these uses. Permethrin binds tightly to the fabrics, resulting in little loss during washing and minimal transfer to the skin. Permethrin is poorly absorbed through the skin, although sunscreens and other products may increase the rate of skin absorption.

If you decide to use permethrin-treated clothing, consider these tips:

- Read the application instructions carefully and apply the product according to the label directions. Do not over-treat products.
- Permethrin treatments are only intended for use on fabrics; do not apply them directly to the skin or other items.
- Do not apply permethrin to clothing while it is being worn.
- Apply the products outdoors in well ventilated areas that are protected from wind.
- Hang treated fabrics outdoors and allow them to dry completely before wearing them.
- Wash permethrin treated clothing separately from other clothing items.

1.2.5 Plants

The potential for contact with poisonous plants, such as poison ivy, sumac, and oak, exists when performing fieldwork in wooded or boggy areas. These plants can cause allergic reaction when in contact with the leaves or vines.

Poison ivy can be found as vines on tree trunks or as upright bushes. Poison ivy consists of three leaflets with notched edges. Two leaflets form a pair on opposite sides of the stalk, and the third leaflet stands by itself at the tip. Poison ivy is red in the early spring and turns shiny green later in the spring. Poison ivy grows throughout much of North America, including all states east of the Rocky Mountains. It is normally found in

wooded areas, especially along edge areas where the tree line breaks and allows sunshine to filter through. It also grows in exposed rocky areas, open fields and disturbed areas.

Poison sumac can be present in the form of a flat-topped shrub or tree. It has fern-like leaves, which are velvety dark green on top and pale underneath. The branches of immature trees have a velvety "down." Poison sumac has white, "hairy" berry clusters. Poison sumac grows exclusively in very wet or flooded soils, usually in swamps and peat bogs, in the eastern United States.

Poison oak can be present as a sparingly branched shrub. Poison oak can grow anywhere in the United States with the exception of Hawaii, Alaska, and some southwest areas that have desert climates. Poison oak is similar to poison ivy in that it has the same leaflet configuration; however, the leaves have slightly deeper notches.

Keep in mind that for each of these plants,



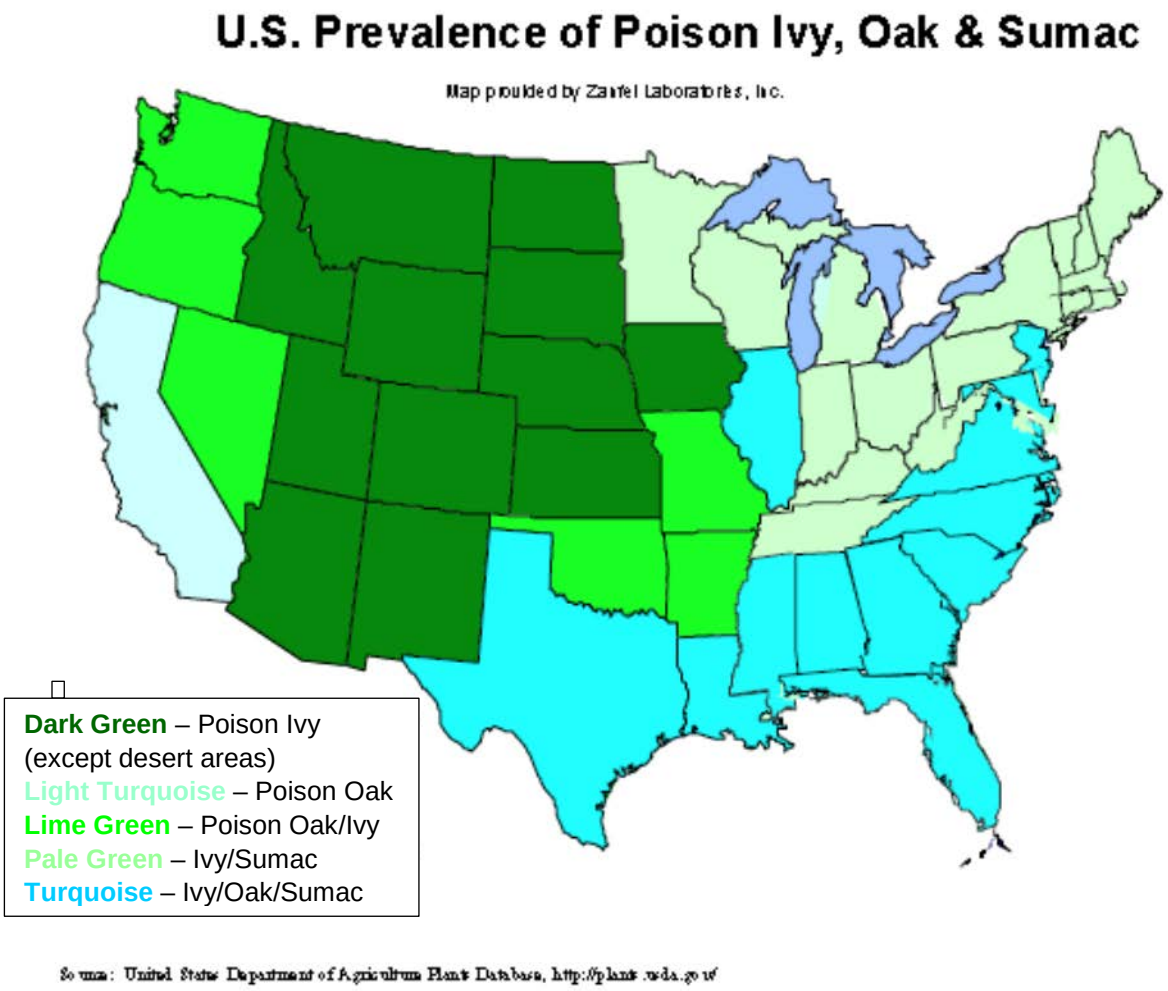
Poison Oak



Poison Ivy



Poison Sumac



To prevent exposure to these poisonous plants:

- Barrier skin creams, such as lotion containing bentoquatum (Tecnu®), may offer some protection prevent the occurrence of exposure symptoms.
- Wear long sleeves, long pants, boots, and gloves.

Contact with poison ivy, sumac, or oak may lead to a skin rash, characterized by reddened, itchy, blistering skin which needs first aid treatment. Susceptible individuals should identify themselves to the SSO or GEI Project Manager. If you believe you have contacted one of these plants:

- Immediately wash skin thoroughly with soap and water, taking care not to touch your face or other body parts.
- Wash exposed clothing separately in hot water with detergent.
- After use, clean tools, and soles of boots with rubbing alcohol or soap and lots of water. Urushiol can remain active on the surface of objects for up to 5 years.

- If a rash occurs, contact the CHSO and complete and submit an Accident Report Form.

1.2.6 Sewage and Bacterial Impacted Sediments

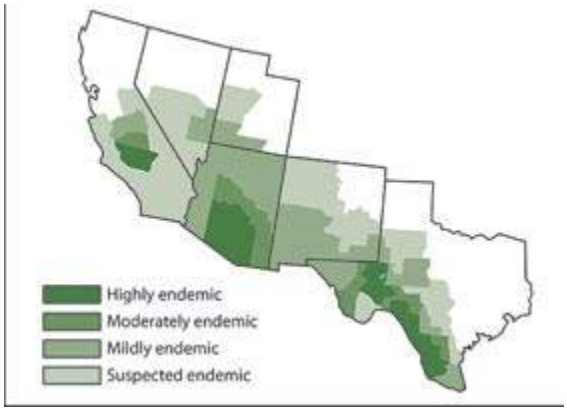
Some project work may be conducted at sites that serve or have served as a combined sewer overflow (CSO) and consequently may have received untreated sanitary sewage from numerous sources. Decomposed sewage can potentially be encountered within sites and their sediments. Sediments could contain soil and marine microorganisms, and bacterium associated with sewage. Many of these bacterium can cause illness through ingestion, direct contact, or the inhalation of a bio-aerosol. Potential respiratory exposure to biological agents can also occur through the inhalation of aerosols produced during sediment handling activities. Personal protective equipment as identified in the site-specific HASP will be worn to minimize potential exposures. Employees will follow the decontamination or disposal procedures identified in the HASP.

1.2.6 Fungal Spores in Soil – Valley Fever

Valley Fever is an illness that usually affects the lungs. It is caused by the fungus Coccidioides immitis that lives in the top 2 to 12 inches of soil in many parts of California. When fungal spores are present, any work activity that disturbs the soil, such as digging, grading or other earth moving operations, or vehicle operation on dirt roads, can cause the spores to become airborne, therefore increasing the risk of Valley Fever. All employees on sites where the fungus is present, and who are exposed to dusty conditions and wind-blown dusts are at increased risk of becoming infected.

Valley Fever fungal spores are too small to be seen, and there is no reliable way to test the soil for spores before working in a particular place. Valley Fever can be found throughout the southwestern United States, parts of Mexico and South America. Some California counties consistently have Valley Fever fungus present in the soil. In these regions Valley Fever is considered endemic. Health departments track the number of cases of Valley Fever illness that occur. This information is used to map illness rates as seen on the figure below.


California county-specific coccidioidomycosis incidence rates, 2011
Merced
Madera
Fresno
Tulare
Kings
San Luis Obispo
Kern
Cases per 100,000 population
0.0
0.1—19.9
20.0—74.9
75.0—304.0
Potentially unreliable rate, relative standard error 23 percent or more
Center for Infectious Diseases - Division of Communicable Disease Control
Infectious Diseases Branch - Surveillance and Statistics Section


Highly endemic
Moderately endemic
Mildly endemic
Suspected endemic

When present, symptoms usually occur between seven to 21 days after breathing in spores, and can include:

- Cough
- Fever
- Chest pain
- Headache
- Muscle aches
- Rash on upper trunk or extremities
- Joint pain in the knees or ankles
- Fatigue

Symptoms of Valley Fever can be mistaken for other diseases such as the flu (influenza) and TB (tuberculosis), so it is important for employees to obtain medical care for an accurate diagnosis and possible treatment.

While there is no vaccine to prevent Valley Fever, the following steps are important to take in order to limit risk:

- Determine if the worksite is in an endemic area. Contact the local health department for more information about the risk in the county GEI is performing work that may disturb soils.
- Prepare work plans and work practices that reduce employee's exposure, which may include:
    - Provide air conditioned cabs for vehicles that generate heavy dust and make sure employees keep windows and vents closed.
    - Suspend work during heavy winds.
- When exposure to dust is unavoidable, provide National Institute for Occupational Safety and Health (NIOSH)-approved respiratory protection with particulate filters rated as N95, N99, N100, P100, or High Efficiency Particulate Air (HEPA). Employers must develop and implement a respiratory protection program in accordance with California's Occupational Safety and Health Administration (Cal/OSHA's) Respiratory Protection standard (8 CCR 5144).
- Take measures to reduce transporting spores off site, such as:
    - Clean tools, equipment, PPE and vehicles before transporting off site.
    - If employee's clothing is likely to be heavily contaminated with dust, provide coveralls and change rooms, and showers where possible.

1.3 Limitations

Follow safety procedures as defined in the site-specific HASP. Appropriate PPE must be worn correctly to provide the intended level of protection.

1.4 References

http://www.cdc.gov/ncidod/dvbid/westnile/index.htm
http://www.cdc.gov/ncidod/dvbid/westnile/qa/insect_repellent.htm
http://www.epa.gov/pesticides/health/mosquitoes/insectrp.htm
http://www.cdc.gov/niosh/topics/lyme/
Protecting Yourself From Ticks and Mosquitoes, NIOSH Fast Facts, Publication No. 2010-119
http://npic.orst.edu/pest/mosquito/ptc.html

1.5 Attachments

None

1.6 Contact

GEI Corporate Health & Safety Officer
GEI East – North Regional Health & Safety Officer
GEI East – South Regional Health & Safety Officer
GEI Central Regional Health & Safety Officer
GEI West Regional Region Health & Safety Officer

STANDARD OPERATING PROCEDURES

SOP No. HS-002 Infectious Materials and Bloodborne Pathogens Exposure Control Plan

1.1 Objective

GEI personnel may come in contact with potentially infectious agents when performing first aid or cardiopulmonary resuscitation (CPR). Employees may also come into contact with these materials when working at certain contaminated sites (i.e., urban sites, discarded contaminated needles or sewer outfall exposures). This standard operating procedure (SOP) has been developed to minimize the potential for exposure to employees who may contact, directly or indirectly, infectious agents.

1.2 General

This SOP is intended for use by employees engaged in work with the potential for contact with infection materials and bloodborne pathogens. The site-specific health and safety plan (HASP) should include a hazard assessment for the project that identifies the potential for encounters with infectious materials or bloodborne pathogens and the control methods to be implemented by GEI employees. These hazards should be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Health and Safety page of the GEI intranet.

- Universal Precautions (i.e., treat all potentially infectious materials as if it were infected) will be used by GEI employees.

1.3 Exposure Control Plan

1.3.1 Standard Procedures

Sampling of potentially infectious materials will be performed in a manner that minimizes the potential for creating splashes, droplets, or aerosols. Mechanical pipetting devices will be used for manipulating sanitary sewer effluent. Mouth pipetting is prohibited.

The use of glassware or equipment with sharp or pointed edges will be kept at a minimum to reduce the potential of injury that would create a direct route of entry into the body for infectious materials.

Minor cuts, scratches, or other breaks in the skin barrier will be covered prior to the handling of infectious materials. Employees experiencing exudative lesions or weeping dermatitis will refrain from direct contact with infectious materials.

Eating, drinking, smoking, or application of cosmetics is not permitted in areas where potentially infectious materials are handled or sampled.

Employees will wash and disinfect their hands, face, or other potentially contaminated skin surfaces upon completing the handling of infectious or potentially infectious agents or after rendering first aid.

1.3.2 Personal Protective Equipment

Personal Protective Equipment (PPE) will be worn to reduce the potential of exposures to splashes or aerosols. At a minimum, this equipment will include safety glasses and appropriate gloves, but may also require the use of face, respiratory, foot, and full-body protection. Refer to the site-specific Health and Safety Plan for specific PPE requirements.

Gloves used in the handling or sampling of infectious materials will be appropriately disposed of and not reused.

1.3.3 Medical Monitoring

Medical monitoring is required for an employee when a potential workplace exposure has occurred. The employee must notify the Corporate Health and Safety Officer (CHSO) and Human Resources regarding the potential exposure as soon as possible. For infectious agents in which a medically accepted vaccination has been developed (e.g., hepatitis B virus [HBV]) potentially exposed employees will be given the option to receive an inoculation at no cost. Employees who have been exposed will be given the option to receive a confidential medical evaluation at no cost. Required records for exposed employees will be kept confidential.

1.3.4 Training

Employees with a reasonable risk for exposure must attend Bloodborne Pathogen training covering the following topics:

- An explanation of the Occupational Health and Safety Administration (OSHA) bloodborne pathogen standard.
- A general explanation of bloodborne diseases.
- An explanation of the modes of transmission of bloodborne diseases.
- An explanation of the GEI's Bloodborne Pathogen SOP and exposure control plan.
- Appropriate methods for recognizing tasks that involve potential exposure.
- An explanation of the use and limitations of methods to prevent exposure.
- Proper types, use, handling, decontamination, and disposal of PPE.
- The availability of HBV vaccines and the procedures for obtaining a vaccination.
- Appropriate actions to take during an emergency involving bloodborne pathogens.

- Post-exposure procedures.
- An explanation of required signs and labels.

1.4 Limitations

Follow safety procedures as defined in the site-specific HASP. Appropriate PPE must be worn correctly to provide the intended level of protection.

1.5 Reference

OSHA 29 CFR 1910.1030 - Bloodborne Pathogens.

1.6 Attachments

1.7 Contact

GEI Corporate Health & Safety Officer
GEI East – North Regional Health & Safety Officer
GEI East – South Regional Health & Safety Officer
GEI Central Regional Health & Safety Officer
GEI West Regional Region Health & Safety Officer

STANDARD OPERATING PROCEDURES

SOP NO. HS-003 Container Management

1.1 Objective

This standard operating procedure (SOP) has been developed to minimize the potential for injuries to GEI employees performing container and drum handling and sampling, through proper use of engineering and administrative controls, personal protective equipment (PPE), and education.

1.2 General

This SOP is intended for use by employees engaged in work with the management of containers that may contain hazardous substances or contaminated media. The site-specific health and safety plan (HASP) should include a hazard assessment and control methods to be implemented by GEI employees. These hazards should be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Health and Safety page of the GEI intranet.

Hazardous substances and contaminated media will be handled, transported, labeled, and disposed of in accordance with this paragraph. Drums and containers will meet the appropriate United States Department of Transportation (DOT), Occupational Safety and Health Administration (OSHA), and Environmental Protection Agency (EPA) regulations for the wastes that they contain.

Site operations will be organized to minimize the amount of drum or container movement. Prior to movement of drums or containers, employees exposed to the transfer operation will be notified of the potential hazards associated with the contents of the drums or containers. Unlabeled drums and containers will be considered to contain hazardous substances and handled accordingly until the contents are positively identified and labeled.

DOT specified salvage drums or containers and suitable quantities of proper absorbent will be kept available and used in areas where spills, leaks, or ruptures may occur. Where spills may occur, a spill containment program, which may be part of the HASP, will be implemented to contain and isolate the entire volume of the hazardous substance being transferred.

1.3 Opening Drums and Containers

The following procedures will be followed in areas where drums or containers are being opened:

- Employees not actually involved in opening drums or containers will be kept a safe distance from the drums or containers being opened.

- If employees must work near or adjacent to drums or containers being opened, a suitable shield that does not interfere with the work operation will be placed between the employee and the drums or containers being opened to protect the employee in case of accidental release.

- GEI employees will not handle or attempt to open bulging containers. Employees will not stand upon or work from drums or containers. GEI will contract with a hazardous waste company to handle, manage, and dispose of a bulging drum.

1.4 Material Handling Equipment

Material handling equipment, such as drum dollies, used to transfer drums and containers will be selected, positioned, and operated to minimize sources of ignition.

1.5 Radioactive Wastes

GEI does not routinely handle or manage radioactive waste. If required to do so for a project, procedures will be approved by the Corporate Health and Safety Officer (CHSO) and Regional Health and Safety Officer (RHSO).

1.6 Shock-Sensitive Wastes

GEI employees will not handle shock-sensitive waste. Shock-sensitive waste or chemicals may explode with friction, movement or heat. Some chemicals are shock-sensitive by nature-, others become shock-sensitive through drying, decomposition, or slow reactions with oxygen, nitrogen, or the container. Some chemicals that are, or can, become shock-sensitive will have that hazard noted in the safety data sheet (SDS).

- Drums and containers containing packaged laboratory wastes will be considered to contain shock-sensitive or explosive materials until they have been characterized. *Caution: Shipping of shock-sensitive wastes may be prohibited under U.S. Department of Transportation regulations. Shippers will refer to 49 CFR 173.21 and 173.50.*

1.7 Laboratory Waste Packs

GEI employees will not handle or open laboratory waste packs.

1.8 Sampling of Drum and Container Contents

Sampling of containers and drums will be done in accordance with a site-specific sampling plan that will be developed in conjunction with a site-specific HASP.

1.9 Staging Areas

Drums and containers will be identified and classified prior to packaging for shipment. Drum or container staging areas will be kept to a minimum number as approved by the client to safely identify and classify materials and prepare them for transport. Staging areas will be provided with adequate access and egress routes. Bulking of hazardous wastes will be permitted only after a thorough characterization of the materials has been completed and approved by the Client. GEI employees will not sign manifests unless a written authorization agreement is in place with the Client.

1.10 Tank and Vault Procedures

GEI employees do not routinely sample vaults and tanks. Entry procedures will be coordinated and approved by the CHSO and RHSO.

1.11 Limitations

Follow safety procedures as defined in the site-specific HASP. Appropriate PPE must be worn correctly to provide the intended level of protection.

1.12 References

OSHA 1910.120 Hazardous Waste Operations and Emergency Response (j) Handling of Drums and Containers.

1.13 Attachments

None

1.14 Contact

GEI Corporate Health & Safety Officer
GEI East – North Regional Health & Safety Officer
GEI East – South Regional Health & Safety Officer
GEI Central Regional Health & Safety Officer
GEI West Regional Region Health & Safety Officer

STANDARD OPERATING PROCEDURE
HS-004 Driver Safety

1.1 Objective

GEI has implemented a Safe Driving Program to encourage safe driving habits and promote the ongoing safety of our staff and the communities where we work. For more information, refer to the Operation of Vehicles section of GEI's Employee Handbook.

This standard operating procedure (SOP) provides requirements and recommendations to minimize the potential risks while operating or riding in a motor vehicle.

1.2 General

GEI employees will adhere to the following requirements when operating a vehicle while conducting business on behalf of GEI. These requirements apply to GEI owned, rental, and personal vehicles used to conduct GEI business:

- Employees must maintain a valid and current driver's license.
- Employees using a personal vehicle for work-related travel must have proper insurance coverage that meets the requirements in the state in which they reside.
- Employees must wear their safety belt while in a moving vehicle.
- Vehicle accidents will be reported in accordance with GEI's accident reporting procedures. .
- Vehicles will be properly maintained and safely operated (refer to GEI's Fleet Maintenance Program).
- Employees will follow safe driving behaviors, which include limiting distractions such as manipulating radios or other equipment that may cause a distraction. Employees should not exceed the posted speed limit and should maintain a safe distance between other vehicles.
- When parking a vehicle at a job site, the employee should position the vehicle in a manner to reduce or eliminate the need to operate the vehicle in reverse. A safety cone should be placed at the rear of the vehicle after parking the vehicle and be removed prior to moving the vehicle. This procedure makes the employee aware of other vehicles, equipment, and structures within the backup radius of the vehicle.

When driving a rental vehicle or GEI vehicle that you are unfamiliar with orient yourself to the vehicle by:

- Walking around the vehicle to observe the condition of the vehicle and hazards that could be within the travel path.
- Becoming familiar with the size of the vehicle.

- Adjusting mirrors (rear and side).
- Becoming familiar with dashboard, center console, and steering controls.
- Locating the turn signals, windshield wipers, lights, emergency flashers, and the heating, air conditioning, and defrost controls.

1.3 Driving Defensively

Driving defensively means not only taking responsibility for yourself and your actions but also keeping an eye on "the other guy." Good defensive drivers may be able to anticipate what the other driver will do next. GEI recommends the following guidelines to help reduce your risks on the road.

Do not start the vehicle until each passenger and their belongings are secured in the vehicle.

- Remember that driving above or below the speed limit can increase the likelihood of a collision.
- If you notice that a car is straddling the center line, weaving, making wide turns, stopping abruptly or responding slowly to traffic signals, the driver may be impaired or using a cellular telephone.
- Avoid an impaired driver by turning right at the nearest corner or exiting at the nearest exit. If it appears that an oncoming car is crossing into your lane, pull over to the roadside, sound the horn and flash your lights.
- Notify the police if you observe motorist who is driving suspiciously.
- Follow the rules of the road. Do not contest the "right of way" or try to race another car during a merge. Be respectful of other motorists.
- Allow large vehicles, including tractor trailers, extra breaking distance, turning radius, and avoid traveling in their blind spots.
- Do not follow too closely. GEI employees should use a "three-second following distance" or a "three-second plus following distance."
- While driving be cautious, aware, and responsible.
- Use extra caution and reduce speed in construction areas and school zones.
- Be aware of pedestrians, bicyclists, and motorcyclists.

1.4 Cellular Phone Use and Other Distractions

Refer to the Human Resources policy on use of cellular telephones while operating a vehicle on company business.

1.5 Drugs and Alcohol

The use of illegal drugs or alcohol is prohibited when driving a vehicle on GEI business. Be aware of the side effects of prescription and over-the-counter medications which can impair an employee’s ability to drive.

1.6 Adverse Driving Conditions

1.6.1 Driving at Night

Vision maybe limited at night due to impairment of the driver's depth perception, color recognition, and peripheral vision. Another factor adding danger to night or early morning driving is fatigue. Drowsiness makes driving more difficult by dulling concentration and slowing reaction time.

Effective measures to minimize these hazards by preparing your car and following guidelines:

- Have your headlights properly aimed. Misaimed headlights blind other drivers and reduce your ability to see the road.
- Alcohol severely impairs your driving ability and acts as a depressant.
- Avoid smoking when you drive. Smoke's nicotine and carbon monoxide hamper night vision.
- Lights will not help the driver see better in early twilight, but they will make it easier for other drivers to see you. Do not overdrive your headlights. You should be able to stop inside the illuminated area. If you do not, you create a blind crash area in front of your vehicle.
- If an oncoming vehicle does not lower beams from high to low, avoid glare by watching the right edge of the road and using it as a steering guide.
- Make frequent stops for light snacks and exercise. If you are too tired to drive, stop in a safe area and get some rest.
- Observe driving safety as soon as the sun goes down. Twilight is one of the most difficult times to drive, because your eyes are constantly changing to adapt to the growing darkness.

1.6.2 Snow/Freezing Conditions

When snow and ice are present, be prepared by following these winter driving safety tips.

1.6.2.1 Prepare the Vehicle Before a Snowstorm

- Check under the hood and take a look at the vehicles cooling system. Make sure the vehicle contains adequate antifreeze and the hoses are in good condition.
- Test heaters and defrosters ahead of time to make sure they are in good working condition.
- Test your windshield wipers and check the condition of your wiper blades. If wipers leave streaks on your windshields, replace the blades.
- It is recommended that a windshield washer/antifreeze solution is used during winter conditions.
- Check your lights and periodically clear them of snow and dirt.
- Car batteries need extra power in cold conditions. Make sure the battery's terminals are clean and cables are secure.

- Keep your gas tank at least half full in the winter to help avoid gas line freeze up.

1.6.2.2 Driving During and After a Snowstorm

- Wear sunglasses to aid in limiting reflection from snow.
- Be aware of blind spots created by snow banks.
- Be extra cautious of pedestrians and other vehicles in intersections.
- Allow extra time for braking and increase the distance between you and the car ahead of you.
- Reduce your speed and do not exceed the posted limit.
- If you start to lose traction take your foot off the gas and gradually reduce your speed. Accelerate slowly once you feel traction is regained.
- If you start to skid, steer in the direction of the skid. Remember, steering can be more important than braking on slippery roads.

1.6.3 Driving In the Rain

To prevent losing control of your car on wet pavement, take these preventive measures.

- Prevent skids by driving slowly and carefully, especially on curves.
- Steer and brake with a light touch.
- When you need to stop or slow, do not brake hard or lock the wheels.
- Maintain mild pressure on the brake pedal.

If you skid, ease your foot off the gas, and carefully steer in the direction you want the front of the car to go. For cars without anti-lock brakes, avoid using your brakes. This procedure, known as "steering into the skid," will bring the back end of the car in line with the front. If your car has anti-lock brake systems (ABS), brake firmly as you "steer into the skid."

Hydroplaning happens when the water in front of your tires builds up faster than your car's weight can push it out of the way. The water pressure causes your car to lose contact with the road surface and slide on a thin layer of water between your tires and the road. At this point, your car can be completely out of contact with the road, and you are in danger of skidding or drifting out of your lane, or even off the road.

To avoid hydroplaning, keep the tires properly inflated and maintain good tread on the tires. If tires need to be replaced on a company vehicle, notify the branch manager or their designee. Slow down when roads are wet, and stay away from puddles. Try to drive in the tire tracks left by the cars in front of you. If you begin to hydroplane, do not brake or turn suddenly. This could throw your car into a skid. Ease your foot off the gas until the car slows and you can feel the road again. If you need to brake, do it gently with light pumping actions. If your car has ABS, then brake normally; the car's computer will mimic a pumping action, when necessary.

If weather conditions worsen to the point where the driver is not comfortable driving, pull the vehicle over to a safe location until conditions improve. Do not drive during severe weather conditions. Do not attempt to drive on roads with standing water or that have been flooded. Find an alternate route if these conditions exist.

1.6.4 Off Road

If operation of a vehicle is required off publicly or privately maintained roads or in situations where four-wheel-drive vehicles are required, the appropriate vehicle for the situation will be used.

1.7 Driver Training

GEI employees are required to complete driver safety training every 3 years. Employees will complete the examination at the end of each module and forward the training certificate to Human Resources.

1.8 Limitations

Follow safety procedures as defined in the site-specific HASP.

1.9 References

National Safety Council
Oklahoma Safety Council
GEI Consultants, Inc. Employee Handbook

1.10 Attachments

1.11 Contact

GEI Corporate Health & Safety Officer
GEI East – North Regional Health & Safety Officer
GEI East – South Regional Health & Safety Officer
GEI Central Regional Health & Safety Officer
GEI West Regional Region Health & Safety Officer

STANDARD OPERATING PROCEDURES

SOP No. HS-006 Excavations and Trenches

1.1 Objective

GEI employees may be involved with projects that include some type of excavation and trenching as part of the work activities. The following guidelines will be followed when excavations or trenches are present on GEI projects.

1.2 General

This standard operating procedure (SOP) is intended for use by employees engaged in work on project sites that include trenching and/or excavation operations. The site-specific health and safety plan (HASP) should include a hazard assessment for the project that identifies the potential for trenching and excavation hazards and the control methods to be implemented by GEI employees. These hazards should be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Health and Safety page of the GEI intranet.

Hazards associated with excavations and trenches can include collapse, falls, falling objects, hazardous atmospheres, and incidents involving mobile equipment.

GEI employees will not enter trenches or excavations that do not comply with OSHA 29 CFR 1926.650. If a project requires GEI employees to enter a trench or excavation, the trench or excavation should meet the following requirements:

- The excavation must be inspected daily by a competent person to identify potential hazards associated with the excavation. GEI generally does not act as the competent person.
- A protective system should be in place for trenches or excavations greater than 5- feet in depth.
- Employees will be protected from vehicular traffic by the use of barricades, cones and tape or other physical barriers.
- The protective system should be designed based on soil type, depth of excavation, water level, loads adjacent to the excavation, changes in weather conditions, or other operations in the area. Protective systems can include sloping or benching of the sidewalls, shoring the sidewalls using an approved support system, or shielding workers with a trench box or other similar type of support.
- If the excavation is greater than 20-feet in depth, the protection system requires a design by a registered professional engineer or based on tabulated data prepared and/or approved by a registered professional engineer.

- Excavations and trenches greater than four feet in depth require a safe access and egress including ladders, steps, or ramps. These points of access and egress are to be no greater than 25 feet of lateral travel in any direction.

- Where oxygen deficiency (atmospheres containing less than 20.7 percent oxygen) or a hazardous atmosphere exists or could reasonably be expected to exist, such as in excavations in landfill areas or excavations in areas where hazardous substances are stored nearby, the atmospheres in the excavation shall be tested before employees enter excavations greater than four feet in depth.

When GEI is subcontracting the excavation activities:

- Care should be taken not to create new hazards like narrow walkways along edges of an excavation.
- Heavy equipment should not be parked or working at the edge of the excavation.
- Spoils should not be stockpiled within 2 feet of the trench edges.
- Confirm with subcontractor that underground utilities have been located before any excavation or trenching activities begin (refer to SOP HS-014 Utility Mark-out).
- When required guardrails will be installed for crossings and walkways to provide fall protection.
- Confirm with the subcontractor that the excavation or trench has been tested for hazardous atmospheres before entering.
- Confirm with the subcontractor that the excavation or trench has been inspected by a competent person before each work shift and after any type of precipitation. Water should be directed away from the excavation or trench whenever possible. If hazards are identified during this inspection, verify that the hazards are controlled prior to entering the trench or excavation.
- GEI employees will not work under raised or suspended loads.

In circumstances where GEI employees are working on sites where a contractual agreement with the excavation contractor does not exist and we cannot confirm the above stated conditions, entry into trenches or excavations should not be conducted.

1.3 Soil Classifications

The soil classification system means a method of categorizing soil and rock deposits in a hierarchy of Stable Rock, Type A, Type B, and Type C, in decreasing order of stability.

1) Stable rock means natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.

2. Type A means cohesive soils with an unconfined, compressive strength of 1.5 ton per square foot (tsf) (144 kPa) or greater. Examples of cohesive soils are: clay, silty clay, sandy clay, clay loam and, in some cases, silty clay loam and sandy clay loam. Cemented soils such as caliche and hardpan are also considered Type A. However, no soil is Type A if:

a) The soil is fissured; or
b) The soil is subject to vibration from heavy traffic, pile driving, or similar effects; or
c) The soil has been previously disturbed; or
d) The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or greater; or
e) The material is subject to other factors that would require it to be classified as a less stable material.

3) Type B means:

a) Cohesive soil with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa); or
b) Granular cohesionless soils including: angular gravel (similar to crushed rock), silt, silt loam, sandy loam and, in some cases, silty clay loam and sandy clay loam.
c) Previously disturbed soils except those which would otherwise be classed as Type C soil.
d) Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subject to vibration; or
e) Dry rock that is not stable; or
f) Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H:1V), but only if the material would otherwise be classified as Type B.

4) Type C means:

a) Cohesive soil with an unconfined compressive strength of 0.5 tsf (48 kPa) or less; or
b) Granular soils including gravel, sand, and loamy sand; or
c) Submerged soil or soil from which water is freely seeping; or
d) Submerged rock that is not stable, or
e) Material in a sloped, layered system where the layers dip into the excavation or a slope of four horizontal to one vertical (4H:1V) or steeper.

Where soils are configured in layers, i.e., where a layered geologic structure exists, the soil must be classified on the basis of the soil classification of the weakest soil layer. Each layer may be classified individually if a more stable layer lies below a less stable layer, i.e., where a Type C soil rests on top of stable rock.

1.4 GEI Requirements for the Excavation/Trenches Competent Person

Although GEI does not normally act as the competent person for excavations and trenches this person should have and be able to demonstrate the following:

- Training, experience, and knowledge of:
  - soil analysis;
  - use of protective systems; and
  - requirements of 29 CFR Part 1926 Subpart P.
- Ability to detect:
  - conditions that could result in cave-ins;
  - failures in protective systems;
  - hazardous atmospheres; and
  - other hazards including those associated with confined spaces.
- Authority to take prompt corrective measures to eliminate existing and predictable hazards and to stop work when required.

1.5 Test Equipment And Methods For Evaluating Soil Type

Many kinds of equipment and methods are used to determine the type of soil prevailing in an area, as described below.

A. Pocket Penetrometer. Penetrometers are direct-reading, spring-operated instruments used to determine the unconfined compressive strength of saturated cohesive soils. Once pushed into the soil, an indicator sleeve displays the reading. The instrument is calibrated in either tons per square foot (tsf) or kilograms per square centimeter (kPa). However, Penetrometers have error rates in the range of ± 20-40%.

   1. Shearvane (Torvane). To determine the unconfined compressive strength of the soil with a shearvane, the blades of the vane are pressed into a level section of undisturbed soil, and the torsional knob is slowly turned until soil failure occurs. The direct instrument reading must be multiplied by 2 to provide results in tons per square foot (tsf) or kilograms per square centimeter (kPa).

2. Thumb Penetration Test. The thumb penetration procedure involves an attempt to press the thumb firmly into the soil in question. If the thumb makes an indentation in the soil only with great difficulty, the soil is probably Type A. If the thumb penetrates no further than the length of the thumb nail, it is probably Type B soil, and if the thumb penetrates the full length of the thumb, it is Type C soil. The thumb test is subjective and is therefore the least accurate of the three methods.
3. Dry Strength Test. Dry soil that crumbles freely or with moderate pressure into individual grains is granular. Dry soil that falls into clumps that subsequently break into smaller clumps (and the smaller clumps can be broken only with difficulty) is probably clay in combination with gravel, sand, or silt. If the soil breaks into clumps that do not break into smaller clumps (and the soil can be broken only with difficulty), the soil is considered unfissured unless there is visual indication of fissuring.

B. Plasticity or Wet Thread Test. This test is conducted by molding a moist sample of the soil into a ball and attempting to roll it into a thin thread approximately 1/8 inch (3 mm) in diameter (thick) by 2 inches (50 mm) in length. The soil sample is held by one end. If the sample does not break or tear, the soil is considered cohesive.

C. Visual Test. A visual test is a qualitative evaluation of conditions around the site. In a visual test, the entire excavation site is observed, including the soil adjacent to the site and the soil being excavated. If the soil remains in clumps, it is cohesive; if it appears to be coarse-grained sand or gravel, it is considered granular. The evaluator also checks for any signs of vibration.

   During a visual test, the evaluator should check for crack-line openings along the failure zone that would indicate tension cracks, look for existing utilities that indicate that the soil has previously been disturbed, and observe the open side of the excavation for indications of layered geologic structuring.

   The evaluator should also look for signs of bulging, boiling, or sluffing, as well as for signs of surface water seeping from the sides of the excavation or from the water table. If there is standing water in the cut, the evaluator should check for "quick" conditions. In addition, the area adjacent to the excavation should be checked for signs of foundations or other intrusions into the failure zone, and the evaluator should check for surcharging and the spoil distance from the edge of the excavation.

1.6 Shoring Types

Shoring is the provision of a support system for trench faces used to prevent movement of soil, underground utilities, roadways, and foundations. Shoring or shielding is used when the location or depth of the cut makes sloping back to the maximum allowable slope impractical. Shoring systems consist of posts, wales, struts, and sheeting. There are two basic types of shoring, timber and aluminum hydraulic.

Hydraulic shoring can be a prefabricated strut and/or wale system manufactured of aluminum or steel. Hydraulic shoring provides a critical safety advantage over timber shoring because workers do not have to enter the trench to install or remove hydraulic shoring. Other advantages of most hydraulic systems are that they:

- Are light enough to be installed by one worker;
- Are gauge-regulated to ensure even distribution of pressure along the trench line;
- Can have their trench faces "preloaded" to use the soil's natural cohesion to prevent movement; and
- Can be adapted easily to various trench depths and widths.

All shoring should be installed from the top down and removed from the bottom up. Hydraulic shoring should be checked at least once per shift for leaking hoses and/or cylinders, broken connections, cracked nipples, bent bases, and any other damaged or defective parts.

Pneumatic Shoring works in a manner similar to hydraulic shoring. The primary difference is that pneumatic shoring uses air pressure in place of hydraulic pressure. A disadvantage to the use of pneumatic shoring is that an air compressor must be on site.

- Screw jack systems differ from hydraulic and pneumatic systems in that the struts of a screw jack system must be adjusted manually. This creates a hazard because the worker is required to be in the trench in order to adjust the strut. In addition, uniform "preloading" cannot be achieved with screw jacks, and their weight creates handling difficulties.
- Single-Cylinder Hydraulic Shores. Shores of this type are generally used in a water system, as an assist to timber shoring systems, and in shallow trenches where face stability is required.
- Underpinning. This process involves stabilizing adjacent structures, foundations, and other intrusions that may have an impact on the excavation. As the term indicates, underpinning is a procedure in which the foundation is physically reinforced. Underpinning should be conducted only under the direction and with the approval of a registered professional engineer.

1.7 Shielding Types

Trench Boxes are different from shoring because, instead of shoring up or otherwise supporting the trench face, they are intended primarily to protect workers from cave-ins and similar incidents. The excavated area between the outside of the trench box and the face of the trench should be as small as possible. The space between the trench boxes and the excavation side are backfilled to prevent lateral movement of the box. Shields may not be subjected to loads exceeding those which the system was designed to withstand.

Trench boxes are generally used in open areas, but they also may be used in combination with sloping and benching. The box should extend at least 18 in (0.45 m) above the surrounding area if there is sloping toward excavation. This can be accomplished by providing a benched area adjacent to the box.

Earth excavation to a depth of 2 ft (0.61 m) below the shield is permitted, but only if the shield is designed to resist the forces calculated for the full depth of the trench and there are no indications while the trench is open of possible loss of soil from behind or below the bottom of the support system. Conditions of this type require observation on the effects of bulging, heaving, and boiling as well as surcharging, vibration, adjacent structures, etc., on excavating below the bottom of a shield. Careful visual inspection of the conditions mentioned above is the primary and most prudent approach to hazard identification and control.

1.8 Sloping And Benching

Maximum allowable slopes for excavations less than 20 ft (6.09 m) based on soil type and angle to the horizontal are as follows:

Soil type	height / Depth ratio	Slope angle
Stable Rock	Vertical	90°
Type A	¾:1	53°
Type B	1:1	45°
Type C	1½:1	34°
Type A (short-term)	½:1	63°
(For a maximum excavation depth of 12 ft)		

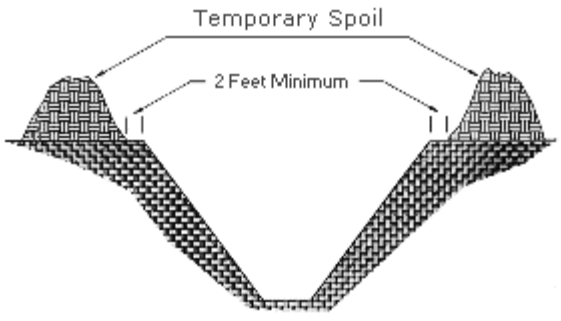
There are two basic types of benching, simple and multiple. The type of soil determines the horizontal to vertical ratio of the benched side.

As a general rule, the bottom vertical height of the trench must not exceed 4 ft (1.2 m) for the first bench. Subsequent benches may be up to a maximum of 5 ft (1.5 m) vertical in Type A soil and 4 ft (1.2 m) in Type B soil to a total trench depth of 20 ft (6.0 m). All subsequent benches must be below the maximum allowable slope for that soil type. For Type B soil the trench excavation is permitted in cohesive soil only.

1.9 Spoil

Temporary spoil must be placed no closer than 2 ft (0.61 m) from the surface edge of the excavation, measured from the nearest base of the spoil to the cut. This distance should not be measured from the crown of the spoil deposit. This distance requirement ensures that loose rock or soil from the temporary spoil will not fall on employees in the trench.

Spoil should be placed so that it channels rainwater and other run-off water away from the excavation. Spoil should be placed so that it cannot accidentally run, slide, or fall back into the excavation.



Permanent spoil should be placed at some distance from the excavation. Permanent spoil is often created where underpasses are built or utilities are buried. The improper placement of permanent spoil, i.e. insufficient distance from the working excavation, can cause an excavation to be out of compliance with the horizontal-to-vertical ratio requirement for a particular excavation. This can usually be determined through visual observation. Permanent spoil can change undisturbed soil to disturbed soil and dramatically alter slope requirements.

1.10 Limitations

Follow safety procedures as defined in the site-specific HASP. Appropriate PPE must be worn correctly to provide the intended level of protection.

Do not enter a trench or excavation without consulting with the project manager, Corporate Health and Safety Officer (CHSO), or Regional Health and Safety Officer (RHSO).

Some states, including Massachusetts, require a trench permit prior to trenching or excavation activities. Verification of local requirements will be evaluated in the planning stage.

1.11 References

OSHA 29 CFR 1926.650 – Subpart P; *Excavations.*
OSHA Construction eTool - http://www.osha.gov/SLTC/etools/construction/index.html
OSHA Technical Manual (OTM), Section V: Chapter 2 - Excavations: Hazard Recognition In Trenching And Shoring

1.12 Attachments

None

1.13 Contact

GEI Corporate Health & Safety Officer
GEI East – North Regional Health & Safety Officer
GEI East – South Regional Health & Safety Officer
GEI Central Regional Health & Safety Officer
GEI West Regional Region Health & Safety Officer

STANDARD OPERATING PROCEDURES

HS-007 General Safety Requirements

1.1 Objective

GEI is committed to providing its employees with a safe and healthy work environment. To maintain a safe work environment, GEI has established general safety requirements to promote safe work practices.

1.2 General Health and Safety Training

GEI requires employees to complete Health and Safety Training on an annual basis. Project employees must have completed, at a minimum, GEI's General 4-Hour Health and Safety Training or when required, HAZWOPER training before beginning on-site work activities. In addition, field staff must be current in First Aid and CPR Training. Site-specific safety training will also be completed before beginning work on each project site. Further Health and Safety training requirements can be found in Section 2 of the GEI Health and Safety Manual.

1.3 Tailgate Meetings

Health and Safety tailgate meetings will be conducted by the GEI Project Manager or Site Safety Officer (SSO), and be recorded in the GEI field book or on the GEI daily safety briefing log. Employees on-site will sign the daily safety briefing log to indicate attendance.

1.4 Health and Safety Plans

GEI projects must have a health and safety plan (HASP) before beginning site work. GEI HASP templates are located on the Health and Safety page on the GEI intranet. Specific requirements for HASPs are located in Section 7 of GEI's Health and Safety Manual. After the HASP has been completed, it must be sent to the Corporate Health and Safety Officer (CHSO) and the Regional Health and Safety Officer (RHSO) for review. Project employees must read the HASP and sign the signature page to document that they have read, understood, and will comply with the requirements of the HASP. The site-specific HASP must be kept on-site at all times.

1.5 Personal Protective Equipment

Project-specific personal protective equipment (PPE) will be identified in the HASP based on the hazards present during work tasks. Required PPE must be worn on the project site. More information regarding PPE is located in Section 6 of GEI's Health and Safety Manual.

1.6 Fire Protection and Prevention

The work site should be kept clear of flammable materials and debris. GEI field personnel should know where fire extinguishers are located, and be familiar in the use of the extinguisher. Information on the correct use of a fire extinguisher is included in GEI's general health and safety training. Call 911(or other number identified in the project HASP) in the event of a fire.

1.7 Accident/Incident Reporting

The following accident reporting procedures must be followed:

- Seek medical attention.
- Notify your supervisor.
- Notify CHSO and Human Resources (HR) within two hours of the accident/incident.
- Complete Accident Reporting Form (found on the Health and Safety page of the GEI Intranet or on the GEI App) within **24 hours** and send to the CHSO and Human Resources. Refer to Section 8 of the GEI Health and Safety Manual for more information.

1.8 Near Miss Reporting

GEI employees will complete a near-miss reporting form if a hazardous or unsafe condition or near miss is observed. The near-miss reporting form is located on the Health and Safety page of the GEI Intranet. Refer to Section 8 of the GEI Health and Safety Manual for more information.

1.9 Housekeeping

Work areas, passages, and stairs will be kept clear of debris. Debris will be removed from the project site at regular intervals.

1.10 Illumination

Project sites will be illuminated either with natural or artificial illumination, in compliance with OSHA regulations.

1.11 Sanitation

Hand-washing is an essential form of protection from chemical and biological exposures and illness. GEI employees should wash their hands after performing work tasks and

regularly throughout the day. If soap and water are not available, hand sanitizers and/or wipes should be used.

1.12 Machinery, Tools, Material, and Equipment

Machinery, tools, material, and equipment will be kept in good working condition and will be inspected by a competent person. Unsafe equipment will be identified as unsafe by tagging or locking the controls to render them inoperable. Arrangements will be made to repair or dispose of damaged or unsafe equipment.

1.13 Vehicles

GEI's motor vehicles will be maintained in accordance with the GEI fleet maintenance program. Each GEI-owned vehicle will have a fire extinguisher and first aid kit. Additional fire extinguishers and first aid kits are kept in each GEI office for use in personal or rental vehicles.

1.14 Heavy Equipment

GEI employees will keep a line of sight between them and heavy equipment operators. If a GEI employee needs to communicate with heavy equipment operators, they will use hand signals or direct communication with the operator. GEI employees should not:

- Operate or climb on heavy equipment
- Approach heavy equipment while it is in operation.
- Use cellular telephones when working near operating equipment.

For more information regarding heavy equipment, refer to GEI's SOP HS-018 Heavy Equipment.

1.15 Limitations

Follow safety procedures as defined in the site-specific HASP. Appropriate PPE must be worn correctly to provide the intended level of protection.

1.16 Attachments

None

1.17 Contact

GEI Corporate Health & Safety Officer
GEI East – North Regional Health & Safety Officer
GEI East – South Regional Health & Safety Officer

GEI Central Regional Health & Safety Officer
GEI West Regional Region Health & Safety Officer

STANDARD OPERATING PROCEDURES

SOP NO. HS-009 Hazardous Substances Management

1.1 Objective

This Standard Operating Procedure (SOP) is intended to outline the steps GEI employees will take to identify potential hazards associated with exposure to hazardous substances, the risks associated with these hazards, and the proper controls to use to minimize exposure. The site-specific health and safety plan (HASP) should include a hazard assessment for the project that identifies the potential for encounters with biological hazards and the control methods to be implemented by GEI employees. These hazards should be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Health and Safety page of the GEI intranet.

1.2 Hazard Identification

An initial identification of hazards should be done based on a review of available documents including lists of chemicals used on site, analytical data from soil, surface water, groundwater, air, spill history, site history, equipment on site, maps, photos, and a preliminary survey.

1.3 Risk Identification

Once the presence and concentrations of specific hazardous substances and health hazards have been established, the risks associated with these substances will be identified. GEI employees and GEI subcontractors who will be working on the site will be informed of risks that have been identified.

Risks to consider include, but are not limited to:

- Potential exposures exceeding the permissible exposure limits and published exposure levels.
- Potential Immediately to Life and Health (IDLH) Concentrations.
- Potential Skin Absorption and Irritation Sources.
- Potential Eye Irritation Sources.
- Potential hazardous atmospheres, including oxygen deficiency and fire and explosion hazards.

1.4 Engineering Controls, Work Practices, and Personal Protective Equipment for Employee Protection

Engineering controls, work practices, and personnel protective equipment (PPE) for substances regulated in OSHA Subpart Z (Toxic and Hazardous Substances) will be implemented in accordance with this section to protect employees from exposure to hazardous substances and safety and health hazards.

1.4.1 Engineering Controls, Work Practices, and Personal Protective Equipment for Substances Regulated in Subparts G (Occupational Health and Environment Control) and Subpart Z (Toxic and Hazardous Substances)

Engineering controls and work practices will be instituted to reduce and maintain employee exposure at or below the permissible exposure limits for substances regulated by 29 CFR Part 1910.

Engineering controls that may be feasible include the use of pressurized cabs or control booths on equipment, and/or the use of remotely operated material handling equipment. Work practices may include removing non-essential employees from potential exposure during opening of drums, wetting down dusty operations, and positioning employees upwind of potential hazards.

If engineering controls and work practices are not feasible, or not required, a reasonable combination of engineering controls, work practices, and PPE will be used to reduce and maintain at or below the permissible exposure limits or dose limits for substances regulated by 29 CFR Part 1910, Subpart Z.

GEI will not implement a schedule of employee rotation as a means of compliance with permissible exposure limits or dose limits except when there is no other feasible way of complying with the airborne or dermal dose limits for ionizing radiation.

The provisions of 29 CFR, subpart G, Occupational Health and Environment control, will be followed.

1.4.2 Engineering Controls, Work Practices, and Personal Protective Equipment for Substances <u>Not</u> Regulated in Subparts G and Subparts Z

An appropriate combination of engineering controls, work practices, and personal protective equipment will be used to reduce and maintain employee exposure to or below published exposure levels for hazardous substances and health hazards not regulated by 29 CFR Part 1910, Subparts G and Subparts Z. GEI will use published literature and Safety Data Sheet (SDS) as a guide in making the determination of what level of protection is appropriate for hazardous substances and health hazards for which there is no permissible exposure limit or published exposure limit.

1.4.3 Decontamination Procedure

Decontamination procedure(s) will be developed, communicated to employees, and implemented before employees or equipment enter areas on site where potential for exposure to hazardous substances exists. Procedures will be developed to minimize employee contact with hazardous substances or with equipment that has contacted hazardous substances.

GEI employees leaving a contaminated area will be properly decontaminated; contaminated clothing and equipment leaving a contaminated area will be properly disposed of or decontaminated.

Decontamination procedures will be monitored by the site safety officer (SSO) to determine their effectiveness. When such procedures are found to be ineffective, the site safety officer will contact the CHSO and appropriate steps will be taken to correct deficiencies.

1.4.3.1 Location

Decontamination will be performed in areas that will minimize the exposure to employees, equipment, and the environment.

1.4.3.2 Equipment and Solvents

Equipment and solvents used for decontamination will be decontaminated or disposed of properly.

1.4.3.3 Personal Protective Clothing and Equipment

Protective clothing and equipment will be decontaminated, cleaned, laundered, maintained or replaced as needed to maintain their effectiveness.

Employees whose clothing comes in contact with hazardous substances will immediately remove that clothing and rinse the exposed area with water. The clothing will be disposed of or decontaminated before it is removed from the work zone.

1.4.3.4 Commercial Laundries or Cleaning Establishments

Commercial laundries or cleaning establishments that decontaminate protective clothing or equipment will be informed of the potentially harmful effects of exposures to hazardous substances.

1.4.3.5 Showers and Changing Rooms

Where the decontamination procedure indicates a need for regular showers and change rooms outside of a contaminated area, they will be provided and meet the requirements of

29 CFR 1910.141 (Sanitation). If temperature conditions prevent the effective use of water, then other effective means for cleansing will be provided and used.

1.5 Limitations

None

1.6 Attachments

None

1.7 References

OSHA 1910.120 Hazardous Waste Operations and Emergency Response
OSHA 1910 Subpart G Occupational Health and Environment Control
OSHA 1910 Subpart Z Toxic and Hazardous Substances
OSHA 1910.141 General Environmental Controls - Sanitation

1.8 Contact

GEI Corporate Health & Safety Officer
GEI East – North Regional Health & Safety Officer
GEI East – South Regional Health & Safety Officer
GEI Central Regional Health & Safety Officer
GEI West Regional Region Health & Safety Officer

STANDARD OPERATING PROCEDURES

SOP No. HS-010 Inclement Weather

1.1 Objective

Inclement weather can affect work activities and pose safety hazards to employees working in these conditions. The following guidelines will be followed when weather conditions become a safety concern.

1.2 General

This standard operating procedure (SOP) is intended for use by employees engaged in work with the potential to be affected by inclement weather. The site-specific health and safety plan (HASP) should include a hazard assessment for the project that identifies the potential for encounters with biological hazards and the control methods to be implemented by GEI employees. These hazards should be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Health and Safety page of the GEI intranet.

Employees should be aware of local weather conditions and monitor advisories issued by the National Weather Service and other local reporting services. Depending on location and season, storms are capable of producing heavy rain, floods, extreme temperatures, high wind conditions, lighting, tornados, and/or snowfall.

1.2.1 Heavy Rain

If working or driving in a storm use extreme caution. When driving, turn your lights on when the rainfall becomes heavy. Employees should be aware of the following:

- Heavy rain decreases visibility, especially when driving.
- Surfaces and tools become slippery.
- If you are working in the rain and your clothes become wet there is a risk of hypothermia when exposed to winds, even in warm temperatures.
- If the storms are going to produce thunder and/or lightning, leave the work area immediately and move to a safe area.
- Use your best judgment to determine if the rainfall becomes too heavy to continue working safely.

1.2.2 Lightning

Lightning can strike as far as 10 miles from the area where it is raining. That's about the distance you can hear thunder. **If you can hear thunder, you are within striking distance. Seek safe shelter immediately.** This can be within a building or vehicle. Wait 30 minutes after the last clap of thunder or flash of lightning before going outside again.

1.2.3 Flooding

Flooding may occur as a result of heavy rain in a short period of time. Flooding can be particularly acute in canyon areas where dry creek beds can turn into raging rivers from rainfall in distant or higher elevation areas. Be aware of this and your surroundings and move to a safe place if you begin to see signs that flooding may occur. Do not attempt to drive through areas or streets that are flooded. Seek alternate routes. Be particularly cautious at night when flooded areas are difficult to see. Urban flooding can stop traffic and increase the potential for traffic accidents and becoming trapped in vehicles.

1.2.4 Extreme Temperatures

Work activities may take place in extreme heat or cold. Be prepared if these conditions are anticipated. Have the appropriate personal protective equipment (PPE) available, exercise proper fluid intake, and take breaks to prevent heat and cold stress. For more information about these conditions see the heat stress and cold stress programs found in GEI's Health and Safety Manual.

1.2.5 High Wind and Tornados

Tropical storms are described as storms with sustained winds ranging from 39 to 73 miles per hour (mph) and hurricanes produce sustained winds that exceed 74 mph. When winds approach 40 mph (gale force winds) twigs begin to break off of trees and vehicles will veer off of the road. When winds approach **40 mph** or the GEI employee feels unsafe based on the activities being performed, stop work and seek shelter as soon as possible. Blowing or falling debris and overhanging limbs/signs can be a significant hazard. If possible, avoid driving in these conditions; 70 percent of injuries during hurricanes are a result of vehicle accidents. Note that tall or elevated equipment will have manufacturer's safe operating wind speeds defined that could be less than 40 mph. The operator's manual should be consulted prior to operation of the equipment.

A tornado is a violent, dangerous, rotating column of air that is in contact with both the surface of the earth and a cumulonimbus cloud or, in rare cases, the base of a cumulus cloud. The Fujita Scale is used to rate the intensity of a tornado by examining the damage caused by the tornado after it has passed over a man-made structure. Based on the Fujita Scale or F-Scale Numbers begin at F0: 40-72 mph and go to F6: 319-379 mph (F6 is generally theoretical). Nearly three-fourths of tornados are on the weak F0-F1 scale with just over two-thirds of deaths resulting from the violent F4-F5 tornados. If tornado wind

speeds exceed the 40 mph, stop work and seek shelter immediately if a tornado is seen. If a tornado siren is sounded move immediately to safety indoors and then move to a windowless interior space, basement, stair well, or designated fall-out shelter. Windows should not be opened before an oncoming tornado. If there is no shelter available, seat belt yourself into your stationary vehicle or seek a depression or low spot on the land surface.

1.2.6 Snowfall and Ice Conditions

Working in the winter months will result in activities taking place during periods of snowfall or icy conditions. If you are working during or after snow has fallen, dress appropriately for the conditions. Snow and ice can cause working surfaces to become slippery. Clear snow and ice from work areas to prevent slip hazards. Use caution when performing snow or ice removal activities to prevent injuries. Driving in snowy and icy conditions is also hazardous. Reduce speed and use caution if you must drive in these conditions.

If the weather conditions deteriorate and you do not feel safe working in these conditions, stop work, move to a safe indoor location, and contact your Project Manager to let them know the weather, work conditions, and your location.

1.3 Limitations

Follow safety procedures as defined in the site-specific HASP. Appropriate PPE must be worn correctly to provide the intended level of protection. Protection extreme weather conditions can best be accomplished if the conditions are anticipated. Monitor local weather conditions prior to starting work.

1.4 References

Center for Disease Control and Prevention – Natural Disasters and Severe Weather
http://www.bt.cdc.gov/disasters/
National Lightning Safety Institute
NOAA, National Weather Service
Office of Climate, Water, and Weather Services

1.5 Attachment

None

1.6 Contact

GEI Corporate Health & Safety Officer
GEI East – North Regional Health & Safety Officer

GEI East – South Regional Health & Safety Officer
GEI Central Regional Health & Safety Officer
GEI West Regional Region Health & Safety Officer

STANDARD OPERATING PROCEDURES

SOP No. HS-012 Noise Exposures

1.1 Objective

Working in loud environments can cause hearing damage and loss if the proper protection is not in place. The following procedures describe methods to mitigate unhealthy noise levels and protect hearing.

1.2 General

This SOP is intended for use by employees engaged in work within loud environments. The site-specific health and safety plan (HASP) should include a hazard assessment for the project that identifies the potential for work in loud environments and the control methods to be implemented by GEI employees. These hazards should be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Health and Safety page of the GEI intranet.

Prior to working on a project, an Activity Analysis or Job Hazard Analysis will be performed by the Project Manager or their designee to evaluate the potential hazards and identify steps to be taken to protect workers from hazards. If projects involve high levels of noise from such sources as heavy equipment, power tools, pumps, generators, or other noise source employees should take steps to remove the noise exposure. GEI has an established Hearing Conservation Program located in the GEI Health and Safety Manual.

Hearing protection is required if noise levels in a work area are known to be above 85 decibels (dB), which can be measured with a noise meter. When decibel levels are not known, hearing protection is required if you need to raise your voice to talk to someone standing within a normal speaking distance from you.

The first option for employee protection from hazardous noise levels is to remove the hazard by taking away the source of the noise or using engineering controls to reduce the level. If this cannot be accomplished, the next control measure to be used is to remove the employee from the source. This can be done by moving the work area to a quieter location or distancing the employee from the noise source. For example, GEI employees do not need to be standing next to an operating drill rig or other heavy equipment, by distancing themselves from heavy equipment or other noise sources the need for hearing protection can be eliminated. The final option for employee protection is personal protective equipment (PPE). Disposable ear plugs are made available to GEI employees

and are to be used when required. Additional means of hearing protection will be provided, such as ear muffs, if the disposable ear plugs are not adequate.

Employees should be aware of surroundings such as moving equipment, traffic, and other site hazards when wearing hearing protection.

1.3 Proper Use of Hearing Protection

DISPOSABLE EAR PLUG FITTING INSTRUCTIONS

Before fitting any ear plugs, make sure your hands are clean.
Foam ear plugs are disposable and not intended for reuse.

Hold the ear plug between your thumb and forefinger. Roll and compress the entire ear plug to a small, crease-free cylinder. While still rolling, use your other hand to reach over your head and pull up and back on your outer ear. This straightens the ear canal, making way for a snug fit.



Insert the ear plug and hold for 20 to 30 seconds. This allows the ear plug to expand and fill your ear canal.



Test the fit. In a noisy environment, and with earplugs inserted, cup both hands over your ears and release. You should not notice a significant difference in the noise level. If the noise seems to lessen when your hands are cupped over your ears, your ear plugs are not fitted properly. Remove and refit following instructions.



Always remove ear plugs slowly, twisting them to break the seal. If you remove them too quickly, you could damage your ear drum.



REUSABLE EAR PLUG FITTING INSTRUCTIONS

Before fitting any ear plugs, make sure your hands are clean. Reach around your head and pull up and back on your outer ear. This straightens out the ear canal, making way for a snug fit.

Reusable ear plugs should be inspected and cleaned often in soapy water. If they become hard, torn, or deformed they should be replaced.

Hold the stem end of the ear plug and insert it well inside your ear canal until you feel it sealing and the fit is comfortable.



Test the fit. In a noisy environment, and with ear plugs inserted, cup both hands over your ears and release. You should not notice a significant difference in the noise level. If the noise seems to lessen when your hands are cupped over your ears, your ear plugs are not fitted properly. Remove and refit following instructions.



Always remove ear plugs slowly, twisting them to break the seal. If you remove them too quickly, you could damage your ear drum.



1.4 Limitations

Follow safety procedures as defined in the site-specific HASP. Appropriate PPE must be worn correctly to provide the intended level of protection.

1.5 References

OHSA 29 CFR 1910.95 – Occupational Noise Exposure
OHSA 29 CFR 1926.101 – Hearing Protection
Texas American Safety Company (TASCO)

1.6 Attachment

None

1.7 Contact

GEI Corporate Health & Safety Officer
GEI East – North Regional Health & Safety Officer
GEI East – South Regional Health & Safety Officer
GEI Central Regional Health & Safety Officer
GEI West Regional Region Health & Safety Officer

STANDARD OPERATING PROCEDURE

SOP HS-014 Utility Mark-out

1.1 Objective

This standard operating procedure (SOP) provides guidance for utility mark-out procedures related to drilling, excavation, or other sub-surface or intrusive activities to avoid injury to GEI employees or property damage. This SOP is applicable when GEI is responsible for its operation or our subcontractor's operation for utility mark-out.

Clients or local agencies may have additional requirements or procedures for the marking of utilities. If local utility mark-out procedures differ from those described within this SOP, applicable state or municipal regulations should be followed.

1.2 General

- This SOP is intended for use by employees engaged in work with sub-surface or intrusive activities. The site-specific health and safety plan (HASP) should include a hazard assessment for the project that identifies the potential for subsurface hazards and the control methods to be implemented by GEI employees. These hazards should be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Health and Safety page of the GEI intranet.
- The contractor or GEI employee visits the site and marks out each exploration area with white paint, flags, or stakes. Mark-outs will be performed wearing required PPE, including eye protection when using spray paint to perform the mark-out.
- Exploration locations should be marked out with sample identification number(s) and type of sample (e.g., boring, test-pit, or monitoring well).
- The contractor compiles information about the work areas on a request form specified by the state utility mark-out program and provides this information to the mark-out program call center with a phone call or electronic submittal. Work area location maps can be sent to the utility mark-out program to clarify locations.
- The mark-out program customer service representative will provide a mark-out ticket number and a list of utilities notified upon receipt of the request information. This information will be recorded on the GEI documentation form or in other project documents.

- If known, the contractor will also notify non-member utility operators (such as apartment complexes, commercial complexes, railroads with communication cables, etc.).
- Utility companies or their sub-contractors will only mark-out, or clear, utilities under their responsibility. Generally, this means that they will only mark-out utilities within the public right-of-way up to private property boundaries. Information needed to determine the location of utilities on private properties will be requested from the property owner. This may include available property drawings or as-built figures. If this information is not available, additional non-intrusive surveys of the property may be required by a private utility locator to find underground utilities by using techniques, including ground penetrating radar (GPR).
- American Public Works Association (APWA) Uniform Color Code For Marking Underground Utility Lines are:

    1. **White** – Proposed Excavation
    2. **Pink** – Temporary Survey Markings
    3. **Red** – Electric Power Lines, Cables, Conduit and Lighting Cables
    4. **Yellow** – Gas, Oil, Steam, Petroleum, and Gaseous Material
    5. **Orange** – Communications, Alarm, Signal Lines, Cables or Conduit
    6. **Blue** – Water
    7. **Purple** – Radioactive Materials
    8. **Green** – Sanitary and Storm Sewers and Drain Lines

- Before the intrusive work activities begin, the contractor will verify that each utility company has completed a utility location for the work area or the location has been cleared by a private locator and record this on the mark-out request information sheet.
- A visual survey of the project area will be done prior to the start of intrusive activities. This visual inspection will be done to identify signs, manholes, utility boxes, or other evidence of an underground utility is present and has been considered.
- The contractor can begin work on the scheduled work date and time if the utility operators have responded, taking care to find and preserve markings that have been made.
- Completed clearance documentation will be located on the excavation site during excavation activities and kept in project files.
- When excavating near a buried utility, observe the approximate location around that utility.

- If exposing a utility, proper support and protection must be provided so that the utility will not be damaged.
- If the excavation work requires significant spans of the utility to be exposed, it is the contractor's responsibility to support them (to prevent sagging or collapse) as needed. Contact the utility operator for support, guidance, or assistance.
- When the excavation is complete, provide proper backfill for utilities that have been exposed.

- Take care not to damage the conduit or protective coating of a utility. If the contractor damages this, leave the damaged utility exposed and immediately call the utility owner.
- If a gas line is contacted, the contractor must notify police, fire, and emergency personnel, and evacuate employees according to the site evacuation procedures. No attempt should be made to tamper with or correct the damaged utility.
- If the contractor/consultant needs to dig within the approximate location of a combustible, hazardous fluid, or gas line (natural gas, propane or gasoline), soft digging is required (hand digging, vacuum extraction) to a maximum depth of five feet. The approximate location is defined as 24 inches on either side of the designated center line of the utility if the diameter is not provided or 24 inches from each outside edge if the diameter is provided.

1.3 Limitations

- Follow safety procedures as defined in the site-specific HASP. Appropriate PPE must be worn correctly to provide the intended level of protection.
- Mark-out notification time usually does not include holidays. Make sure holidays are considered and mark-out time is scheduled accordingly. Under no circumstances are intrusive activities allowed to be performed prior to the required mark-out.
- Do not use white paint if precipitation is eminent. Consider using stakes if snow is predicted.

1.4 References

Reference the website for the "Call Before You Dig – 811" for the utility mark-out agency for the state you working in prior to site work. If you have issues locating the appropriate agency, contact the Health and Safety Committee for assistance.

1.5 Attachment

Attachment A – Standard Utility Color Codes
Attachment B – GEI Utility Clearance Documentation Form

1.6 Contact

GEI Corporate Health & Safety Officer
GEI East – North Regional Health & Safety Officer
GEI East – South Regional Health & Safety Officer
GEI Central Regional Health & Safety Officer
GEI West Regional Region Health & Safety Officer

COLOR CODE FOR UTILITY MARKING

(BASED ON 'THE AMERICAN PUBLIC WORKS ASSOCIATION' RECOMMENDATIONS AND THE ANSI STANDARD Z-53.1 FOR SAFETY COLORS)

UTILITY	COLOR
PROPOSED EXCAVATION	WHITE
ELECTRIC POWER LINES, CABLES, CONDUIT AND LIGHTING CABLES	RED
POTABLE WATER	BLUE
STEAM, CONDENSATE, GAS OR OIL COMPRESSED AIR	YELLOW
TELECOMMUNICATIONS, ALARM OR SIGNAL LINES, CABLES OR CONDUIT	ORANGE
TEMPORARY SURVEY MARKINGS	PINK
SEWER AND STORM DRAINS	GREEN
CHILLED WATER, RECLAIMED WATER, IRRIGATION AND SLURRY LINES	PURPLE
OTHER	LIGHT BLUE

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Utility Clearance Documentation

Client: _____

Project: _____

Site: _____

Excavation/Drilling Location ID: _____

Excavator/Driller: _____

GEI PM: _____

GEI Field Team Leader: _____

Utility Drawings Reviewed: _____

Provided By: _____

Reviewed By: _____

Utility Clearance Call Date: _____

Utility Clearance Received back from (list utilities): _____

Completed By (Company): _____ Date: _____

GEI Staff Responsible for Oversight: _____

Metal Detector Survey (yes/no): _____

Drilling Location Cleared by: _____

Contractor: _____ Date: _____

GEI Staff Responsible for Oversight: _____

Private Location Clearance Required (yes/no): _____

Contractor: _____ Date: _____

Methods used for utility location (i.e. GPR, electronic pipe location) _____

GEI Staff Responsible for Oversight: _____

Hand clearing Performed: _____ Date: _____

Contractor: _____

GEI Staff Responsible for Oversight: _____

Notes: _____

Based upon the best available information, appropriate utility clearance procedures were performed for the invasive work specified. If client ordered/site specific deviations from existing GEI utility clearance procedures exist, they are approved by the client signature below.

Client Signature (Optional): _____ Date: _____

GEI, Inc. Representative: _____ Date: _____

STANDARD OPERATING PROCEDURES

SOP No. HS-016 Traffic Hazard Management

1.1 Objective

The objective of this standard operating procedure (SOP) is to prevent or limit the potential for GEI personnel to encounter traffic hazards during field activities.

1.2 General

This SOP is intended for use by employees engaged in work with the potential for traffic hazards. The site-specific health and safety plan (HASP) should include a hazard assessment for the project that identifies the potential for exposure to traffic hazards and the control methods to be implemented by GEI employees. These hazards should be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Health and Safety page of the GEI intranet.

1.3 Traffic Hazard Management

Traffic Hazard Management is the process of identifying and managing the potential risks associated with the movement of traffic through, around, or past a work area. This Traffic Hazard Management SOP is designed to assist employees in identifying and managing these hazards. Work areas should be as safe as possible. It is the responsibility of GEI employees to follow the Traffic Hazard Management plan and adhere to these safety standards. Safety is not negotiable.

Under no circumstances are GEI employees permitted to commence work in a situation that they feel puts their health and safety, or the health and safety of others, at risk.

Major risk factors for work site Traffic Hazard Management include:

- The speed of traffic past or through a work site.
- The clearance between moving traffic, workers, vehicles and equipment, and over-head power lines.
- Traffic volume and vehicle composition.
- Nature and conditions at the work site and approaches to the work site.
- Other factors such as the time of day, sight distance, weather, presence of pedestrians, or cyclists, and the type of work being carried out.

- Other hazards in proximity to the work site (e.g., power lines, open excavations) that may have conflicting measures needing to be considered when developing the plan.

1.4 Site Preparation

The following management measures will be considered whenever working in traffic areas. In addition, remain aware of the amount of traffic around the working area. The work space should be large enough for the job to be completed safely. Check permit, traffic control plans, and flagger/police detail requirements for the local jurisdiction. Perform routine checks of the work zone to make sure there are adequate levels of protection.

1.4.1 Warning Cones and Warning Signs

GEI employees will comply with the Department of Transportation's (DOT) Manual on Uniformed Traffic Control Devices (MUTCD) and/or state regulations for temporary traffic barriers (cones, barriers) and sign placement when required for working in traffic areas. Clearly define the work site by placing traffic barriers around the work space to indicate the space that is needed to safely perform the work. The traffic barrier will help make the work site more visible to other workers and moving vehicles. Place traffic barriers to give yourself adequate space to work, so equipment is not outside the space. OSHA suggests placing the first warning sign at a distance calculated to be 4 to 8 times (in feet) the speed limit (in MPH).

1.4.2 Adequate Light

Requirements for night conditions and work areas with poor visibility are similar to day requirements; however there are a number of additional things to consider, such as visibility of the work site to advancing traffic and sufficient lighting. OSHA requires lighting for workers on foot and equipment operators to be at least 5 foot-candles or greater.

Visibility of the work area can be increased by employing the following measures:

- Using parked vehicles hazard and flashing lights.
- Wearing reflective safety vest that is in good condition.
- Providing adequate lighting to illuminate the work area. This lighting should be positioned so that there is no glare to approaching drivers.
- Placing advance warning signs and cones with retro reflective stripes so that they are visible to road users.

1.4.3 Distance from the Nearest Traffic Lane

Work areas located along roadsides will have a minimum clearance as defined by DOT's MUTCD and/or state or local DOT regulations for cone and sign placement.

1.4.4 PPE

The proper personal protective equipment (PPE), as outlined in the project HASP, will be worn when appropriate. The color/type of safety vest will comply with site regulations.

1.5 Equipment Operation

Vehicles and heavy equipment operators should use a spotter when possible if it is necessary to drive in reverse to reduce risk of collision with oncoming traffic. If it is necessary to drive against the flow of traffic make sure this area is within the work zone and properly blocked off from oncoming traffic.

1.6 Pedestrian Safety

When working near pedestrian traffic, a safe walkway will be established. Refer to local regulations when establishing pedestrian walkways.

1.7 Limitations

Follow safety procedures as defined in the site-specific HASP, federal DOT, and local jurisdictions. Appropriate PPE must be worn correctly to provide the intended level of protection.

1.8 References

DOT's Manual on Uniformed Traffic Control Devices (2009 Edition)
https://www.osha.gov/SLTC/etools/hurricane/work-zone.html

1.9 Attachments

None

1.10 Contact

GEI Corporate Health and Safety Officer
GEI East-North Regional Health and Safety Officer
GEI East-South Regional Health and Safety Officer
GEI Mid-West Regional Health and Safety Officer

GEI Western Regional Health and Safety Officer

STANDARD OPERATING PROCEDURES

SOP No. HS-018 Working Around Heavy Equipment

1.1 Objective

The objective of this standard operating procedure (SOP) is to prevent or limit the physical hazards when working around heavy equipment for GEI personnel.

1.2 General

This SOP is intended for use by employees engaged in work with the potential for working near heavy equipment. The site-specific health and safety plan (HASP) should include a hazard assessment for the project for working near heavy equipment to be implemented by GEI employees. These hazards should be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Health and Safety page of the GEI intranet.

1.3 Heavy Equipment

Heavy equipment (excavators, backhoes, drill rigs, etc.), can present many physical hazards that can result in serious injury or death if the proper safety precautions are not followed. The following is a list of precautions to be aware of when working around heavy equipment:

- Wear appropriate personal protective equipment (PPE), including a reflective, high-visibility safety vest.
- Always keep your distance from moving vehicles.
- Do not assume the vehicle operator knows where you are or where you are going. Make sure to make eye contact and receive acknowledgement of your presence with the operator. Avoid working near heavy equipment, but if unavoidable, communicate your location with the heavy equipment operators. If using hand signals, discuss the signals with the equipment operator prior to starting work.
- Watch for moving equipment. Construction sites can have a lot of activity and vehicles may be moving closer than you may think.
- Do not rely on back-up or other alarms. They may not be working or you may not hear them with the noise of other activities taking place in the area.
- Stay out of the swing radius of cranes, excavators, or other equipment that swings or rotates.
- Do not walk beside a moving vehicle, the vehicle may turn, slip, or the load may shift causing the vehicle to go off course.

- Do not ride on the outside of a moving vehicle.
- Always stay out from under a suspended load on cranes or hoists, even if it means taking the long way around.
- Do not walk behind a piece of equipment that is backing up. The operator may not see you.
- If working next to heavy equipment is unavoidable, be aware of the hazards including pinch points and moving parts. Use a spotter to watch the work area for moving equipment.
- If necessary, ask the operator to stop equipment operation to perform your work tasks.
- Verify the location and operation of emergency shut-off devices on the equipment.
- Be aware of the fuels and chemicals associated with the equipment. Have a spill prevention and response plan in place that includes the appropriate containment materials (i.e., spill kit).
- Do not wear loose fitting clothing when working around moving equipment (i.e., drill rig augers).
- Do not operate heavy equipment.
- Do not use cellular telephones near operating equipment.

1.4 Limitations

Follow safety procedures as defined in the site-specific HASP. Appropriate PPE must be worn correctly to provide the intended level of protection.

1.5 References

OSHA 29 CFR 1926.600 – Subpart O; Motor Vehicles, Mechanized Equipment, and Marine Operations.
www.*toolboxtopics.com*/Construction
Caterpillar Safety – http://safety.cat.com/

1.6 Attachment

None

1.7 Contact

GEI Corporate Health & Safety Officer
GEI East – North Regional Health & Safety Officer
GEI East – South Regional Health & Safety Officer
GEI Central Regional Health & Safety Officer
GEI West Regional Region Health & Safety Officer

STANDARD OPERATING PROCEDURES

SOP No. HS-025 Manual Lifting

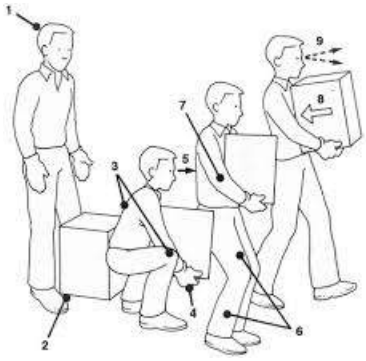
1.1 Objective

The purpose of the GEI Consultants, Inc. (GEI) Manual Lifting SOP is to identify and reduce potential work-related musculoskeletal disorder (WMSD) hazards. The SOP is intended to comply with state regulations and safe work practices developed by the Occupational Safety and Health Administration (OSHA). Modifications to meet these requirements will be made to this program as changing laws or regulations dictate.

1.2 General

The following Safe Lifting guidelines will be followed by GEI employees involved in manual lifting activities:

- Before manual lifting is performed, a hazard assessment must be completed. The assessment must consider size, bulk, and weight of the object(s), if mechanical lifting equipment is required, if two-man lift is required, whether vision is obscured while carrying and the walking surface and path where the object is to be carried.
- Get a co-worker to help if equipment or other item is too heavy to lift.
- If possible, use powered equipment instead of manually lifting heavy materials. Lifting equipment such as dollies, hand trucks, lift-assist devices, jacks, or carts can be provided for employees.
- Reduce lifts from shoulder height and from floor height by repositioning the shelf or bin.
- Make sure walkways are clear of tripping hazards before moving materials.
- Use your legs and keep your back in a natural position while lifting. Keep the load close to your torso.



- Test the load to be lifted to estimate its weight, size, and bulk and to determine the proper lifting method.

- Do not twist while carrying a load. Instead, shift your feet and take small steps in the direction you want to turn.
- Make sure there are appropriately marked and sufficiently safe clearances for aisles and at loading docks or passageways where mechanical-handling equipment is used.
- Properly stack loose or unboxed materials which might fall from a pile by blocking, interlocking, or limiting the height of the pile to prevent falling hazards.
- Bags, containers, bundles, etc. should be stored in tiers that are stacked, blocked, interlocked, and limited in height so that they are stable and secure to prevent sliding or collapse.
- Storage areas should be kept free from accumulation of materials that could lead to tripping, fire, or explosion.
- Work methods and stations should be designed to minimize the distance between the person and the object being handled.

Supervision must periodically evaluate work areas and employees' work techniques to assess the potential for and prevention of injuries. New operations should be evaluated to engineer out hazards before work processes are implemented.

1.3 Injury Reporting

Injuries experienced during manual lifting activities should receive prompt medical attention. If a GEI employee suffers an injury on the job, he/she is to report the injury to their immediate supervisor within 2 hours of the incident. The supervisor will immediately notify the CSHO and Director of Human Resources.

After verbal notification has been made, an Incident and Accident Report Form is to be completed by the employee and/or Project Manager and submitted to Human Resources and the CHSO within 24 hours of its occurrence. This form is available on the Health and Safety site on the GEI Intranet.

Upon notification from a Branch or Office Manager, Human Resources, and/or the receipt of the Incident and Accident Report Form, the CHSO and/or the RHSO will conduct an investigation and evaluation of the incident and the incident response. Information received will be analyzed for the hazards and risk factors associated with the incident. The CHSO will then recommend (as necessary) engineering controls, PPE, training or other appropriate measures to minimize the potential for future musculoskeletal injuries. The CHSO/RHSO will develop educational information based on lessons learned for distribution to GEI employees.

1.4 Training

Training will include general principles of ergonomics, correct maul lifting training to avoid musculoskeletal injuries, recognition of hazards and injuries, procedures for reporting hazardous conditions, and methods and procedures for early reporting of injuries.

1.5 Ergonomic Evaluation Process

1.5.1 Requesting an Evaluation

An evaluation can be requested by the employee if they have concerns about their workstation, tasks, or are experiencing discomfort while working. The employee can request an evaluation by directly contacting their supervisor, Branch Manager, RHSO, HR or the CHSO via email. The Branch Manager will be notified of the requested evaluation. The Coordinator will send the Worksheet to the employee, who will complete it and return it to the Coordinator. The Coordinator will review the Worksheet and suggest modifications to the employee. If these modifications do not resolve the issue, the Coordinator will then schedule an in-person evaluation with the employee. If an employee is experiencing discomfort at their workstation and a request for an evaluation has been made, the evaluation will occur as soon as possible to assist the employee. If the Coordinator is not available another Coordinator will be assigned the evaluation.

Coordinators will be trained to treat the information obtained during the evaluation as confidential. If there are concerns the employee does not wish to discuss with the Coordinator due to their personal nature, a representative from HR will be designated to assist with the evaluation.

1.5.2 Job Hazard Analysis

Once the evaluation has been scheduled, the Coordinator will meet with the employee at their workstation and conduct the interview and review their work area. The Ergonomic Evaluation Checklist will help guide the Coordinator through a series of questions to help evaluate the potential ergonomic safety concerns. The evaluation is designed to be a conversation between the employee and Coordinator to help develop an open dialog. During the evaluation the Coordinator will identify ergonomic risk factors and implement immediate corrective actions, if possible. In many cases, simple adjustments can be made to the work station using existing equipment. Ergonomic work practices including “ergo breaks” and stretching can also be recommended.

1.5.3 Corrective Actions

During the evaluation the Coordinator may suggest adjustments that can be made to the existing work station. The employee will be encouraged to adopt the suggestions but ultimately has the choice to accept and implement them. Once the evaluation has been completed, the Coordinator will review the evaluation and if there are concerns, they will evaluate them with the HSC. Once the HSC has discussed the evaluation and developed corrective actions, they will be documented on the Checklist. The corrective actions will be shared with the employee and the Branch Manager. Prior to equipment purchases, approval will be authorized by the local branch manager.

Broken equipment will be taken out of service, properly disposed of and replaced. If improper equipment is being used, the proper equipment will be obtained or purchased with approval. If the employee's workspace presents a hazardous condition (fire hazards, trip hazards, noise exposure, etc.) the hazard will be corrected, if possible, or the employee will be moved to a safe workspace. If the equipment being used is not an appropriate fit for the employee, a suggestion will be made in the evaluation report to obtain or purchase the equipment that fits the employee properly.

If a repetitive task is identified, options will be discussed with the Branch Manager, the HSC and/or other appropriate personnel to evaluate whether the task can be altered to facilitate a safer condition. Many times accelerated deadlines, apprehension, or lack of options cause an employee to believe they don't have a choice and will just push through to complete the task potentially causing an ergonomic injury. These types of situations need to be recognized and corrected. A proactive approach by both the Branch Manager and employee should be instituted to prevent or anticipate these situations so that the correct equipment, additional employees or better planning can be incorporated while still meeting the deadline.

The organization of the workspace is also an important ergonomic factor. Items should be placed so that frequently used equipment is within arm's reach and located on the correct side of the body for which that equipment is used to prevent unnecessary twisting or reaching. Having adequate space to complete tasks is necessary but may not be achieved if piles and unnecessary items occupy the space. The Coordinator can suggest how to take advantage of tools and organizational skills to free up space.

Other areas of concern may be outside factors that occur away from the office. If the employee conducts field work, the tasks should be completed with ergonomics in mind.

A separate evaluation of these tasks may be conducted to determine if a different process or equipment may be used to reduce any unnecessary pressure or fatigue to the employee's body. At times when employees have permission to work from home or use their GEI computers at home, in hotels while traveling, in an environment that is not ergonomically correct, employees will be encouraged to adopt the ergonomic recommendations they learn at work.

Employee's hobbies can also pose ergonomic risks. Hobbies that involve repetitive motions, prolonged postures, vibration, excessive force/overexertion and adverse environmental factors may cause ergonomic injuries that can be aggravated at work.

During the interview process, the Coordinator will try to identify these risks and discuss techniques to help alleviate discomfort and minimize additional injury. It will be up to the employee to modify anon-related work risks.

If an employee is experiencing discomfort, efforts will be made to alleviate the discomfort while at work. For example, if an employee has a physical injury that occurred outside of work that requires them to keep their leg elevated, the employee can work with their Coordinator to determine a solution. This may involve temporarily modifying their workstation or transferring to another workstation. Healthy work practices and generally good health are keys to staying comfortable at work too. Regular stretch breaks, good posture, vision check-ups, good sleep habits and maintaining a healthy weight are factors in creating a comfortable work environment. If a physical non-work related problem persists and impedes the employee from being effective at work, suggestions may be made to see a personal physician for further advice.

1.5.4 Reporting and Follow-up

Once the evaluation has been completed and the Coordinator's suggestions have been implemented, the Coordinator will document the findings on the Checklist and an evaluation report will be completed and submitted to the employee, the evaluated employee's Branch Manager, and the CHSO. Then a follow-up will be conducted by the Coordinator to evaluate whether the adjustments were successful. The timeline for follow-up will be based on the adjustments suggested and employed. If new equipment is installed, the Coordinator will follow-up after the equipment has been installed and the employee has had time to adjust to it. If an injury has been identified, the Coordinator will notify the Branch Manager and CHSO immediately following the evaluation. This will confirm on-going management of the injury.

During the follow-up evaluation the Coordinator will make visits to the employee's workstation and assess visually and through interviews determine how the changes have been received. Each of these follow-ups will be documented on the Checklist. If during the follow-up a re-adjustment or different equipment is needed, the reevaluation process will continue until the employee is comfortable.

1.6 Limitations

Follow safety procedures for manual lifting.

1.7 References

OSHA Technical Manual (OTM), Section VII: Chapter 1 - Back Disorders And Injuries

1.8 Attachments

None

1.9 Contact

GEI Corporate Health & Safety Officer
GEI East – North Regional Health & Safety Officer
GEI East – South Regional Health & Safety Officer
GEI Central Regional Health & Safety Officer
GEI West Regional Region Health & Safety Officer

Appendix F

National Grid, Contractor Safety Requirements

FOREWORD

National Grid's vision is to be a world-class safety organization with zero injuries every day. This includes working to help ensure the safety of our employees, contractors and the community. National Grid is committed to delivering operational excellence, including excellent levels of safety internally and in cooperation with the external contractors we rely on.

The Executive Safety Committee provides review and input for Safety Policies and Procedures through the Safety Policies and Procedures Subcommittee.

The Safety department is the owner of this procedure and is responsible for maintaining and implementing this procedure, soliciting comments from stakeholders and revising as necessary.

This document, "Contractor Safety Requirements", represents the current contractor safety requirements that are unique to operations and various functional groups at National Grid. This document does not specifically reference actions that are required by OSHA, other laws, rules, or regulations. These are requirements that should be understood by the contractor and contractor compliance with all applicable federal, state and local laws, rules, and regulations is expected by National Grid as a contractual condition.

Questions regarding this procedure should be referred to the National Grid Safety Department.

This document will be updated as necessary to communicate all aspects of National Grid's contractor safety to bidders, current contractors and to reflect changes in National Grid's Safety Policies and Procedures.

Date of Review/Revision:

Revision	Date	Description
1	8/5/2004	Initial
2	3/2/2005	Additions
3	1/30/2007	Additions
4	8/1/2008	Additions
5	8/1/2010	Additions
6	2/1/2011	Audit recommendations included

Date of Review/Revision Continued:

Revision	Date	Description
7	9/11/2013	Additions included OH; technical changes; Compliance Monitoring; Ethics; Job Briefs
8	11/2/2015	Additions include Audit & IA recommendations; ISN alignment; technical changes, 1910. 269 updates
9	8/17/2016	Format update and technical changes
10	3/29/2017	Additions to sections 2.2.6 and 6.5
11	2/26/2018	Process Safety, PM&CC Electric and PM&CC Vegetation Additions
12	3/12/2019	Contaminated Site Work Additions
13	10/24/2019	Job brief, Hi-Vis clothing, ladder use, and air gap revisions
14	1/13/2020	Hi-Vis clothing and ladder use revisions; Fatigue Risk Addition in HASPs
15	3/10/2021	EH rated work boot and Dielectric (DI) footwear definitions and requirements; OSHA 1910.136(a) reference; requirement not to wear loose clothing; Hi-Vis vest or garment requirements
16	3/24/2021	One HASP form; HASP revisions; self-assessments; qualifications; and notice of subcontractors

17	6/14/2021	Loose garments/items for heavy equipment operators revision; addition of heavy equipment definition
18	5/4/2022	Removed requirements to upload contractor orientation/pre-construction meeting documents to ISN; Removed requirement to upload forestry training qualifications to ISN; Clarified that medium/high risk contractors acknowledge N1402 requirements by signing the N1402 acknowledgment form in ISN; Added additional examples to the medium/high risk exposure category; Revised the pre-construction meeting/contractor orientation requirement from “may” to “shall”; Changed Corporate Safety team references to Safety Policies & Programs

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1.0 CONTRACTOR SAFETY AT NATIONAL GRID

1.1 Definitions

Adverse Public Impact
Incident that disrupts service to the public or results in adverse public reaction.

Bulk Commodity Transportation
Activities involved in the movement of bulk commodities via truck, rail, plane or water vessel onsite and offsite on behalf of National Grid that if released could have safety and / or environmental consequences. Examples include but are not limited to: gasoline, oil, boiler chemicals, LNG, Nitrogen.

Compliance Assessments (CAs)
An act of observing and engaging in discussion with employees at a job site or work area locations. Compliance Assessments are documented using the Compliance Assessment checklist for each segment of operation and are not considered anonymous. Compliance Assessments are utilized to comply with internal policy and external regulatory requirements.

Contracted Services
Contracted Services refers to any activity that is conducted by an organization or individual under the terms of a purchase order or through other financial arrangements (Procurement Card or credit card) between a National Grid representative and a contractor. Contracted services may include all types of construction and maintenance services, tree trimming, building maintenance and demolition, electrical structure dismantling, site restoration, engineering design, recycling and waste disposal, drilling, rigging, electrical, and utility pole/structure maintenance.

Contractor
An independent person or company that undertakes a contract to provide materials or labor to perform a service or do a job and are responsible for the safety of his/her employees and subcontractors.

Contractor Orientation
Contractor orientation is intended to serve as a resource in order to provide the contractor with the tools necessary to educate their employees and subcontractors. The session is not intended to train the contractor management, their employees or subcontractors. The extent and content of the orientation session shall be commensurate with the scope and type of the contractor's activities.

Dielectric (DI) Footwear
This term describes either boots or overshoes that are labeled in accordance with ASTM F1117, marked clearly and permanently with the name of the manufacturer or supplier, the size and AC voltage rating. The footwear shall meet dielectric strength testing prescribed in ASTM F1116. Dielectric footwear shall have a minimum rating of 15kV.

Effective Safety Discussion (ESD)
A discussion with an individual or group about their safety programs, issues or concerns (safety plans, tools, equipment, procedures, etc.). They are safety discussions amongst employees that share similar work environments…office to office, field to field.

EH Rated Work Boot
ASTM F2413 EH rated work boots are the minimum foot protection standard. This boot protects against impact, compression, and low voltage exposure.

Health & Safety Plan (HASP)
Contractors who perform high or medium risk-ranked services shall submit a project-specific HASP prior to the start of the project. In this plan, the contractor shall identify all significant tasks, their anticipated hazards and mitigation steps.

Hazardous Conditions
A condition that can and is rectified immediately by the person who identified the hazard.

Heavy Equipment
Maintenance and construction equipment including excavators, compact (mini) excavators, backhoe loaders, towable compact backhoes, front end loaders, skid-steer loaders, compact loaders, digger derricks, boom trucks, cranes and bulldozers.

Incident
An unplanned event that has a human component and results in or could potentially result in harm to people, damage to property and/or adverse public impact.

Incident Management System (IMS)
National Grid's online incident management tool that allows the company to report safety, environmental and asset-related incidents, perform incident analysis, generate safety reports and monitor the organization's safety performance.

ISNetworld, Inc. (ISN or ISN System)
Third party contractor that is a global resource for connecting Hiring Clients with safe and reliable contractors and is a contractor information management system currently contracted with National Grid.

Job Brief
A planned interactive discussion that covers, but is not limited to, potential hazards associated with the job including situational awareness (assets or other items which may impact the job at hand), work procedures involved, special precautions, and personal protective equipment requirements. The discussion should include all contractor employees, sub-contractors and team members working on a job that occurs just prior to a job, task or project. A new job brief shall be conducted for each of the following events: prior to a change in planned work specific to the job site, changes in weather conditions, extended breaks (i.e. lunch breaks) or when a new worker or company joins the crew. When possible and reasonably practical, a National Grid Representative should be present at contractor job briefings. Truck drivers for daily, non-hazardous material deliveries such as stone, gravel, concrete material or porta john cleaning are exempt from completing a job brief unless there are potential hazards associated to the driver or delivery. A National Grid representative shall talk to the driver to determine if a job brief is needed.

Major Hazard Asset (MHA)
A class of assets at National Grid, including Compressed Natural Gas (CNG), Gas Transmission (≥ 125 psig), Power Generation sites, Liquefied Natural Gas (LNG) plants, and LNG Trucking, in which any condition, or set of conditions, presents potential for a major accident to occur. Also referred to as process safety assets.

Major Accident
An event involving the release of potentially dangerous materials, the sudden and uncontrolled release of large amounts of energy (such as fires and explosions), or both. These can have catastrophic effects and can result in multiple injuries and fatalities, as well as substantial reputational, economic, property, and environmental damage

Operator Qualification (OQ)
As defined in the Code of Federal Regulations, Transportation, 49 Subpart 192.801 through 192.809 and/or DOT pipeline qualified for gas contractors doing work at National Grid. Additional state requirements pursuant to the state the contractor is working may be required.

Process Safety Management
Method of focusing and mitigating concerns of major hazards impacting safety, environmental damage and business losses. It is an organized effort to identify and analyze the significance of hazardous situations associated with a process or activity to aid management in making critical safety decisions

Project Representative
National Grid Owner's Representative or designee who is assigned to certain contracted projects and communicates regularly with the contractor during the course of the contracted service. This person also ensures the work is being performed in accordance with the contract, including the safety requirements.

Purchase Order (P.O.)
An agreement/contract between National Grid and a contractor to provide services and/or materials. The P.O. is set up by Procurement. The term "Contract" and "P.O." are similar and may be used interchangeably. A "Blanket P.O." is set up for contractors whose work is on-going. A "one-time P.O." is set up for project work.

Qualified Electrical Worker
Those who are knowledgeable in the construction and operation of the electric power generation, transmission and/or distribution equipment involved, along with the associated hazards.

Qualified Gas Worker
Any contractor who performs covered tasks in accordance with National Grid's Operator Qualification Program and the Northeast Gas Association are required to be knowledgeable and meet all regulatory standards.

Risk Assessment
A risk assessment is the process of identifying hazards and calculating or ranking the associated risks according to: the likelihood of occurrence, the severity of the harm from the hazard, and the amount of time of exposure to the hazard.

Safety Observer
A person who is responsible for alerting the work team to any potential unsafe conditions or lack of compliance with approved work practices, procedures or guidelines.

Transportation Advisor
Third party agency specializing in federal and company mandated drug and alcohol testing programs.

1.2 Introduction

Safety performance is a prime consideration in the selection of contractors. National Grid will stipulate safety performance requirements and responsibilities in our contracts, purchase orders (POs) and will hold the contractor accountable for meeting the contractual requirements.

National Grid's goal is to establish a long-term working relationship with contractors who share the same safety values and demonstrate those values through their work performance.

Contractor safety at National Grid involves three broad areas:

1. **The Contractor Procurement (Selection) Process**
   Contractor safety begins with the selection of contractors who have demonstrated a strong safety record. National Grid will complete a review during the procurement process that involves determining a contractors' risk and the scope(s) of work involved. National Grid currently uses ISNetworld, Inc. as a third (3rd) party assessment process for assisting with contractor procurement. The 3rd party entity will vet and continually monitor individual contractors' compliance with applicable safety and/or risk and insurance program requirements.

2. **Safety Communication**
   Safety communication covers all the avenues and forums in which National Grid and the contractor communicates safety. Communication begins early in the bidding phase and is on-going as an integral part of the contractor-customer relationship. The goal is to ensure clarity, transparency and to limit misunderstandings.

3. **Safety Compliance**
   Safety compliance is the process of ensuring that the necessary technical provisions of the contract are being followed. National Grid will assign a project representative or other designee to provide guidance and oversight. The Contractor is responsible for their employees and subcontractors and shall be held accountable for ensuring compliance with all applicable safety rules while working on National Grid property, rights of way (ROWs) and our assets. Primary contractors are required to notify National Grid of any subcontractors and ensure that there is an appropriate contractual relationship in place in line with the terms and conditions of their contract.

1.3 Risk Ranking of Work

1. National Grid characterizes and ranks risk by the scopes of work performed. The categories are classified as high, medium or low risk. Prior to being considered for work at National Grid, contractors who perform High or Medium Risk work must be pre-qualified in ISN. See Appendix A for more information regarding the National Grid Contractor Risk Matrix.

2. Activities that are designated as “high risk” means that catastrophic event can result if safety measures are not followed. Activities designated as “medium” risk present certain opportunities for moderate to significant injuries, property or reputational damage, and/or loss of service and/or possibly business continuity. Activities designated as “low” risk may still require safety compliance and control measures, although the contractor performing the work does not necessarily need to be enrolled in ISN, if that is the only classification of work that contractor performs for National Grid.

3. The designation High Risk, Medium Risk, or Low Risk, refers only to the inherent risk associated with the work activity and is not an opinion on the ability of a contractor to work safely.

4. If ,at any time, the risk changes from low to medium/high, per the risk matrix, then the medium/high risk process shall be followed. It’s the contractor’s responsibility to identify if the risk changed and to escalate to National Grid personnel.

5. The Procurement Agent will notify the bidder/contractor at the beginning of the procurement process if their contracted service has been ranked as high or medium risk.

1.4 Bidder Information Request – High and Medium Risk Work

1. Any contractor bidding on high or medium risk work shall be required to complete a questionnaire regarding the Contractor’s safety program, compliance and history of occupational illnesses and injuries (ISNetworld New Vendor Onboarding application form, located on the ISNetworld website). Contractors will also be required to demonstrate in ISN that all employees, including subcontractors, are qualified to perform the scope of services.

2. ISNetworld then thoroughly reviews contractors’ qualifications against a prerequisite list of National Grid criteria. National Grid has established that contractors performing high or medium risk work MUST HAVE and MAINTAIN a grade of “C” or better in the ISN system to perform work and services for National Grid. ISN will track and manage the National Grid pre-

qualified contractor bidder lists. This bidder list is the first step for a contractor in establishing a working relationship with National Grid. For active ISN contractors, ISN will request updated information monthly. Contractors who do not have a current PO, contract, or authorized scope of work with National Grid will be considered as a Prospective bidder and will be asked to submit information quarterly. It is understood that insurance may not be maintained within National Grid standards, however, once a contractor is awarded a contract, proper and adequate insurance must be provided to ISNetworld to achieve a passing grade. Lack of insurance or inadequate insurance is an immediate "F" grade in the ISN system per National Grid criteria.

3. Project representatives may request an exemption or variance from requiring a contractor to be placed in ISNetworld for various reasons. A Supplier Exemption Request form (located in the safety policies and procedures section of Grid:home) shall be completed, documented and signed by the business unit VP and Safety Policies & Programs Director prior to contract award.

4. The information that the Bidder provides National Grid via ISN serves as the basis for assessing safety qualification. For this reason, it is important for contractors to maintain transparency throughout the process. National Grid and ISN will review all submitted information. Any effort in avoiding complete disclosure will disqualify the Bidder from bidding work at National Grid.

1.5 Safety Compliance

1. Medium/high risk contractors certify that they have been informed of National Grid safety requirements, that employees and subcontractors have the appropriate qualifications to perform the work, and agree to comply with all applicable safety requirements. This will be accomplished by the contractor signing the N-1402 Contractor Safety Requirements Acknowledgment Form in ISN annually and when there are revisions to N-1402.

2. National Grid representatives evaluate contractor compliance by conducting routine site visits, Compliance Assessments (CA's), Effective Safety Discussion (ESD) visits and attending periodic contractor safety meetings. Contractors should also perform and document safety self-assessments to ensure compliance to federal, state, local and National Grid regulations. This combined effort enhances, solidifies safety compliance and has the added benefit of quality control / quality assurance of the work performed.

3. Contractors bidding on new work shall provide worker qualifications to the National Grid procurement representative via the “Bidder Information Request” form and/or ISN National Grid On-boarding form.

4. If a safety violation is observed by a National Grid representative, the violation will be discussed with the contractor at the time of discovery.

5. Contractor employees enrolled in ISNetworld that are involved in any accident, incident or significant near-miss event, will be required to lead an investigation and root cause determination process. In addition, the contractor must implement corrective actions and establish measures to prevent a recurrence through an incident investigation process and document the details within ISN.

6. Individual contractor personnel who habitually violate any safety rules should be identified, and the contractor should remove the individual(s) from the project. National Grid reserves the right to remove any contractor employee(s) who violate safety rules or procedures; pose a safety risk to themselves, other contractors; our employees; or the general public.

7. If a contractor is observed to be operating in a manner that creates an imminent danger to persons or property, it is the responsibility of all individuals observing the hazard to cease the hazardous operation impacted until the issue has been resolved to the satisfaction of National Grid, the Owners Representative or Safety Representative.

8. Contracts/POs shall require the contractor to immediately forward any citations, notices, or OSHA reportable cases per 29 CFR 1904.39 from a National Grid project, upon receipt to the appropriate project representative and/or ISN. The project representative shall distribute copies of the citation or notice to senior management, Safety, Procurement, and the Legal Department.

9. Willful and/or repeat violations of safety requirements by the contractor may be considered a breach of the contract and reason for contract termination.

10. If the contractor’s overall safety performance is viewed as being unsatisfactory or noncompliant with contract provisions, and if the contractor is unwilling to demonstrate satisfactory program improvement, the result may be considered a breach of the contract and reason for contract termination.

11. National Grid project managers and/or construction supervisors shall document safety compliance by completing a “Contractor Performance Evaluation” for each project. This documents both positive and negative

safety performance or behaviors and this feedback will be used in the decision process for awarding future contracts.

2.0 GENERAL SAFETY REQUIREMENTS

2.1 Introduction

1. All contractors are required, and expected to comply with all applicable requirements of the Occupational Safety and Health Administration (OSHA), and all other applicable federal, state and local laws, ordinances, regulations, and other project and site-specific permits unless superseded by identified National Grid procedures.

2. This document represents policies and safety-related work methods unique to National Grid and they may be more stringent than OSHA regulations. Contractors must follow these requirements as well as their own rules or regulations that meet or exceed OSHA and other regulatory requirements.

3. National Grid will provide more detailed information and guidance regarding specific procedures prior to commencement of work.

4. Per OSHA 1910.136(a) general requirements, the employer shall ensure that each affected employee uses protective footwear when working in areas where there is a danger of foot injuries due to falling or rolling objects, or objects piercing the sole, or when the use of protective footwear will protect the affected employee from an electrical hazard, such as a static-discharge or electric-shock hazard, that remains after the employer takes other necessary protective measures.

2.2 Applicability

Applies to: All contractors, as needed

1. In any contracted task, where a safety observer is required, it is the responsibility of the contractor to provide that person and ensure that he/she is qualified to perform the role when needed.

2. A 4:1 pitch shall be maintained when using an extension ladder or the ladder shall be tied off and/or secured and 3 points of contact shall be maintained by the climber. If both hands are needed to perform work, then fall protection is required.

3. Although not preferred, if hard hats are worn backwards, the suspension adjuster must always face the rear. Class E hard hats are required for all electrical work.

4. ASTM F1117 Dielectric (DI) footwear is required when:
    - Workers on the ground are working within 50’ of the master ground connection point to earth.
    - Operating a wire trailer and pulling/tensioning machine.
    - Operating a winch truck or reel trailer with its payout in an energized area that may result in inadvertent contact.
    - Hand digging in close proximity to energized cables within the tolerance zone.
    - Making repairs in a trench to a faulted primary cable without de-energizing any adjacent energized primary cables within close proximity.
    - Using approved live line tools to move energized primary cables in a trench.
    - If removing underground cable rubber covering or arc suppression blankets from an energized cable.
    - Working within minimum approach distance (MAD) of downed electrical wires or foot patrolling for such wires.
    - If setting poles in proximity to energized lines or equipment and using truck controls from the ground.

5. National Grid expects that all cargo will be secured in accordance with U.S. DOT requirements.

    - As of January 2004, the Federal Motor Carrier Safety Administration (FMCSA) within the U.S. DOT published Cargo Securement Rules 393.100-136 Subpart I – Protection Against Shifting and Falling Cargo.

6. Chaps are required to be worn by ANY person using a chainsaw to make a cut on the ground or assisting in that cut and within striking distance. Other situations where cut off machines are used, chaps designed for the purpose of providing durable protection from abrasion, spatter and sparks from cutting ferrous metals shall be required; however, a hazard assessment should be completed to determine the need. Always use proper cutting techniques and push blades away from the body when using tools that may slip or inadvertently make contact with the leg. Never leave any equipment running while not in use.

7. All applicable contractors must meet the requirements of drug and alcohol testing in accordance with FMCSA DOT 49 CFR Part 40 and Pipeline and

Hazardous Materials Safety Administration (PHMSA) DOT 49 CFR Part 199. National Grid shall monitor contractor compliance to the drug and alcohol regulatory requirements through Transportation Advisor or ISNetworld as needed.

8. Contractors who drive regularly in delivery of service for National Grid shall:

   a. Have a safe motor vehicle operations policy which must be communicated to their employees before they begin driving for company business. The contractor is expected to follow National Grid's *Safe Motor Vehicle Operations* policy to include the following:
      - Prior to moving any vehicle, the driver shall perform a "circle of safety" inspection. This is to confirm not any person, animal, equipment, or property will be injured or damaged when the vehicle is moved.
      - Drivers should back into or pull through a parking space so that when you re-enter the vehicle, the first move is forward.
      - No driver shall use a hand-held mobile telephone while driving a vehicle for National Grid business.
      - The driver shall eliminate or minimize sources of potential driving distractions to include, eating, smoking, reading, writing, grooming, use of any electronic devices, mirror or seat adjustment. These shall be done when the vehicle is not in motion.

   b. Comply with all requirements of all federal, state and local regulations regarding safe motor vehicle operations.

   c. Ensure that new and existing employees have a valid Driver's License in accordance with requirements of specific job duties and classification/type of the vehicle they are operating. Contractors must have an acceptable driving record. If their driving record is unacceptable, the driver shall not be permitted to operate a vehicle on behalf of National Grid.

   d. Provide vehicles in safe operating condition, in accordance with federal state and local regulations. The vehicle should be equipped with proper safety equipment as appropriate for the vehicle type and its intended use.

e. Track and evaluate any vehicular accidents or incidents experienced by their employees. Corrective actions, such as driver coaching, corrective action driver training and medical/vision tests should be recommended and acted upon where appropriate. All accidents or near misses while performing work for National Grid shall be communicated to the National Grid project representative or designee and documented in the ISN system.

f. For more information, contact a National Grid representative for a copy of the National Grid Safety Policy *Safe Motor Vehicle Operations*

9. All contractors that require the use of heavy equipment shall ensure that competent, appropriately licensed, skilled and qualified personnel are in control of this equipment at all times. In addition, contractors shall ensure the following:

- Equipment is inspected for safety and use at the beginning of the work period of shift. All failing or defective equipment and components shall be removed from service.
- Equipment is under the control of trained operators who are always aware of their location and the locations/presence of persons working near the equipment, its swing zones and blind spots.
- While operating heavy equipment, operators shall ensure that loose fitting vests, jackets or other garments/items shall not be worn that could inadvertently get caught on equipment controls. Upon exiting the heavy equipment, the operator shall immediately put on their hi-vis vest/garment.
- Equipment is kept free of debris, water, oil, grease, mud or anything that could create a slip/fall hazard inside the cab.
- Keep hands, feet, and clothing away from power-driven and moving parts.
- Equipment cab windows should be kept clean and free of mud, ice, snow and/or fog for maximum visibility.
- Never carry passengers on heavy equipment or any equipment unless it is equipped to do so.
- Ensure that stabilizers are extended prior to starting a task.

- Before making a swing, operators shall always look out the windows and mirrors for confirmation that the area is clear. If visual confirmation is impaired or the operator is unsure due to weather, lighting or other interferences, the operator shall cease operation until an independent spotter can check the swing area and confirm it is clear.

- All excavations shall have signs posted, demarcation and controlled to prevent unauthorized persons from entering and falling inadvertently into the excavation. Excavations shall only be opened under the supervision of a competent person for excavation.

- All pot holing/test holing and exploratory excavations shall utilize vacuum excavation whenever near known or the possibility of unknown hazards such as live electrical or gas conveyances. When using vacuum excavation in combination with air blowing/air knife tools, all persons in the immediate area shall be wearing safety glasses in addition to a full face shield.

- No one is to work under a suspended load.

- Never use a bucket to lift personnel.

- Ensure stabilizers are in the upright and stored position before moving equipment.

- Operators shall not leave heavy equipment running unless the following requirements are met:

    - Parking break is engaged and wheels are chocked (if applicable)

    - Surroundings create no hazard of unqualified personnel entering unattended equipment

    - Vehicles and equipment idling limited to that designated state and local environmental regulations (generally, 3 to 5 minutes maximum). See table below for additional information

Region	Vehicles	Idling Limit	Exemptions Include
New York	Diesel trucks	5 minutes	• Traffic conditions • Temperatures < 25°F and motionless for two hrs • Hybrid electric engine charging battery vehicles • To provide power to auxiliary sources
NYC	All Motor vehicles	3 minutes	• Emergency vehicles • Loading/unloading • Temperatures <40°F
New Hampshire	Diesel/ Gas vehicles	5 minutes >32°F 15 minutes -10°F to 32°F No Limit <-10°F and no nuisance created	• Traffic conditions • Emergency vehicles takeoff power for auxiliary uses • Vehicles being serviced or repaired • Operated solely to defrost windshield
Massachusetts	All Motor Vehicles	5 minutes	• Vehicles being serviced or repaired • Vehicles in operation for which associated power is needed • Delivery vehicle in which engine power is needed
Rhode Island	Diesel Motor Vehicles	5 minutes	• Traffic conditions • Operate defrosting, heating, or cooling equipment to ensure health and safety of the driver or passenger. • Temperatures between 0 & 32°F - 15 minutes per hour. If < 0°F idling as needed for heat • To provide power to auxiliary sources • Vehicles being serviced or repaired
Vermont	All Motor Vehicles	5 minutes within any 60-minute period	• Emergency/public safety vehicles while engaged in "official operations" • Idling necessary to operate safety equipment • Vehicles in operation for which associated power is needed • Vehicles being serviced or repaired

- All lifts that occur on National Grid properties, ROWs or near critical assets require formal lifting plans developed by the contractor and reviewed with the National Grid project representative. Some lifts will also require formal critical lifting plans and this may include PE or geotechnical assessments to ensure a stable lifting base for the crane or other apparatus.

10. All temporary, metal fencing installed or located under transmission lines shall be grounded and have signage according to National Grid grounding standards. Contact a National Grid representative for a copy of the Engineering Documents ST 03.05.001ST 03.06.001 and SP 08.00.001.

3.0 ADMINISTRATIVE SAFETY REQUIREMENTS

3.1 Worker Qualification Assurance

1. In order to meet National Grid safety requirements, the contractor must describe how workers, including subcontractors, are qualified. The contractor must supply information concerning the type of skills assessment performed, training programs and how they ensure that employees

demonstrate competencies. National Grid reserves the right to review this information and request additional training requirements. All documents shall be uploaded and maintained in the ISN system for high/medium contractors. For work on process safety assets, the contractor shall ensure all workers and sub-contractors are trained and receive appropriate refresher training to maintain their appropriate level of certification and qualifications needed to perform work safely.

2. For low-risk contractors who perform activities that require PPE, which excludes office-based contractors and/or consultants, or other non-physical low-risk contractors, the contractor is required to watch an on-boarding video annually prior to any jobs starting for that year. The contractor employees and subcontractors are required to watch the video to be clear on safety expectations. Contractor to ensure that any new employees performing services for National Grid watch the on-boarding video if they hadn't watched it in the annual release. A link to the video can be obtained from the Project Representative.

3. Medium/high risk contractors shall complete an annual in-person on-boarding hosted by National Grid supervisor or project manager. The on-boarding shall emphasize required qualifications, HASP requirements, and requirements on revisions to HASPs when changes to the scope of work on the site or changes to risk occur. The National Grid supervisor or project manager are to conduct the on-boarding and determine the appropriate material to be used to communicate and emphasize the expectations.

4. Contractors shall conduct their own safety self-assessments.

Periodic field visits and/or verbal contact shall be conducted by the National Grid supervisor or project manager who are familiar with the work and existing scope. The National Grid supervisor or project manager shall review the work performed during the field checks and/or verbal contact and can ask the contractor to provide qualifications upon request.

During the field visits/verbal contacts, National Grid supervisor or project manager shall also review existing HASPs and/or job briefs as applicable for current work scope and require any revisions based on observations. The field checks/contacts are to be documented using Compliance Assessments, Contractor Evaluations, or ESDs.

If HASP or job brief does not cover observed hazards and risk mitigation, work shall be stopped until a revised HASP or job brief and approval of the revision occurs, which is required before work can continue.

The frequency of the field visits/verbal contacts are based on risk perception of the job, including variability of conditions, and if there is greater chance of serious injury or fatality based on high-energy presence (gravity, pressure, energy). Higher volume of visits should be conducted if it's a new contractor, based on contractor's performance (review IMS, Compliance Assessments, etc.), or if variations exist including: change in project scope, weather, change in crew and/or subcontractors, change in equipment on site, new high energy factors are present (greater chance of SIF), and long duration job.

5. The contractor shall provide management personnel qualifications through resumes or other documents. National Grid may interview and/or approve management personnel if considered necessary.

6. For work on Process Safety assets (Gas Transmission, Generation, LNG, LNG Transportation and CNG), contractors shall provide a description of their experience in the business asset and specific tasks including similar projects, lists of licenses/certifications, and references from previous similar projects. Contractors shall be made knowledgeable of National Grid process safety requirements that are relevant to their specific work activities by the business hiring them.

3.2 Meetings

Applies to: All contractors; as needed

1. The pre-bid meeting is coordinated by National Grid Procurement to provide bidders with an opportunity to become acquainted with contractual requirements and specific safety issues concerning the project, including company-specific safety rules and known site conditions.
   a. For contractors working on Major Hazard Assets, contractual language including designation of site medical facilities, locker rooms, bathrooms, etc. should be discussed by the project team with the contractor at this time.

2. At this time, Procurement will notify the prospective bidders of the following:

   a. If they are required to submit a project safety plan (HASP) prior to the pre-construction meeting

b. The cost of specific safety equipment, practices and personal protective equipment shall be factored into their bid/proposal.

3.3 Project Health & Safety Plan (HASP)

Applies to: Contractors performing high or medium risk work

All HASPs shall be submitted to the National Grid project owner for review and approval before work commences. The National Grid project owner shall ensure the HASP meets National Grid criteria and includes all aspects of the project prior to a review by Field Safety (if applicable). The project owner shall review the HASP. Field Safety shall also review the HASP after the business conducts its review only if the work is unique, there's a new project manager or supervisor, the work involves PHAs, or there's unfamiliarity with the project or safety standards.

If changes are required, a new HASP shall be created and rereviewed.

If the scope of work on the job site changes from the approved HASP, work shall be stopped. The HASP shall be revised and rereviewed by National Grid Business (Field Safety review as applicable), and work can continue once the revised HASP has been reviewed for risk controls of changed scope. Until the HASP is updated work shall remain stopped. Failure to update the HASP will be considered a violation of safety requirements in line with section 1.5. It's the contractor's responsibility to inform National Grid personnel if the scope changes.

1. Contractors who perform high or medium risk-ranked services shall submit a project-specific HASP plan prior to the start of the project and/or at pre-construction meeting. The HASP is to be followed by the contractor's employees and its subcontractors.
2. At a minimum, the HASP shall include the following elements:
   a. Roles and Responsibilities
   b. Scope of Work
   c. For contractors working on Major Hazard Assets - List of all equipment contractor is expected to use in work activities and indication that it meets regulatory and National Grid requirements
   d. For contractors working on Major Hazard Assets - List of contractor materials to be brought onto work site for review and approval by National Grid

e. Task and hazard identification and risk assessment of the hazards

f. Hazard mitigation/control procedures and work methods

g. Incident investigation and reporting

h. Compliance and monitoring

For an example of a HASP, a National Grid representative can provide related policies and procedures under the *Contractor Safety* website in Grid:home.

3. The following requirements shall be included in the HASP for all work at contaminated sites. The HASP shall be site-specific and meet the requirements of 29 CFR 1910.120(b)(4)(ii). The HASP must include at a minimum:

a. A safety and health risk or hazard analysis for each site task and operation

b. Personal Protective Equipment to be used by employees for each of the site tasks and operations

c. Medical surveillance requirements

d. Frequency and types of air monitoring and personnel monitoring to be used

e. Site control measures

f. Decontamination procedures

g. An emergency response plan for safe and effective responses to emergencies, including the necessary PPE and other equipment

The contractor/National Grid project representative shall contact the Environmental Department for guidance on site requirements and to initiate any required regulatory notifications.

For contractors performing bulk commodity transportation activities, a risk assessment including the potential consequences, frequency and safeguards to be used shall be performed and included in the HASP. If a preexisting National Grid requirement is in place for managing bulk commodity transportation activities, one shall follow those requirements, with no additional risk assessment being required.

Every contracted and subcontracted employee, including those working alone, performing work on the project shall review the HASP to ensure steps in the plan are adhered to in order to mitigate hazards during the pre-job orientation. These mitigation steps shall be incorporated into all work plans and job briefs.

Truck drivers for daily, non-hazardous material deliveries such as stone, gravel, concrete material or porta john cleaning are exempt from completing a job brief unless there are potential hazards associated to the driver or delivery. A National Grid representative shall talk to the driver to determine if a job brief is needed.

In addition, all workers shall sign an attendance sheet during the pre-job orientation that they have reviewed the plan, will adhere to the mitigation steps and they fully understand the plan. This document will be kept at the job site and available for review as needed and if requested by any National Grid representative, or any other parties.

A. Roles and Responsibilities

The HASP shall identify who is providing project oversight and how they are qualified. For example, if the work requires excavation, there must be someone on-site who is qualified as an excavation competent person.

For multi-employer work-sites, the general contractor is responsible for all their employees and subcontractors. The safety plan shall clearly state this responsibility.

If requested to do so, Contractors shall designate a competent person to participate in or conduct a process hazard analysis (PHA) regarding a portion or the entirety of the project. National Grid will not be responsible for training the contractor on the PHA methodology.

B. Scope of Work

The Contractor shall clearly and briefly state the scope of work as provided by National Grid. The plan must specifically address the project or services requested by National Grid.

C. Task and Hazard Identification and Risk Assessment

The contractor shall perform a risk assessment by identifying all significant tasks, the anticipated hazards and hazard mitigation procedures.

If, at any time, the risk level changes on the job site, the contractor is to stop work until a revised HASP or job brief is created and discussed on site and reviewed by National Grid personnel.

Contractors performing work where their employees are exposed to fatigue, shall assess fatigue risk in their HASPs and identify the mitigations they will take to manage the risk to their employees.

The contractor's cost to provide adequate safety measures and to comply with National Grid requirements must be considered and budgeted in the bid/proposal.

D. Hazard Mitigation Procedures and Work Methods

For each hazard, the contractor shall specify measures that will be taken to eliminate, control or mitigate these hazards.

A table below is an example of a method to simply and clearly organize and present the task, hazard, and mitigation steps:

Location: Substation Yard		
Task	**Hazard**	**Mitigation Steps**
Material Handling	Contact with overhead energized lines/equipment	Off load in the clear and have a safety observer present

E. Incident Investigation and Reporting

All work related incidents involving injury or illness to employees, the public or property damage (including contractor vehicle accidents) shall be reported to the National Grid project representative and documented in the ISN system.

F. Compliance Monitoring

To ensure that both contractor employees and subcontractors will achieve safety compliance, jobs with over 100 workers at any point in time or in excess of $1 million will require a full time safety professional hired by the contractor. This safety professional must be qualified, competent and be on site anytime work is performed. Qualifications of this safety representative must be acceptable to National Grid prior to hire by the contractor and may be documented in the ISN system.

For other jobs that don't meet the above criteria, contractors shall monitor jobs in line with their safety management system.

G. Environmental Compliance

Unless otherwise specified and based on the scope of work, any potential environmental risks shall be determined and addressed by the contractor following all applicable National Grid procedures. For more information, contact a National Grid representative regarding Environmental Procedure No.6 *Contracted Services* and Environmental Procedure No.25 Appendix A, *Environmental Screening Checklist.*

3.4 Contractor Orientation/Pre-Construction Meeting

Applies to: All contractors, as needed

1. A National Grid project representative, construction supervisor, or other designated National Grid representative that hires the contractor shall hold a contractor orientation and/or pre-construction meeting prior to the contractor working for National Grid. Other attendees may include: the Safety department, Environmental representatives, as well as contractor management as needed.

2. It is intended to serve as a method to provide the contractor with the tools necessary to educate their employees and subcontractors on National Grid's procedures and requirements. The session is not intended to train the contractor management, their employees or subcontractors.

3. All contractors are required to attend a National Grid orientation program specific to the type of work they will be performing. Contractor management representation shall also be present meeting and all documentation of attendance shall be kept at the job site and available to any National Grid representative. For visitors and contractors working on Major Hazard Assets, site orientation shall at a minimum include the following:

   - General site hazards
   - Specific hazards involved in each task the employee may perform
   - Safety policies and work rules, including Process Safety policies
   - Location of emergency equipment like fire extinguishers, eyewash stations, and first-aid supplies
   - Smoking regulations and designated smoking areas if applicable
   - Steps to take following an accident or injury

- Proper reporting of emergencies, accidents, and near misses
- Selection, use, and care of personal protective equipment
- Emergency evacuation procedures, routes, and security systems
- Safe housekeeping rules
- Safe use of tools and equipment
- Hazardous materials in use and location of safety data sheets

Site access shall not be granted to contract employees working on process safety assets until orientation is conducted.

4. The contractor's Project Health & Safety Plan will be discussed at this meeting including a final review of the safety hazards checklist to ensure proper hazard identification and mitigation plan has been implemented.

5. These hazard mitigation measures shall be reviewed and work shall not commence until these hazards have been adequately addressed. The National Grid project representative will discuss the methods by which compliance will be achieved to National Grid safety requirements with the contractor.

6. An Emergency Call List shall be exchanged with the National Grid project representative for high or medium risk projects or as applicable. This list must contain 24-hour contact information for key contractor and project personnel, including the project representative and Safety representatives. This list should be distributed to all concerned, as determined by the project team, prior to the start of work. For contractors working on process safety assets who have an emergency response role, the emergency response plan shall be updated to clarify the contractor's role in the event of an emergency on site.

7. For routine maintenance services, a review of associated safety issues and specific facility issues, restrictions or practices, such as evacuation procedures, shall be discussed with the contractor upon initial hiring. Any changes in the facility that may affect the safety of contractor or National Grid employees or third parties must be communicated immediately.

3.5 Job Safety Briefs

Applies to: All contractors; as needed

1. Job safety briefs shall be documented in writing. Written job safety briefs, permits, and/or plans shall be available at the job site for inspection and retained for 30 days after the job is completed.

2. National Grid reserves the right to perform a safety stand-down with any contractor for purposes including, but not limited to: recent injuries, incidents or near misses; identified hazards at job site or equivalent, and for other reasons to communicate with the contractor crew.

3. Each crew shall conduct these job safety briefs prior to commencing work at the job location. A new job brief is required when there are changes to the day's work order or plan, when there are changes in weather conditions, when a new worker or company joins the crew, and if the crew members take any extended breaks (i.e. lunch breaks). Working alone: A contractor working alone need not conduct a job brief; however, the contractor must review the hazards associated with the job as if a formal job brief had been performed.

4. Each worker must have the opportunity to voice concern. The work cannot begin until each worker signs off on the job safety brief stating that they have discussed the work, raised any questions, and agree with the plan.

5. Visitors to the work site shall be asked to read and sign the job brief acknowledging they understand contents. Contractors shall review the job brief and discuss the elements of the hazards and mitigation steps with each visitor prior to entering the job site. If a visitor refuses to sign, the general foreman will note it on the brief and will not allow the visitor to enter.

6. SITE SIGNAGE: An assessment of the work site should be conducted by the National Grid project representative overseeing the work with the contractor to determine if site signage will be needed to protect site visitors, the public or any other persons entering the work site. If Site Signage is required at the site, the signage shall be posted at the main entrance to the work site. The sign shall direct all visitors to check in with the Person in Charge (PIC), be escorted to the designated safe area and advised of all work currently in progress. The visitor is expected to comply with all related safety requirements and sign off on the Job Brief before entering the work site.

3.6 Safety Meetings

1. In addition to job safety briefs, the contractor shall have regular safety meetings with their employees and subcontractors. Contractors performing high or medium risk work shall have weekly safety meetings, while low risk contractors, at a minimum, shall have safety meetings monthly and attendance must be documented.

2. The safety meetings shall include the following topics: statistics, incidents, near misses, updates on old business and new business raised. It will include the round table discussion by the workers and the action items discussed. Meeting minutes must be documented and shall include specific action items, their due dates, persons responsible and a completion date. This documentation shall be available for inspection during the project period, and for 30 days after the project is completed. For contractors working on Process Safety assets, meeting minutes from contractor shall be shared and discussed with National Grid site management.

3. Routine Safety meetings/calls between National Grid and the Contractor shall be coordinated on a regular basis. Safety meetings may include but are not limited to ESD/Compliance Assessments, Safety Briefs, Safety Day discussions and regularly scheduled calls to promote safety and best safety practices. Contractors working on Process Safety assets for more than 6 months shall schedule leadership visits to discuss process safety topics.

4. Contractors are to perform their own safety self-assessments.

5. Contractors working on process safety assets for greater than three (3) months, or as needed, shall hold project planning meetings to discuss short term and long term work items. Project planning meetings shall include safety performance monitoring against project targets and should include a National Grid SHE representative for jobs on Major Hazard Assets in addition to a National Grid site representative.

3.7 Incident Investigation

Applies to: All contractors (regardless of risk ranking)

1. All contractors are required to report any work-related incidents involving injury or illness to employees, the public or property damage to the National Grid project representative. The first priority is to ensure that anyone injured receives medical treatment. Examples of incidents may include, but is not limited to: injury, property damage, adverse public impact, near miss, a hazardous condition and road traffic collisions (RTC).

2. Contractors will then be responsible to perform an incident investigation immediately following the incident and document root cause/corrective actions in the ISN system and to National Grid.

Incident Response Steps

In the event of an incident, the contractor shall provide details of the incident to National Grid that follows the steps below.

1. Contractor supervisor collects basic information about the incident from the employee or witnesses:
    - What happened?
    - Who and how many people were injured?
    - What treatment was administered?
    - What was the nature and seriousness of the injury?
    - Where did the incident occur?
    - When did the incident occur (date, time of day)?
    - Were there any witnesses?

2. Contractor supervisor immediately calls the project representative or other National Grid point of contact. All incidents shall be entered into the Incident Management System (IMS) as soon as possible by the National Grid project representative or National Grid designee. When dialing 1-866-322-5594, the caller will be prompted to select option 2 for anything other than an employee injury.

3. Contractor shall conduct an investigation within 24 hours of the incident that will identify contributing factors and root cause analysis relating to the incident and the corrective actions that will be taken to prevent future occurrence. This information will be documented in the ISN system.

4. Contractor vehicle accidents occurring during the performance of work will also be investigated and reported to National Grid.

Other Reporting

National Grid may periodically request the following annualized data for all work activities limited to National Grid operations:

- Lost Time Incident (LTI) rate for workers
- Restricted Work rate
- OSHA Recordable Incident (ORI) rate

4.0 TECHNICAL SAFETY REQUIREMENTS

4.1 Personal Protective Equipment (PPE) Requirements – General

Applies to: All contractors (regardless of risk ranking)

1. The contractor and their employees, including subcontractors are expected to follow the same rules and protocols as National Grid personnel. Basic PPE attire at construction sites and other similar work zones include, at a minimum:

   - Hard hat
   - ASTM F2413 EH rated safety shoes
   - Safety glasses with side shields
   - Any contractor who is exposed to vehicular traffic shall wear ANSI 107 certified class 3 hi-vis vest or garment.
   - All contractors who are exposed to vehicular traffic and are exposed to energized electrical equipment or live gas are required to wear ANSI 107, class 3 hi-vis vest or garment, that also meets ASTM 1506 FR standard with a minimum Arc rating of HRC 1. All FR vests must be lime green/yellow. When FR clothing is required the FR vest shall be worn over appropriately rated FR clothing. Please reference the Gas PPE Matrix.
   - All contractors that are exposed to vehicular traffic, but will never be exposed to energized electrical equipment or live gas shall wear at a minimum ANSI certified class 3 vest or garment that is orange OR wear the FR vest in lime green/yellow.
   - ASTM 1506, HRC Category 1 FR vests must be in lime green or yellow. Any vest that does not meet the ASTM 1506, HRC 1 FR rating must be orange.

Storm contractors that do not have a Contractor of Choice contract should follow their existing practices and rules. All other contractors shall refer to the US Department of Transportation's Manual on Uniform Traffic Control Devices (MUTCD) to determine the correct class of hi-vis clothing / vests.

2. The contractor shall ensure that their employees and subcontractors use protective safety toe footwear when working in areas where there is a danger of foot injuries due to falling or rolling objects, or objects piercing the sole, and where such employee's feet are exposed to electrical hazards. In

addition, during inclement weather conditions or adverse events, the addition of anti-slip footwear or outer foot wear may be appropriate.

3. Guidance for additional PPE is referenced in other sections of this document.

4.2 Flame Resistant Clothing Requirements

Applies to: All contractors; as needed

1. Flame Resistant (FR) clothing shall be worn when personnel work on energized equipment/lines or when distance and position will expose the worker to electric arc or flame hazards. FR clothing shall also be worn during live gas work as outlined in the gas PPE Matrix (Gas Policy SHE01001) and within LNG operations locations as required. FR clothing also includes arc- resistant rain gear. This additional ensemble may also be required as part of the job for contractor personnel. Contact a National Grid representative for a copy or to view the PPE matrix.

2. FR clothing shall be worn as the outermost layer of clothing and when workers measure voltages, test or ground electrical equipment/lines.

3. FR clothing shall be worn when work requires the use of rubber protective equipment or the use of insulated live line tools.

4. FR clothing shall be worn when workers control/operate electrical equipment over 50 volts at the device location or are within 10 feet of equipment which is being physically operated/ worked on by another worker.

5. Visitors are not required to wear FR clothing in substations or production plants unless they are engaged in electrical work. The National Grid project representative will be able to determine whether FR clothing will be required based on the specific contractor task. Note: Gas contractor FR requirements may differ slightly. Please refer to National Grid PPE Matrix for Gas operations within Gas Policy SHE01001 as needed.

6. FR clothing shall meet a minimum arc rating of 8 cal/cm^2 (HRC 2) for energized electrical equipment unless otherwise specified based on increased potential exposure as indicated in the Arc Flash Tables in H-807 *Arc Flash Analysis and Mitigation* program.

7. Additional FR clothing protection is required when performing work on the distribution system in NY North and New England (legacy National Grid) stations. Contact a National Grid representative for a copy. (NG

Employees: If the link does not work, copy and paste the URL into your internet browser) Arc Flash Awareness and Mitigation (sharepoint.com)

8. Contractors who may be involved with tasks requiring the implementation of this program shall be informed by National Grid. Contractors will be required to follow all aspects of OSHA and any other applicable regulation as it applies to the tasks they perform.

4.3 Rubber Gloves and Sleeves

1. Rubber glove use is required for work on all electrical apparatus at 50 Volts or greater. Rubber gloves shall be donned before the worker leaves the ground and shall be worn until the worker returns to the ground (commonly referred to as “ground to ground”, “cradle to cradle”)
2. Class 0 gloves are required for exposures up to 1000 Volts.
3. Class 2 gloves are required for voltages between 1000-15,000 Volts.
4. Rubber sleeves must be worn where work is conducted within the MAD of primary electrical apparatus that is not tested, de-energized and grounded.
5. For voltages 23 kV and above, workers can use specialized equipment or work practices as long as these workers have been appropriately trained and qualified. National Grid may request training records from the contractor.
6. Rubber glove exceptions for specific jobs (other than those listed in this section) are permitted only with the dated, written approval of a Division Director.
7. It is the contractor’s responsibility to wear class 2 rubber gloves when grounding trucks or equipment due to a possible difference in potential.

Exceptions

No rubber gloves are required:

- When working in a properly established equi-potential zone.
- When the operator remains at the same potential as the equipment by being off the ground and on the equipment.

- When a qualified worker performs transmission “hot stick” work on lines 69 kV or greater and no other energized wires are on the pole or structure below the worker.

- When work is performed on transmission structures carrying only energized conductors (115kV and above) and the Live Line Techniques are not being employed. While performing these activities, the worker shall utilize conductive clothing such as conductive gloves, boots, leg straps and/or any other applicable conductive clothing.

- When climbing a steel structure to perform structural reinforcements while maintaining MAD from energized conductors or apparatus.

- When climbing a steel structure to access an area that has been properly grounded.

4.4 Isolation of Energized Apparatus

1. **Non-Reclosing Criteria and Live-Line Maintenance and Construction:** The appropriate interrupting devices (breakers, reclosers, circuit switches, etc.) will be placed on NON-RECLOSING in accordance with National Grid tagging procedures.

2. **Tagging Out Lines or Apparatus**

   The National Grid Construction Supervisor or designee shall coordinate all switching and tagging in accordance with the most current EOP on Clearance and Control.

   Upon receipt of Clearance, the project representative will present the Contractor’s Person in Charge with the “Contractor Permission to Work Form” (Form NG0060), which states the specific apparatus that has been de-energized and that certain device(s) are tagged in the Protective Position and will remain so until the Contractor’s Person in Charge informs the construction supervisor or designee of the completion of the work utilizing the “Contractor Completion of Work” section of the “Contractor Permission to Work” form.

   The original transferred copy needs to be returned after the completion of work section is filled out & signed. In some cases the tailboard is outside & is susceptible to elements & damage; a copy shall be utilized in the field instead of the original.

No work will be performed until the “Contractor Permission to Work Form” is received from the construction supervisor stating that the equipment has been de-energized and a clearance to work has been given. The Contractors Permission to Work Form and a written grounding plan shall be attached to the crews Job Briefing and be kept at the work location.

After the “clearance” is received from the National Grid Construction Supervisor, the various substation conductor bus and equipment to be worked will be tested and “Grounds” installed. Grounds shall be rated for the fault current of the line/equipment being grounded. (Note: Rubber Gloves and FR clothing are required when installing and removing grounds). The contractors “Person in Charge” (Construction Supervisor/General Foreman) shall be responsible for determining the location and number of grounds.

Vehicles and equipment may utilize a single 4/0 cu for grounding inside the substation. Employees working on de-energized lines and equipment shall always work between grounds.

Prior to the application of any personal protective grounds, the circuit to be worked on must be tested for the presence of voltage using an approved potential detector. The worker must verify the detector is in operating order prior to and after testing for voltage. MAD must be maintained during the testing, and appropriate PPE shall be worn. Testing for voltage shall be done at the point where the grounding devices are to be attached. All phases of the circuit to be worked on shall be tested at each location that grounds are installed.

When an Air Gap is required to create a work zone, the component (a tap) shall be removed in whole from the system unless removal of the component is impracticable or creates an additional hazard based on National Grid management in charge of the job. If the component (a tap) is deemed impracticable to be removed in whole it shall be disconnected from one end, isolated from all other conductors and properly secured to ensure accidental energization will not create a hazard. When National Grid switches out lines or apparatus, any grounds that may be installed shall only be considered a visual reference, and shall not be considered a means to protect the Contractor’s employees. The Contractor is responsible to install their personal grounds, in accordance with all OSHA, Federal, State and local safety procedures. National Grid may provide guidance on the minimum size of the grounds to be used based on circuit available fault current. Refer to *Electric Operating Procedure D002,* for applicable grounding size. Ground rods shall be fully driven into the earth away from

the workers and work area. T-Bar ground rods are not to be used on National Grid property.

The National Grid Construction Supervisor shall review the contractor's plan for the quantity and locations of grounds, ensuring that the work the contractor is performing is between grounds, covering all potential sources. All three phases shall be grounded. (In stations, from each phase to the station ground grid). Grounds shall be placed as close to the work area as reasonably possible, between the work area and all potential sources of inadvertent energization. A copy of the grounding plan shall be kept with the job safety brief.

It is the contractor's responsibility to account for all their grounds. The contractor shall provide, maintain, and enforce a ground tracking program suitable to National Grid. In the instance of a zone expanding/collapsing, remaining grounds shall be listed on the Contractor Permission to Work Form and verbally communicated to the construction supervisor.

3. Grounding Mobile Equipment

When mobile equipment requires grounding, it shall be solidly grounded by means of appropriate sized copper cable while using rubber gloves. The cable shall be fastened to a securely attached clean metallic portion of the equipment, or shall be fastened to a grounding stud provided for the purpose at one end and an adequate ground at the other end.

Non insulated booms such as digger derricks that have the possibility of encroaching the MAD shall be grounded and barricaded. The ground is to trip the circuit and the barricade is to protect anyone who may become in contact with the truck during this energization.

4. Minimum Approach Distance (MAD)

Refer to OSHA 29 CFR 1910.269 for more information and details regarding qualified and unqualified workers.

4.5 Appointment of a Safety Observer

A safety observer shall be required if an employee (operator) determines that it is difficult to accurately determine the distance between the equipment (minimum approach distance) and energized parts. The Safety Observer shall never be a substitute for minimum approach distance (MAD), personal protective equipment

(PPE), insulate/isolate techniques or work area identification as a form of employee protection.

The person in charge of the work (contractor or National Grid), shall appoint a qualified employee or employees to perform the task of a safety observer. The personal in charge shall:

1. Ensure a documented job brief is completed and includes the name of the safety observer, additional subjects such as the location of gas lines, energized equipment, in or adjacent to the work area and the limits of any de-energized work area
2. Discuss the scope of work and communication techniques used to warn or notify the equipment operator of hazardous conditions.
3. Communicate any changes to work and job completion to the safety observer
4. Select another safety observer if there is a need for the existing observer to have break in service.

The safety observer is a qualified employee who has been appointed by the person in charge based on the hazard assessment and the job brief. The safety observer shall:

1. Observe the worker performing the task/activity until all hazards have been eliminated or the task/activity has been completed
2. Have shown proficiency in the task/activity being observed and have a full understanding of the job and the hazards associated with the task/activity.
3. Remain continuously focused on the task/activity being performed and not perform or assist any other job activities while observing the worker performing the task/activity
4. Notify the person in charge if there is a need to have a break in service. Work must stop until a new observer is appointed or the safety observer returns.

A safety observer shall also be required when a critical lift is being performed. A critical lift plan shall be required during the following circumstances:

1. An object is lifted over energized apparatuses or assets where a failure of the lifting equipment or rigging could result in a significant safety hazard or cause significant disruption in service to National Grid customers.
2. The crane or other lifting apparatus is anticipated to be operated above 80% of its rated capacity for the specific load chart for the lift.

3. A man basket (pinned or suspended) is to be utilized. All fall protection rules shall be followed when in a man basket.
4. Two cranes will be used in concert to lift a single object
5. Internal substation construction involving all power transformers, control houses, capacitor banks and transmission breakers.
6. Lifts in LNG or Gas plants where a hazard assessment or job brief identifies a significant risk.
7. The lifted load will be less than twice the minimum approach distance (MAD) of the nearest energized part. Until a qualified electrical worker confirms the MAD, loads and equipment shall maintain a 20 foot distance. Once nominal voltage is established, the MAD will be according to OSHA tables.
8. The lifted load is hoisted over buildings or the general public.

4.6 Work Zone Traffic Control

1. If work activity is on or near a road, the contractor and their subcontractors shall comply with all applicable parts of the most current US Department of Transportation's Manual on Uniform Traffic Control Devices (MUTCD), state, local Work Zone Traffic Control requirements and the National Grid Work Zone Traffic Control Manual. Please contact your National Grid representative for a copy of the manual found in the Safety Homepage on the Grid:home.

2. If pedestrian traffic is disrupted, pedestrians should be provided with a path that is reasonably safe, convenient and accessible. Pedestrians should not be led into conflicts with work site vehicles, equipment or operations.

3. If working in areas covered by state permits issued to National Grid, contractors shall comply with the provisions (work practices and notifications) of the permit language. These permits must be available on the job site upon request.

4.7 Qualified Gas Worker

Applies to gas projects/activities

1. Gas contractor employees will be operator qualified as required and defined according to the Code of Federal Regulations, Transportation, 49, Subpart 192.801 through 192.809.

2. Until these qualified employees have demonstrated proficiency in the work practices involved, they are considered employees undergoing on-the-job training and must be under the direct supervision of a qualified person at all times. According to the definition of a “qualified employee”, the employee also must have demonstrated an ability to perform work safely at his or her level of training.

3. National Grid requires contractors with gas qualified employees to provide documentation on how they qualify their workers.

4. Additionally any qualifications’ of contractor personnel shall be in full accordance with the Company’s Operator Qualification written plan, (OQ Plan) Refer to the most current list of covered tasks in accordance with National Grids’ Operator Qualification Program and the Northeast Gas Association, (NGA).

4.8 Qualified Electrical Worker

Applies to electrical projects/activities

1. According to 1910.269(a)(2)(ii), a qualified electrical employee must be trained and competent in the following prior to starting work:

    - The skills and techniques necessary to distinguish exposed live parts of electrical equipment
    - The skills and techniques necessary to determine the nominal voltage of exposed live parts
    - The MAD specified in 1910.269 corresponding to the voltages to which the qualified employee will be exposed
    - The proper use of special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools for working on or near exposed energized parts of electrical equipment

2. Until these qualified employees have demonstrated proficiency in the work practices involved, they are considered employees undergoing on-the-job training and must be under the direct supervision of a qualified person at all times. According to the definition of a “qualified employee”, the employee also must have demonstrated an ability to perform work safely at his or her level of training.

3. National Grid requires contractors with electrically qualified employees to provide documentation on how they qualify their workers.

4.9 Qualifying Non-Electrical Worker

Applies to: All qualifying non-electrical contractors working near energized lines and equipment; as needed

1. The contractor shall provide orientation for non-electrical workers entering and working within restricted areas such as a substation and those working near energized lines and equipment.

2. The information provided to these workers must meet the requirements of paragraph 1910.269(a)(2)(ii). However, the orientation and training may not be as comprehensive as the qualified electrical worker would be.

   They must know:

   - What is safe and not safe to touch in the specific areas they will be entering;
   - The maximum voltage of the area;
   - The MAD for the maximum voltage within the area;
   - Proper use of personal protective equipment and in the work practices necessary for performing their specific work assignments within the area.

3. Until these workers have demonstrated proficiency in the work practices involved, they are considered to be employees undergoing on-the-job training and must be under the direct supervision of a qualified person at all times.

4.10 Asbestos, Lead and other Hazardous Materials

1. Asbestos and lead materials associated with electrical and gas equipment includes, but is not limited to: cement-type cable covering, cable wrap, wire coatings, coal tar pipe wrap, and transite panels and conduits. Asbestos and lead materials may also be present in building materials including but not limited to: paint, mastics, caulking, insulation and roofing materials.

2. Where asbestos and other hazardous material is present and likely to be disturbed, the National Grid project representative and contractor shall coordinate how the asbestos, lead or other hazardous materials will be

managed and shall consult National Grid's Safety & Environmental department as appropriate.

3. Removal of this material must be done by individuals specifically trained and qualified to handle asbestos and lead. Refer to National Grid Safety Procedures, F-615, F-617 and F-619 for guidance on asbestos and lead handling and removals. For more information, contact a National Grid representative for a copy of these procedures.

Note: Contractors who will encounter asbestos or lead as part of their work shall reference in their safety plan how they will address this hazard.

4.11 Lift Plans for Work Near Energized Electrical Equipment

1. All work involving hoists, cranes or other lifting equipment **within 10' of energized electrical equipment** must have a detailed lift plan/procedure.

2. As a minimum Lift Plans shall include the following:

    a. Designated Operator and Signal person

    b. Detailed travel and flight path that ensures the boom and material being raised is controlled 100% of the time and will maintain the appropriate clearance

    c. Designated cover up and isolation to ensure employee and equipment safety in the event of an unplanned action or failure

    d. Emergency action plan with detailed instructions to respond to unplanned/uncontrolled event during the lift or positioning of the lifting equipment.

    e. Documented load weight and equipment lifting limits

    f. Rigging equipment and methods that will be used during the lifting. Sign off/approval from the management official responsible for the work

4.12 Fall Protection

1. Fall protection or fall restriction devices shall be used when working at heights over 4 feet. When using portable straight and extension ladders,

three points of contact shall be maintained. If 3 points of contact cannot be maintained a work positioning belt is required.

Step ladders shall be set up on level and stable surfaces, fully open with braces locked. Work positioning belts are not required for properly set up step ladders.

2. All fall protection shall be inspected before use each day to determine if equipment is in good working condition. Defective equipment shall not be used and shall be removed from service.

3. A worker may enter or exit an aerial lift (at heights above four (4) feet) provided that fall protection such as guardrails or a fall arrest system is used while the worker moves between the lift and the working surface. Before any such transfer is made, the employee shall be properly tied-off to an adequate support, the pole or structure prior to and in the direction of the transfer.

Exceptions to fall protection shall be in accordance with Federal & State requirements.

4.13 Herbicide Application

1. Vegetation spraying shall be conducted unescorted only by contractor employees who have been designated as a Qualified Electrical Worker, where applicable.

2. The spray applicator shall have ID cards issued by Security with background checks available from the contractor.

3. National Grid management shall require a schedule of the spraying in their areas.

4. Once spraying begins, the contractor must contact local management on a daily basis to inform them of progress or changes to the schedule.

5. The contractor shall post all stations with dated signs indicating when the station was sprayed. These signs should not inhibit access to the station.

6. The contractor shall ensure that any stored materials and equipment do not get covered with “overspray”. Overspray represents a substantial safety hazard and cannot be allowed.

7. When applying herbicides, contractor employees shall wear appropriate PPE in accordance with product labels.

5.0 UNDERGROUND OPERATIONS WORK

In addition to the other requirements referenced in this document, this section covers requirements that are specific to underground operations work.

5.1 PPE Requirements

All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0.

5.2 Enclosed Space Assessment, Ventilation, Entry and Rescue

Refer to the National Grid EOP-UG006 *Underground Inspection and Maintenance* and National Grid Safety Procedure I-902 *Enclosed Space Procedure* for more information regarding enclosed space requirements.

1. Contractors are required to follow all procedures in this document in regards to enclosed spaces (manholes, sidewalk vaults, etc.), including assessment, ventilation, entry and rescue.

2. Each enclosed space shall be tested prior to removing manhole lids and entry. Atmospheric testing shall be continuous for the duration of the entry using a calibrated, industry approved atmospheric tester.

3. When performing hot lead work or when indicated by atmospheric monitoring, engineering controls such as forced mechanical ventilation shall be used when working in National Grid manholes at all times.

4. All contractors who are qualified electrical workers will treat these spaces as “enclosed spaces” and follow non-entry rescue provisions.

5. In some situations a boom is allowed for retraction from an enclosed space. Refer to Safety Procedure I-902 for more information.

6. Steel cable or wire rope for non-entry rescue is prohibited.

5.3 Equipment Safety Inspection

1. Inspect underground facilities (manholes, vaults, hand holes, splice boxes, junction boxes, pad mount transformers, switchgear and submersible equipment, etc.) each time a crew performs work at one of these facilities. All separable components in these facilities shall be inspected by infrared instrumentation. A National Grid representative can provide details from the

National Grid EOP-UG001 *Infrared – Non-Contact Thermometer Inspection Requirement for Underground Equipment* for more information.

2. The infrared (IR) thermometer or camera shall, at a minimum, have a range of -25°F to 1400°F with a plus or minus 1% accuracy. For more details and current operating procedures, contact a National Grid representative regarding EOP UG001.

3. The format for data collected shall follow the National Grid EOP UG006 *Underground Inspection and Maintenance* requirements. Please contact a National Grid representative for more information.

4. "Touch Potential" testing of metal street lighting poles is required as a part of any maintenance work. For more information, a National Grid representative can provide a copy of the National Grid EOP G016 *Elevated Equipment Voltage Testing* and National Grid Work Methods Bulletin #04-26 *Touch Potential Testing of Metal Street Lighting Poles.*

5. Touch Potential testing results shall be recorded on the job safety brief and the manhole inspection form which shall be given to the National Grid Construction Supervisor or designee.

6. All contractors working for National Grid shall use materials and equipment in accordance with the manufacturing guidelines. It is the contractors' responsibility to understand the manufacturers' limits and prescribed use of their tools and equipment before each use.

7. Workers shall test and verify that the underground cable is de-energized and guillotine the cable if needed from outside the hole. Rubber gloves shall be worn at all times while performing this task.

6.0 OVERHEAD LINE WORK

In addition to the other requirements referenced in this document, this section covers requirements that are specific to overhead line work.

6.1 PPE Requirements

All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0. In addition, contractors will follow ground-to-ground and cradle-to-cradle use of rubber gloves while performing work on energized overhead lines. Any foreign wire, including those on a pole or structure constitutes

an energized source and requires the use of rubber gloves (ex: Cable TV, telephone, fire alarm wire, etc.).

6.2 Fall Protection

All contractors who climb structures such as wood poles or transmission towers shall utilize enhanced fall protection equipment (fall arrest devices) and techniques (ex: *Buckingham Buck-Squeeze, Miller StopFall* or *Jelco Pole Choker*). When working on wooden and steel structures, a full body harness and lanyard shall provide 100% fall protection at all times (100% tie off, Shepperd's Hook, etc.). Climbers shall never be allowed to drop or slide down a pole or structure more than two feet.

Exceptions to fall protection shall be in accordance with Federal & State requirements.

6.3 Pole/Structure Inspection

Contractor shall ascertain the structural integrity of the pole or other structure prior to installation, removal, repair or modification of the equipment on the structure.

1. Prior to climbing any pole, an inspection and test of the condition of any pole being climbed shall be performed. The weight of the employee, the equipment being installed and other working stresses (such as the removal or re-tensioning of conductors) can lead to the failure of a defective pole or one that is not designed to handle the additional stresses.

2. If the pole is found to be unsafe to climb or to work from, it must be secured so that it does not fail while an employee is on it. The pole can be secured by a line truck boom, by ropes or guys, or by lashing a new pole alongside it. [29 CFR 1910.269(q)] If measures cannot secure the pole, the contractor must cease operations and notify the National Grid Construction Supervisor or designee

6.4 Electrical Work Methods

1. Jumpers of any type shall not be used to keep transformers, risers or transformer banks energized for the purpose of changing potted porcelain cutouts. A National Grid representative can provide information to the National Grid Electric Operation Procedure (EOP) D001 *Cutouts – Open Type* for more information.

2. Potted porcelain cutouts must be changed out when work is being completed on a pole even if this is not planned in the scope of the work provided.

3. Properly rated and inspected slings, chains or tongs shall be utilized to move poles and equipment. Winch lines must not be wrapped around poles or looped around transformer ears to lift without a sling or chain.

6.5 Transmission Overhead Lines

1. For work on transmission circuits, red tape shall be placed around any energized pole, pole structure, or tower adjacent to the de-energized line.

2. When one circuit of a double circuit pole or tower line is de-energized for work, a red or orange flag shall be placed on the energized side of the pole or tower nine feet below the lowest energized conductor. In addition, a red or orange flag shall be placed on the lower cage on the side toward the energized circuit at each arm level as employees work on them or pass them.

3. All contractors using ATV's, UTV's or RTV's for transmission or forestry work, are required to follow all local OHRV requirements for PPE and driving safety. Training shall include classroom and in-field instruction as well as a formal driving assessment on an annual basis for each type of vehicle planned for use: i.e. UTV specific training for UTV's and ATV specific training for ATV use. All contractor employees must be fully trained and qualified before use. Proof of individual operator training certifications for each operator shall be available at all times. US DOT rated helmets and safety glasses/goggles are required for any vehicle that does not have a seatbelt and a roll cage. In equipment with a roll cage and seatbelt, operators can utilize a hard hat and chin strap.

4. At the end of each day, unless other arrangements have been made for an extended outage, grounds will be removed and the National Grid project representative will be notified that all personnel are "clear" of the conductor bus work and equipment.

5. Wherever transmission line workers "touch" wires, a personal ground shall be installed at the work area to establish an equipotential zone, unless workers are engaged in live-line barehand work (29 CFR 1926.964)

7.0 SUBSTATIONS

In addition to the other requirements referenced in this document, this section covers requirements that are specific to substations work.

For additional information, a National Grid representative can provide a copy of the National Grid Substation Maintenance Procedure SMP 499.01.2 *Protective Grounding Procedure* under the Substation Work Methods Grid:home page for specifics regarding substation grounding practices.

Grounding plans for substation, major distribution and transmission projects will be submitted to the National Grid construction supervisor a minimum of 1 week prior to construction for review. This plan will show the steps, work area limits and ground cable size and amount. Once reviewed with the National Grid and prior to starting the job, the plan will be reviewed by the contractors with all employees and subcontractors on the project.

The use of an “Equipotential” step/platform or a conductive mat is required for access and egress from the following:

a. Crane or any other equipment, including aerial lift equipment, that is connected to the substation ground grid and/or bonded to transmission line conductors when working outside of the station fence
b. In the rights-of-way
c. In areas inside the substation where there is no ground grid present.

When work is performed inside the substation and there is a ground grid available, the “Equipotential” step/platform or conductive mat is not necessary.

All vehicles shall be grounded and barricaded per OSHA standards and the National Grid Electric Operating Procedure G026 *Mechanized Equipment Grounding*.

Proper clearances shall be maintained from adjacent energized substation bus, energized portions of substation equipment and other transmission lines at all times.

Use of proper insulated tooling (shotguns and sticks) shall be utilized per NECA standard maintaining MAD.

7.1 PPE Requirements

1. All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0.

2. Contractors who perform any ground breaking activities in a substation within a pre-marked area will require Dig Safe marks to be in place; otherwise, the job must be suspended and the National Grid construction supervisor or project representative shall be notified of the condition.

3. When using non-insulated man-lifts, and if provided by the manufacturer, a secure point of attachment for lifelines, or lanyards or deceleration devices shall be utilized, independent of the means to support or suspend the employee. Workers feet shall also always remain on the floor.

7.2 Notification of Control Authority When Entering a Substation

1. When a contractor enters and exits a National Grid substation, the contractor shall ensure that the System Control Center is notified. While work is being conducted, gates must be monitored at all times or the gates shall be locked. For more information, contact a National Grid representative regarding National Grid EOPG022 *Substation Security*.

2. Unescorted entry in substations can only be provided to contractors who provide assurance that their employees and subcontractors are electrically qualified as specified in 29 CFR 1910.269. Refer to Section 4.0 of this document

3. All National Grid specifically identified bulk power stations will require NERC-CIP training, certification and approval prior to entry to those sites.

7.3 Substation Work Area Identification (SWAI)

1. Contractors who will be working in substations shall follow the SWAI procedure. National Grid will provide a copy of this procedure if required by the project. For more information, contact a National Grid representative regarding National Grid SMP499.10.2 *Substation Work Area Identification Procedure*.

2. Qualified contractors as referenced in section 4.8 of this document shall install their own work area identification. National Grid shall arrange work area identification for non-qualified workers as required.

3. Designated storage areas for items not being used will be posted in the yard and should be the only place these items are kept.

8.0 GAS OPERATIONS WORK

In addition to the other requirements referenced in this document, this section covers requirements that are specific to Gas operations work. For more information, contact a National Grid representative regarding National Grid General Safety Requirements SHE1001 *Gas Policy* which can be found following this link:
http://dc-gasweb1/MelSite/WMSafetyAll.asp .

8.1 PPE Requirements

1. All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0.

2. The contractor shall wear all appropriate PPE and Class 2 rubber gloves for personal protection when digging or probing within 2 feet of known electrical conductors and when the location of energized conductors is unknown.

8.2 Gas Operations

1. Any contractor who performs covered tasks shall be operator qualified (OQ) as defined in the DOT Title 49 CFR, Subpart N and all applicable state requirements pursuant to the state the contractor is working in. Additionally, any qualifications of contractor employees shall be in full accordance with the Company's Operator Qualification written plan, (OQ Plan) Refer to the most current list of covered tasks in accordance with National Grids' Operator Qualification Program and the Northeast Gas Association, (NGA).

    a. The Operator Qualified status of contractor employees must be regularly updated and accessible through the ISN system. This listing must detail employees' current tasks they are qualified for, the next recertification date, associated documentation and a documented annual acknowledgement in ISN on their qualified workers as referenced in section 3.1 of this document.

    b. Contractor personnel involved with covered tasks may require certification by National Grid and an orientation of the involved tasks and National Grid Company standards. National Grid reserves the right to validate contractor qualifications prior to performing Live Gas work.

    c. Atmospheres are to be tested with a properly calibrated Combustion Gas Indicator (CGI) or Gas Measurement Instrument

(GMI) in accordance with National Grid excavation procedures as required.

d. Each employee in an excavation shall be protected from cave-ins by an adequate protective system, such as sloping, benching or an appropriate shoring system. For more information, contact a National Grid representative regarding National Grid Safety Procedure M-1301 *Standards for Working in Excavations.*

9.0 FORESTRY AND VEGETATION MANAGEMENT

In addition to the other requirements referenced in this document, this section covers requirements that are specific to vegetation management work.

9.1 PPE Requirements

1. All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0.

2. Flame Resistant Clothing is not required per the applicable OSHA Forestry standard. Forestry contractors must instead wear natural fiber clothing when working within 10 feet of energized equipment.

3. Forestry contractors must wear a properly adjusted full-body fall protection harness connected to an appropriate lanyard when working from an aerial lift. The lanyard must connect to an attachment anchored to either the boom or bucket mounting hardware. Attachment points anchored through only the fiberglass portion of the bucket are not acceptable.

4. Forestry contractors will be required to wear chaps while operating a chainsaw or when assisting and/or working in close proximity to a chainsaw that is being operated.

5. Saws shall not be left unattended with the engine running.

6. When a contractor employee carries a saw, the engine shall be off and/or covered or the saw shall be carried with the blade to the rear and locked.

7. Tree crews will not be allowed to fly their buckets in between the primary and secondary cables if the MAD will be violated in process of doing so.

9.2 Equipment and Work Methods

1. Forestry contractors shall utilize fiberglass sticks and stick saws for work around energized equipment. Additionally, integrity tests shall be performed and documented annually. Test results and expirations shall be available on each vehicle as needed.

2. Forestry contractors shall perform and document dielectric testing of all aerial units annually. Test results and expirations shall be available on each vehicle as needed.

3. For lump sum or unit price mileage trimming projects, a single foreman may supervise up to four (4) bucket trucks on the same project. The minimum qualifications for the "lead" person on each of the other trucks shall be a Journeyman Tree Trimmer or equivalent (Qualified Line Clearance Tree Trimmer). At least one other employee on the truck shall be an OSHA defined, Qualified Line Clearance Tree Trimmer Trainee. For Upstate New York only, it is understood that a Qualified Line Clearance Tree Trimmer shall carry the title, wage and benefits as outlined in IBEW LU 1249's existing contract of a Journeyman Treeman and that a Qualified Line Clearance Tree Trimmer Trainee shall carry, at a minimum, the title, wage and benefits as outlined in IBEW LU 1249's existing contract of a Treeman Trainee, 2nd year.

9.3 Training

1. Forestry contractor management will be required to attend safety council meetings hosted by National Grid as required. The contractor shall ensure that all appropriate safety personnel for the National Grid territory are in attendance.

2. Forestry contractors shall implement and provide the required training and certification programs necessary to provide OSHA defined Qualified Line Clearance Tree Trimmers or Qualified Line Clearance Tree Trimmer Trainees. Contractors shall be able to provide the documentation relative to these training and certification programs upon request by National Grid. Forestry contractors shall provide an updated HASP by April 1st of each year for all work being conducted at National Grid.

3. All contractors using ATV's, UTV's and RTV's for transmission or Forestry work are required to follow all local OHRV requirements for PPE and Driving safety

10.0 LNG PRODUCTION, TRANSPORT AND HANDLING

In addition to the other requirements referenced in this document, this section covers requirements that are specific to LNG Production facilities.

All contractors working at LNG plants will sign in and out of plants daily in the contractors log book. All other gas supply facilities and subcontractors require authorization under the contractor management official. If required by the project, trained National Grid plant personnel shall initially, and as needed, review and re-issue as needed, a work permit process which shall which describe the work being performed, valves with their locations and Lock-out/Tag-out numbers.

10.1 PPE Requirements

1. All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0 and shall include FR outer clothing.

2. Cryogenic protective gloves/gauntlets and face shields are required when making connections to load / unload LNG. National Grid retains the right to enhance PPE requirements as conditions warrant. The use of additional PPE shall be based on the task performed and the PPE matrix for work in production plants.

10.2 Training

1. Contractors who transport LNG/propane at National Grid facilities are required to be certified in first aid/CPR and are required to complete frost-bite awareness training. Documentation of training records shall be maintained in the ISN system.

2. National Grid expects contractors working at LNG plants to meet the requirements of 49 CFR 193 Subpart H for health, training or experience and/or any applicable National Grid procedures that supersede the above requirements. Contractors shall provide documentation on their qualified workers, as referenced in section 3.1 of this document.

3. All Contractor personnel performing work in LNG plants must meet the requirements of the National Fire Protection Association (NFPA), part 59.

11.0 ELECTRIC GENERATION

In addition to the other requirements referenced in this document, this section covers requirements that are specific to Electric Generation.

11.1 PPE Requirements

1. All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0

2. Hearing protection is required when working anywhere inside a generation plant and/or outside the plant where noise may be excessive. Acoustic barriers shall be maintained by the contractor as needed.

3. Safety shoes with a minimum height of six-inches are required in Generation plants.

4. Contractors working in generation plants are required to wear 8-Cal clothing protection. For additional guidance, a National Grid representative can provide reference to Electricity Distribution Operations Grid:home webpage under Electric Generation's Policies and Procedures EGO-028 *Personal Protective Clothing* & EGO-029 *Personal Protective Equipment*.

11.2 Training

1. Required training may include; PCB's, asbestos, mercury, confined space awareness and excavation competent person requirements. HAZCOM is required by contractors working in generation plants as applicable.

2. Contractors who work at a National Grid Generation Station shall attend an orientation regarding plant safety and as required, US Coast Guard Maritime Security (MARSEC) policies.

3. Equipment training is required per federal, state and local regulations and National Grid procedures. Operators of any powered industrial vehicle must be qualified and documentation shall be documented.

11.3 Equipment & Excavations

1. All excavations shall be performed in accordance with EGO-0005 *Procedure for Excavation in National Grid Generation Facilities* and National Grid Safety Procedure M-1301 *Standards for Working in Excavations.* For additional information, contact a National Grid representative for copies.

2. Gasoline and diesel powered fork trucks shall NOT be used inside the plant or other enclosed facility. Only propane/electric fork trucks are permitted except where additional hazards may exist.

3. All wood products necessary for the work must be made of flame retardant material.

11.4 Equipment Isolation

For isolation of hazardous energy sources while working in Generation plants, please contact a National Grid representative regarding EGO-0010, *Control of Hazardous Energy Sources-Work Permit System.*

12.0 CIVIL CONSTRUCTION

In addition to the other requirements referenced in this document, this section covers requirements that are specific to civil construction work.

12.1 PPE Requirements

1. All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0.

2. Rubber gloves shall be worn while carrying out work in and around energized or identified direct buried lines, live duct banks, transformer enclosures, manholes, switch gear and other electrical apparatus when performing civil investigations, installations or repairs.

12.2 Enclosed Space Assessment and Ventilation

Contact a National Grid representative regarding the National Grid EOP-UG006 *Underground Inspection and Maintenance* and National Grid Safety Procedure I-902 *Enclosed Space Procedure* for more information regarding enclosed space requirements.

1. Contractors are required to follow all procedures in this document in regards to enclosed spaces (manholes, sidewalk vaults, etc.), including assessment, ventilation, entry and rescue.

2. Each enclosed space shall be tested prior to removing manhole lids and entry. Atmospheric testing shall be continuous for the duration of the entry using a calibrated, industry approved atmospheric tester.

3. When performing hot work or when indicated by atmospheric monitoring, engineering controls such as forced mechanical ventilation shall be used when working in National Grid manholes at all times.

7. All contractors who are qualified electrical workers will treat these spaces as “enclosed spaces” and follow non-entry rescue provisions.

8. In some situations a boom is allowed for retraction from an enclosed space. Refer to Safety Procedure I-902 for more information.

9. Steel cable or wire rope for non-entry rescue is prohibited.

12.3 Equipment Safety Inspection

All contractors shall comply with the applicable equipment safety inspection procedures referenced in Section 5.3

12.4 Excavation Requirements

All excavation work shall be performed under the control of a competent person. All soils in National Grid territories are to be considered class “C”, considered unstable and shall require all excavations be performed in accordance with OSHA 1926.651, EGO-0005 *Procedure for Excavation in National Grid Generation Facilities* and National Grid Safety Procedure M-1301, *Standards for Working in Excavations.* For more information, contact a National Grid representative for a copy.

Crews that are performing Excavations shall include an excavation log with their job brief that states the soil type, expected depth and length as well as final depth and length. All required steps need to prevent collapse will be documented on this form as well prior to entry.

Protective systems shall be used for certain manhole installations. These scenarios are covered below:

- The hazard assessment, competent person and/or National Grid supervisor deems it necessary
- If an excavation for a manhole in a roadway is completed and installation of manhole and backfill is not able to be done before the day is complete, a protective system will be required before road plating
- Installation of any manhole 3 way or greater in size/

Where trench boxes are required to be built on site, the contractor shall submit a PE stamped plan and the location shall be designated on the excavation drawings.

All lifts (not limited to materials and equipment) shall be planned and rigged by a competent person. A lift plan shall be provided for all “critical lifts” and must be submitted by a qualified professional to the National Grid representative prior to the lift taking place.

12.5 Cable fault finding and replacements

For excavation work needed to support faulted cables and emergency cable locates, the use of Cable Avoidance Tooling (CAT) shall be used in addition to Dig Safe requirements as an added safeguard to further pin point unidentified buried cables.

For excavations within the tolerance zone, all hand digging in and around direct buried cables shall require basic PPE, non-metallic handled shovels, rubber gloves, FR clothing and EH rated work boots with Dielectric (DI) over shoes.

All excavation equipment shall be grounded in accordance with NG EOP G026. For additional information, contact a National Grid representative.

The use of GPR (Ground Penetrating Radar) shall also be required to verify the Dig Safe/811 locates after award of the project and prior to excavation. This shall include electric URD, UCD and Substation projects.

12.6 Technical Review

Where and when applicable, all trench and excavation work shall be reviewed and stamped by a civil PE in the state of record and will be executed under the supervision of a trenching and excavation competent person. All leading edges of trenches and excavations shall be appropriately demarcated, clearly posted and controlled to prevent unauthorized persons from entering and inadvertently falling into the excavation. All trenches and excavations shall be closed as soon as practical/possible. All excavations shall be fully controlled for the duration of the exposure by adequately substantial means to withstand the environment and conditions expected to be present.

All pot holing/test holing and exploratory excavations shall utilize vacuum excavation whenever near known underground utilities or hazards, and when the potential for unknown hazards such as live electrical or gas conveyances exist. When using vacuum extraction in combination with air blowing/air knife tools, all persons in the immediate area shall be wearing safety glasses in addition to a full face shields.

13.0 CONSTRUCTION PROJECTS AT CONTAMINATED SITES

In addition to other requirements referenced in this document, all work on contaminated sites must be conducted per the requirements of 29 CFR 1910.120, including the worker qualification and training requirements of 1910.120(e).

14.0 AVIATION

1. Helicopter Crews of two or more shall perform a preflight documented job brief.

2. Helicopter work shall require the use of aviation helmets for both the pilot and passengers.

3. Helicopter pilots and passengers shall participate in the "Flying in the Wire and Obstruction Environment" training prior to flight.

4. Helicopter pilots shall meet the following minimum flight time experience:
    a. 2000 hours as Pilot in Command or Second in command of a rotor craft
    b. 1000 hours in a turbine rotorcraft / helicopter
    c. 100 hours in a helicopter of the make and model to be utilized at National Grid
    d. 300 hours flight time in Wire Environments

For more information, contact a National Grid representative for a copy of EOP T012 *Helicopter Utilization & Notifications.*

15.0 TRANSPORTATION RISKS

Contractor shall define transportation related activities that can have potential process safety consequences. National Grid shall determine if additional risk assessment is needed and contractor shall participate in the assessment. Contractor shall modify their process to mitigate risk that is determined to be intolerable.

APPENDIX A: NATIONAL GRID CONTRACTOR RISK MATRIX

National Grid Contractor Risk Matrix			
Category	**Description of Work**	**Impact of Work**	**Examples to be included in this category (including, but not limited to)**
Medium / High Risk Exposure **Tier I** **Inclusion in ISN Program is Required**	Physical Work, activity, or service that is performed on National Grid property site or is performed off-site where Owner Client has responsibility and is liable for work performed. Includes, but is not limited to, any activity requiring confined space entry, elevated work, work on operating systems involving hazardous energy, work on contaminated sites, and most work requiring a general work permit, hot work permit, or confined space permit.	Work, activity, or service having: • A potential for causing a catastrophic operational incident; • Access to operations; and/or • A direct role in site operations or maintenance, where failure could result in serious harm to employee or public well-being, company assets, or the environment Also includes any Contractor personnel's job function which has no direct or very limited supervision for operational checks.	• Maintenance, Construction and demolition contractors • Chemical cleaning, tank cleaning • Electricians and Instrumentation Technicians • Movers • Welding • Heavy equipment operations • Well drilling and testing • Environmental investigation, remediation, monitoring activities • Hazardous waste handling and/or transport • Excavation • Food service and handling • Equipment Inspection (e.g., X-ray & other NDT) • On-site sampling / gauging activities (not including escorted storm water sampling) • Common carriers transporting Owner Client-owned LNG or petroleum products • Landscaping services • Snow Removal • Janitorial services

			• Vacuum truck affecting/involving process operations • Oil Spill Response Organizations (OSRO) • Work conducted in a high-risk area (i.e. substations, LNG plants, etc.) • Working at elevations greater than 4 ft (includes, but is not limited to): ○ Working in buckets (includes technical advisors) • Working on ladders (straight ladders, extension ladders or step ladders taller than 4ft)
Low Risk Exposure **Tier II** **Inclusion in ISN Program is NOT Required**	Work that is office based such as: • Consultants that do not perform work or activities as described in the Medium/High Risk exposure category • Offsite services • On-site vendor pick-up/delivery and repair services • Work performed by public and private utilities	Work, activity, or service having an indirect role and no, or limited, access to operations or maintenance where failure could result in serious harm to employee or public well-being, company assets, or the environment.	• Mail/package/part delivery or pick-up (e.g. UPS, Fed EX, vendor-specific) • Samples pick-up by laboratory/courier • Office machine servicing (copiers, printer, computer, etc.) • Laboratory apparatus servicing • Storm water Sampling Labs/Contractors (When Escorted by Owner Client personnel) • Deliver/supply services (vending machine, bottled water, laundry) • Municipal waste pick-up • General trash removal services • Off-site repair/fabrication shops (such as pump, safety valve, piping, vehicle)

	• Personnel on-site with Visitor Status, when escorted		• Telephone, electric, local municipal utility services • Regulatory representatives • Technical representatives • Engineering services (when escorted by Owner) • Auditors
A SHE VP can require any contractor to be part of ISN when deemed as a potential risk to National Grid			

Appendix G

National Grid, Safety Procedure – COVID-19 Health & Safety Plan (A-116)

FORWARD

National Grid's vision is to be a world-class safety organization, with zero injuries every day. A critical component of achieving this vision is the careful development, implementation and maintenance of safety procedures. This guidance document, COVID-19 Health and Safety Plan, describes pandemic response measures, taken by National Grid, to help prevent the spread of COVID-19.

Questions regarding this guidance should be referred to National Grid's Safety Department.

Record of Change

Revision	Date	Description
Initial	04/28/2020	Initial creation
1	5/6/2020	Updated Job Brief Checklist to reflect current face covering requirements, vehicle cleaning guide correction
2	5/27/21	Updated face covering guidelines

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1.0 SCOPE OF HEALTH & SAFETY PLAN

National Grid has developed this Health & Safety Plan (HASP) to uniformly apply pandemic response measures to help prevent the spread of the COVID-19 virus. National Grid field personnel and crews have been provided this information and communications.

2.0 PROJECT PERSONNEL

2.1 Roles and Responsibilities

National Grid shall be responsible for the safety of all its employees and shall ensure COVID-19 pandemic measures are in place. Key National Grid personnel are as follows:

Incident Command Structure

The National Grid Incident Command Structure (ICS) has been activated within all Business Units of National Grid's US Operations to respond to the COVID-19 pandemic. Members of the ICS review and approve all operational decisions, with the Incident Commander ultimately responsible for these decisions. The Incident Commander relies upon subject matter experts within the ICS, including the Operations Officer, the Safety and Health Officer, to help set standards and guidance for protective measures to be used to limit the spread of the COVID-19 virus. These Officers, in turn, utilize the expertise of other members of the organization within Operations, Safety, and Health, to assess risks associated with the work being performed and provide guidance on the most effective measures to be used by employees to protect themselves, their coworkers, our customers, and members of the public.

Field Supervisor

The Field Supervisor shall have the responsibility for monitoring and enforcing National Grid COVID-19 pandemic measures and shall ensure that all employees have received and reviewed this Health & Safety plan.

- Serve as the appointed supervisor to oversee field personnel and ensure pandemic measures are being followed
- Ensure field personnel have the appropriate pandemic supplies
- Disseminate all new National Grid COVID-19 communications to all field employees
- Where non-compliance is observed, take prompt corrective action; and
- Have the authority to order a safety stop in the event of a serious safety issue.

Crew Leader

The National Grid crew leader shall be in charge of the day-to-day details of the work to be performed. They shall ensure that work is performed in accordance with National Grid COVID-19 pandemic measures. They will:

- Walk the job site at the start of each day to ensure a safe work environment;
- Where non-compliance is observed, take prompt corrective action; and
- Have the authority to order a safety stop in the event of a serious safety issue.
- Perform the daily job safety briefing before commencing work, whenever a visitor arrives to the job site, and if there is a significant change in the work or when an extended break occurs. As part of the COVID-19 pandemic response, the COVID-19 job brief checklist (Appendix A) shall be used in addition to the applicable departmental job brief form.

Employees

National Grid employees are responsible for following all COVID-19 pandemic measures;

- Each employee is responsible for reporting to supervision any symptoms of COVID-19, of any direct contact with an individual confirmed to have COVID-19, or in contact with a person in quarantine.
- Each employee is obligated to call a safety stop when a hazardous condition is observed.
- All lone workers shall conduct a self-assessment utilizing the COVID-19 job brief checklist (Appendix A) and adhere to the guidance outlined in this plan.

National Grid Field Safety Representative

National Grid Field Safety Representatives conduct routine and random crew visits to National Grid job sites. The National Grid Field Safety Department shall act as a resource for National Grid field personnel to effectively implement this COVID-19 Health & Safety Plan and will be available on an as-needed basis for inquiries related to this HASP.

3.0 COVID-19 PANDEMIC RESPONSE MEASURES

3.1 COVID-19 Symptoms

COVID-19 Symptoms may include the following:

- Fever
- Cough

- Shortness of Breath
- Chills
- Repeated shaking with chills
- Muscle Pain
- Headache
- Sore Throat
- New loss of taste or smell

3.2 Hygiene and Social Distancing

- Wash your hands often with soap and water for at least 20 seconds, especially after using the restroom, before eating, and after blowing your nose, coughing, or sneezing. Hand washing is the best way to prevent the spread of viruses.
- If soap and water are not readily available, use an alcohol-based hand sanitizer with at least 60% alcohol. Always wash hands with soap and water if hands are visibly dirty.
- **Proper hand washing/sanitizing products will be provided to all employees**
- Maintain a minimum of 6' social distance from other employees on site while performing work and during routine breaks. When work tasks prevent this, ensure proper face coverings are continued to be worn and proper hygiene
- Avoid touching your eyes, nose, and mouth.
- Cover your cough or sneeze with a tissue, then throw the tissue in the trash.
- Clean and disinfect frequently touched objects and surfaces using a disinfecting cleaning spray or wipe; if not available, use a soap and water solution.
- All cleaning product trash and potentially contaminated PPE will be stored in a trash bag and immediately disposed of at a National Grid facility at the end of each shift. Trash should not accumulate in any National Grid vehicle. Immediately wash hands upon disposing of trash bag.

3.3 COVID-19 PPE and Face Coverings

Effective June 1, 2021, National Grid will be revising its <u>outdoor face covering</u> policy to align with recent state guidelines and CDC recommendations. All other COVID protocols, including those related to indoor face covering requirements, will remain in place. The Company will continue to monitor federal and state guidance and will revisit the remaining protocols within 30 days.

Outdoors:
Face coverings will **<u>not</u>** be required outside in public for **fully vaccinated persons** or **where 6 ft socially distancing** can be accomplished. Employee that prefer to continue to mask- up even if fully vaccinated are encouraged to do so.

Indoors:
Face coverings are required inside National Grid facilities and must be worn upon entry. They can be temporarily removed while seated and working alone at a desk/cubicle with 6 ft of distance from

others. Face coverings must be put back on when standing up, moving about or when a coworker is standing or walking in their vicinity. Face coverings can also be removed when an employee is working alone in an enclosed room with a door, such as an individual office. Face coverings cannot be removed in enclosed spaces, including individual offices, conference rooms, training rooms, huddle rooms, storm rooms, locker rooms or any other such space when occupied by more than one person, regardless of ability to social distance within the room.

3.4 COVID-19 Virus Risk Assessment and Adopted Measures

National Grid's prescribed measures (work practices, PPE, hygiene) were selected based upon the risk assessments completed by subject matter experts and reported up through the ICS for approval. They are based upon the Centers for Disease Control & Prevention (CDC) and OSHA guidance, as well as input from Operations, Safety, and Health team members. They are believed to address all risks posed to our workforce, as well as to our customers and members of the public, when jobs are conducted in public places. These measures are reviewed on a continuous basis, for both effectiveness and to ensure the latest guidance is incorporated, with changes made, as necessary, after these reviews.

4.0 COVID-19 REPORTING PROCESS

4.1 COVID-19 Job Brief Checklist

In addition to the applicable departmental job brief form, all crew leaders shall utilize the COVID-19 job brief checklist to facilitate crew discussion regarding symptoms of COVID-19 and allow for discussion to help facilitate the reporting of a COVID-19 incident. All visitors to the job site will be required to have the job brief and COVID-19 checklist reviewed with them by the crew leader prior to entry on the job site.

Remember to maintain social distancing while conducting the job brief

4.2 COVID-19 Incident Reporting

To ensure the safety of all employees and the public, any employee shall immediately contact their Supervisor and National Grid Employee Services if one of the following conditions occur:

- Employee is exhibiting symptoms of COVID-19
- Employee has been in close contact of another individual with COVID-19
- Employee has been in close contact of another individual who is currently being quarantine for a suspected case of COVID-19

Close contact is defined as being within 6' of a sick/quarantined individual for more than 15 minutes.

Please refer to the COVID-19 Suspected/Confirmed Positive Process guidance document in Appendix A.

Appendix A – National Grid COVID-19 Communications

A Message from John Bruckner

National Grid US Coronavirus Incident Commander

Updated Guidance on Face Coverings

April 16, 2020



The state of New York and the state of Rhode Island recently issued executive orders requiring all essential employees who are working in public places to wear face coverings when distance from the public or co-workers cannot be maintained. As a result, we are updating our company policy to align safety standards for all employees.

We had previously communicated that wearing a face covering was voluntary based on CDC recommendations. We are now **requiring** National Grid employees to wear face coverings in the situations below. Please note that this applies to both **office** and **field-based** employees, and applies across **all jurisdictions**.

Face coverings must be worn:

- ✓ When working in public places
- ✓ When working in a customer's premises
- ✓ When social distancing is not able to be maintained with a co-worker, customer or member of the public in a National Grid facility, barn/yard, work location or company vehicle.

- This directive is effective at 8:00 pm this evening for all New York employees.
- It is effective starting this Saturday for all Rhode Island and Massachusetts employees.
- If you are working from home, our company guidance remains: If you can work from home, you should.

What qualifies as a face covering?

Employees may use either a company-issued or a personal face covering, depending on preference and availability. These include:

- Disposable masks, which need to be changed daily or if significantly dirty.
- Reusable FR Balaclavas, which need to be laundered daily, according to CDC cleaning guidance.
- Reusable FR neck warmers, which need to be laundered daily, according to CDC cleaning guidance.
  - Please note: Face pieces must be made from Flame Resistant (FR) material if they are worn when working in an energized zone or there is potential for a gas ignition.

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How to get a face covering:

Our procurement and warehouse teams are working directly with teams to ensure a steady supply of face coverings.

It is our intention to provide company-supplied face coverings widely, but in instances where one is not available or preferred, a personal covering may still be used.

Operations teams should work through their normal channels to order face coverings. We will be providing further guidance to office-based colleagues on where they can access face coverings.

CDC guidance on personal face coverings can be found here:

- https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/cloth-face-cover.html
- https://www.cdc.gov/coronavirus/2019-ncov/downloads/DIY-cloth-face-covering-instructions.pdf

Face coverings should:

- Fit snugly but comfortably against the side of the face
- Be secured with ties or ear loops, if provided
- Include multiple layers of fabric
- Allow for breathing without restriction
- Be removed from behind head or ears to minimize hand contact with face
- Be laundered and machine dried if reusable

Cleaned, dried coverings can be kept in a clean plastic bag until needed for use

It is important to note that face coverings, whether company-issued or personal, are not a substitute for taking measures that are known to be effective in stopping the spread.

Handwashing, and maintaining a social distance of 6 feet apart from others remains the most critical guidance that we can follow.

Sincerely,

John Bruckner

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COVID-19 Job Brief Checklist

Please Distribute

During this trying time it is important that we maintain our same level of focus at work locations conducting hazard assessments and identifying risks prior to the start of each task. Prior to beginning work at every location, when conditions, job focus or crew members change, after each meal period and after any prolonged interruption to the work, a **Job Briefing** shall be held.

The work to be performed shall be discussed and assigned, and the safety aspects of the job shall be reviewed. The National Grid protocol to screen all individuals to determine who may have been exposed to COVID-19 outside of work **must be reviewed** at the start of the workday and Job Briefing.

(Employees working alone shall conduct a self-assessment to determine if they may have been exposed to COVID-19 outside of work or should their condition change during the workday)

The questions are:

- ☐ Are you feeling ill in any way? For instance, do you have any of the following symptoms: A fever? A cough? Shortness of breath? Chills? Repeated shaking with chills? Muscle pain? Headache? Sore throat? New loss of taste or smell?
- ☐ Have you had close contact with a symptomatic person (e.g., fever, cough, and/or shortness of breath, chills, repeated shaking with chills, muscle pain, headache, sore throat, new loss of taste or smell) within the last 14 days?
- ☐ Have you had close contact with a person who was tested with results pending or positive for coronavirus within the last 14 days?
- ☐ Have you recently been out of state for non-work related travel (within the last 14 days)?

*Employees who answer **"YES"** to any of these questions must distance themselves from others, not enter the work area, and immediately contact their supervisor privately for further instruction.*

The employee must also contact the National Grid Employee Services Hotline 1-888-483-2123.

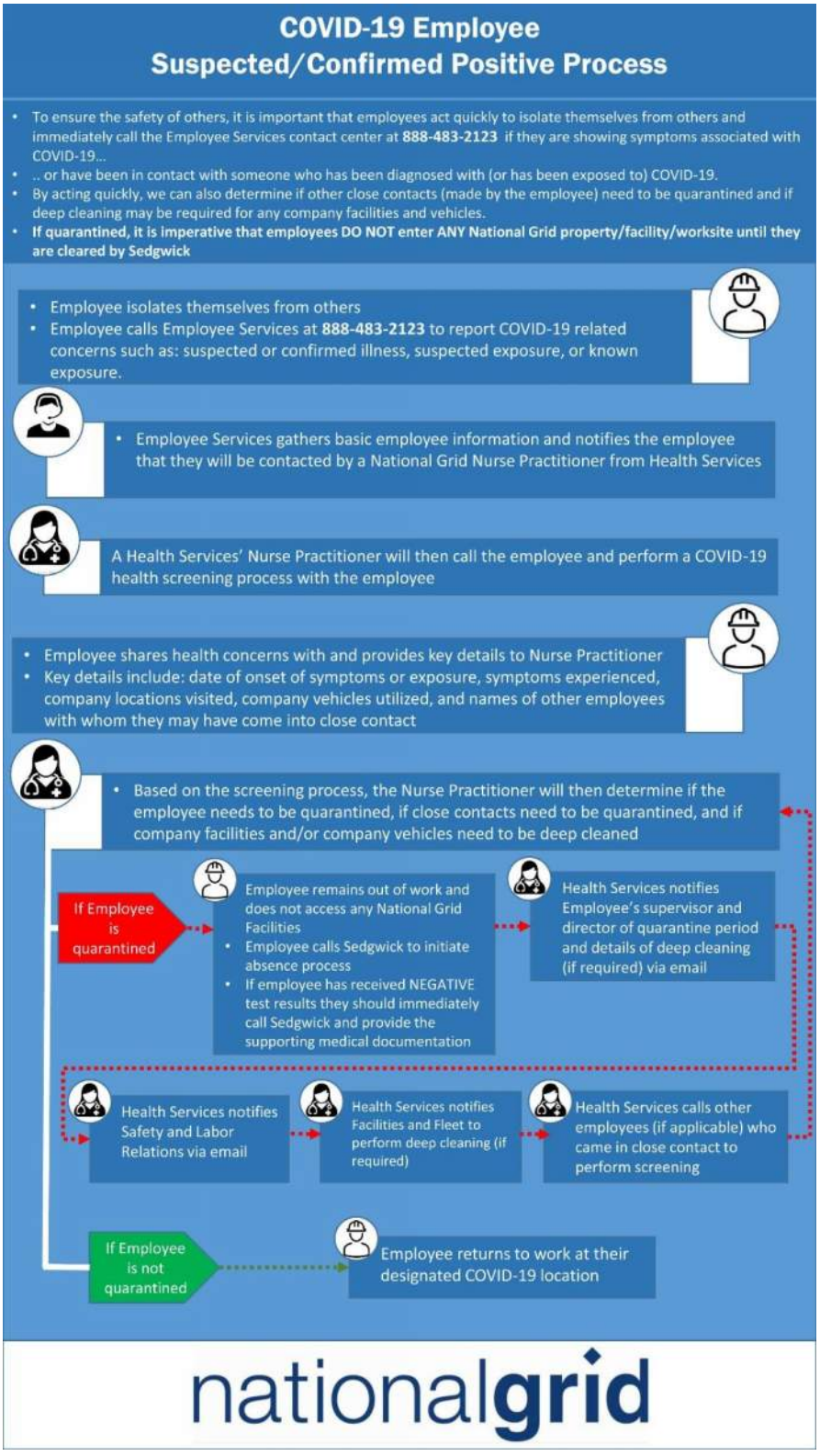
Employees who answer **"NO"** to all of these questions proceed with work activities as planned.

Please note on the Job Brief that you asked these COVID-19 Screening Questions.

To reduce multiple people handling the job brief during the COVID-19 pandemic crew leaders should handle all documentation and record who is present on site after they have reviewed the job brief with each employee or visitor.

REMINDER - Please be sure to follow CDC recommendations

- Maintain a minimum 6' social distance from other people
- Employees must wear a face covering: when working in public places, when working in a customers premise, or when social distancing is not able to be maintained with a co-worker, customer, or member of the public in a National Gird facility, barn/yard, work location, or company vehicle.
- Avoid touching your eyes, nose, and mouth.
- Clean and disinfect frequently touched objects and surfaces using either a EPA registered disinfectant (Lysol, Clorox, etc.), soap and water, or a bleach and water mixture (1/3rd cup bleach per gallon of water)
- Use the fold of your arm to cover a sneeze or cough
- Wash your hands often with soap and water for at least 20 seconds, especially after going to the bathroom; before eating; and after blowing your nose, coughing, or sneezing.
    - If soap and water are not readily available, use an alcohol-based hand sanitizer with at least 60% alcohol. Always wash hands with soap and water if hands are visibly dirty.


COVID-19 Employee
Suspected/Confirmed Positive Process
To ensure the safety of others, it is important that employees act quickly to isolate themselves from others and immediately call the Employee Services contact center at 888-483-2123 if they are showing symptoms associated with COVID-19...
.. or have been in contact with someone who has been diagnosed with (or has been exposed to) COVID-19.
By acting quickly, we can also determine if other close contacts (made by the employee) need to be quarantined and if deep cleaning may be required for any company facilities and vehicles.
If quarantined, it is imperative that employees DO NOT enter ANY National Grid property/facility/worksite until they are cleared by Sedgwick
Employee isolates themselves from others
Employee calls Employee Services at 888-483-2123 to report COVID-19 related concerns such as: suspected or confirmed illness, suspected exposure, or known exposure.
Employee Services gathers basic employee information and notifies the employee that they will be contacted by a National Grid Nurse Practitioner from Health Services
A Health Services' Nurse Practitioner will then call the employee and perform a COVID-19 health screening process with the employee
Employee shares health concerns with and provides key details to Nurse Practitioner
Key details include: date of onset of symptoms or exposure, symptoms experienced, company locations visited, company vehicles utilized, and names of other employees with whom they may have come into close contact
Based on the screening process, the Nurse Practitioner will then determine if the employee needs to be quarantined, if close contacts need to be quarantined, and if company facilities and/or company vehicles need to be deep cleaned
If Employee is quarantined
Employee remains out of work and does not access any National Grid Facilities
Employee calls Sedgwick to initiate absence process
If employee has received NEGATIVE test results they should immediately call Sedgwick and provide the supporting medical documentation
Health Services notifies Employee's supervisor and director of quarantine period and details of deep cleaning (if required) via email
Health Services notifies Safety and Labor Relations via email
Health Services notifies Facilities and Fleet to perform deep cleaning (if required)
Health Services calls other employees (if applicable) who came in close contact to perform screening
If Employee is not quarantined
Employee returns to work at their designated COVID-19 location
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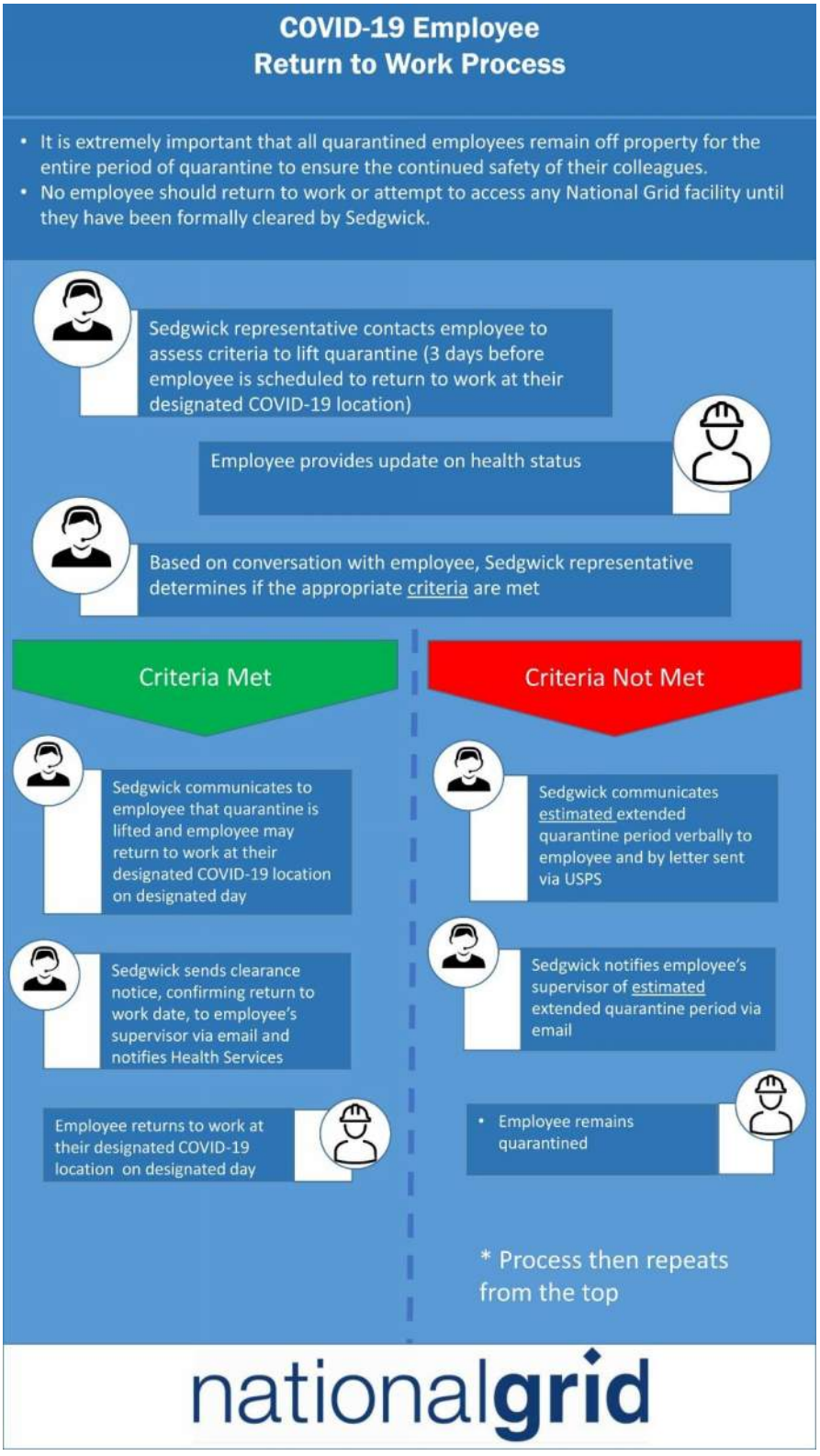
COVID-19 Employee
Return to Work Process
It is extremely important that all quarantined employees remain off property for the entire period of quarantine to ensure the continued safety of their colleagues.
No employee should return to work or attempt to access any National Grid facility until they have been formally cleared by Sedgwick.
Sedgwick representative contacts employee to assess criteria to lift quarantine (3 days before employee is scheduled to return to work at their designated COVID-19 location)
Employee provides update on health status
Based on conversation with employee, Sedgwick representative determines if the appropriate criteria are met
Criteria Met
Criteria Not Met
Sedgwick communicates to employee that quarantine is lifted and employee may return to work at their designated COVID-19 location on designated day
Sedgwick sends clearance notice, confirming return to work date, to employee's supervisor via email and notifies Health Services
Employee returns to work at their designated COVID-19 location on designated day
Sedgwick communicates estimated extended quarantine period verbally to employee and by letter sent via USPS
Sedgwick notifies employee's supervisor of estimated extended quarantine period via email
Employee remains quarantined
* Process then repeats from the top
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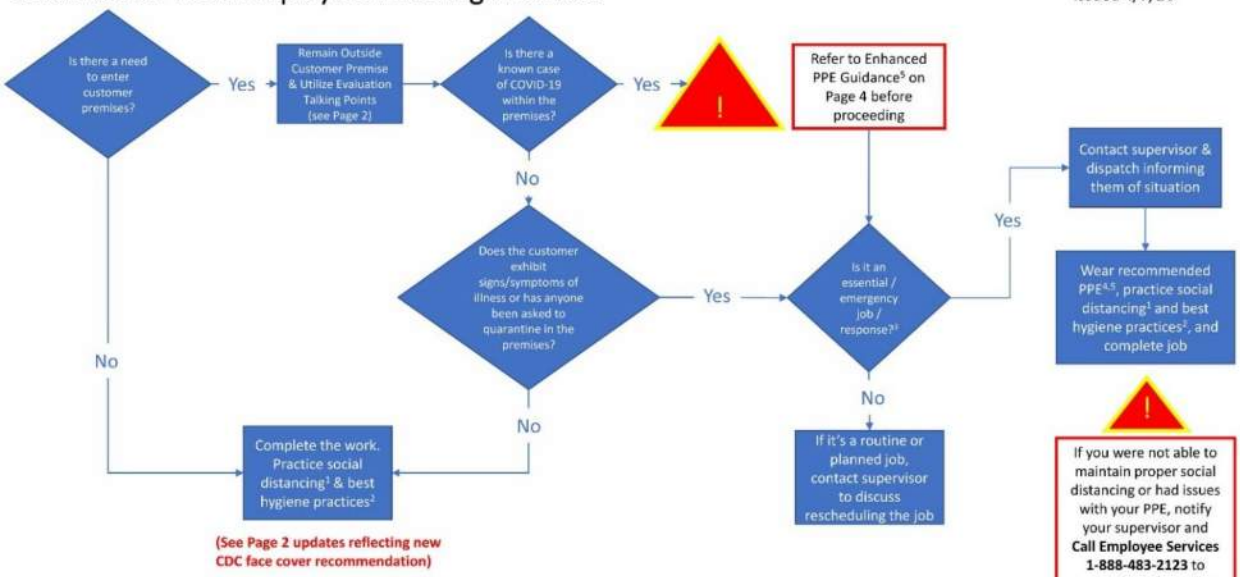
Guidance for Field Employees Entering Premises

Issued 4/7/20



(See Page 2 updates reflecting new CDC face cover recommendation)

See Page 2 for additional information on Talking Points, CDC Recommendations for (1) Social Distancing and (2) Best Hygiene Practices
See Page 3 for National Grid (3) Emergency Work at a Premises and (4) Standard PPE Guidance
See Page 4 for National Grid (5) Enhanced PPE Guidance

1

Issued 4/8/20

Talking Points - Engage Customer

Prior to entry, engage the customer and advise of social distancing practices. Here are some questions and statements.

- Does someone within the premises have a known case of COVID-19? Has someone within the premises tested positive for the COVID-19 virus?

(IF ANSWER IS 'YES' TO EITHER OF THE ABOVE QUESTIONS, REFER TO ENHANCED PPE GUIDANCE ON PAGE 4)

- Do you mind if I follow the social distancing practice today?
- Is anyone currently sick inside the premises?
- If you are feeling sick, would you mind remaining in another room while I am working This is a best practice policy my company is recommending. Can you tell me where your equipment is located?
- I will do my job, keep you updated and tell you when I am done

(1) Social Distancing

- Maintain at least 6 feet distance between yourself and the customer at all times
- Where social distancing measures cannot be maintained, face cover can be worn to help limit the spread of the virus (see National Grid's Face Cover Guidance for details)

(2) Best Hygiene Practices

- Face covering can be worn in public settings where social distancing measures cannot be maintained (see National Grid's Face Cover Guidance for details)
- Use alcohol-based hand sanitizer (at least 60% alcohol), before and after each home visit; OR wash hands using soap and water for 20 seconds

2

Issued 4/8/20

(3) Emergency Work at a Premises

On arrival, assess the premise/situation in its entirety and consider these questions.

- Is it a multi-unit building?
  - Is the unit where work is required affected?
- What work can be done without interaction/entry?
- Is entry through a side or back door possible to limit exposure?
- Can make safe actions be taken without interaction/entry?
  - Securing Outside Meter/Curb Valve
- Would a hardship be caused by isolating the service?

Note: These questions and considerations are meant to help guide in the decision making process. There may be instances where access to a premise cannot be avoided in order to address immediate public safety concerns. Please reference the Social Distancing and applicable PPE Guidance in all situations.

(4) Standard PPE Guidance for Entering a Premises (No Known COVID-19 cases are present)

- Avoid touching ANYTHING in customer premises other than company equipment and customer equipment related to the job
- Wear disposable latex or nitrile gloves to prevent touching contaminated surfaces
- Latex or nitrile gloves should be donned before entering the home
  - If work gloves are needed to perform the task, remove disposable latex or nitrile gloves and dispose of them. Don work gloves and perform task. Once task is complete remove work gloves and store them. Don a new pair of disposable latex or nitrile gloves to exit the home.
- Remove latex or nitrile gloves and dispose in way that won't create other opportunities for exposure
- Immediately wash / sanitize hands after removing latex or nitrile gloves
- All other PPE normally required for the work being performed should be used

3

Issued 4/8/20

(5) Enhanced PPE Guidance for Entering a Premise (Where a Known COVID-19 Case is Present)

The most effective way to protect the employees from contracting the virus is physical distance; if at all possible, the customer diagnosed with COVID-19 should be asked to move to a separate room before premises entry. When available and practicable, the following PPE items may be used at the premises with a known COVID-19 case present. These PPE items can be used in combination with our Social Distancing and Best Hygiene Practices to limit the spread of the virus.

- N-95 / KN-95 mask (see Page 5 for pictures of typical N-95 / KN-95 masks available)
- Reusable Face Shield
- Disposable Surgical Gloves (nitrile or latex)
- All other PPE required for doing the work (i.e. safety glasses, hard hat, etc.)
- If desired, FR-rated balaclava may be worn to provide additional protection while working

The following steps should be taken while conducting work in the premises:

- Prepare a paper or plastic bag for disposal of used PPE prior to entering the premises.
- Avoid touching ANYTHING in customer premises other than company equipment and customer equipment related to the job.
- Wear disposable latex or nitrile gloves to prevent touching contaminated surfaces.
- Any PPE should be donned before entering the home.
- If a mask is in use, avoid touching your face or adjusting the mask.
- If work gloves are needed to perform the task, remove disposable latex or nitrile gloves and dispose of them. Don work gloves and perform task. Once task is complete remove work gloves and store them. Don a new pair of disposable latex or nitrile gloves to exit the home.

Once work is completed in the home, follow these steps to safely remove the PPE items

- Remove face shield, taking care to avoid touching your face. Clean / disinfect and store properly.
- Remove mask from the back of the head first, taking care to avoid touching your face. Place used mask in a bag and dispose in normal trash.
- If balaclava has been worn, remove covering from back of head, similar to removal of mask.
- Remove latex or nitrile gloves (turn inside out while removing) and place in a bag. Dispose of bag in normal trash.
- Immediately wash / sanitize hands after removing latex or nitrile gloves, following Best Hygiene Practices.

4

Issued 4/8/20

Typical N-95 / KN-95 masks





5

Safeguarding your Vehicle

Now, more than ever, with COVID-19, precautions to safeguard your vehicle when transferring the vehicle to another employee, or when taking your vehicle in for maintenance, is very important.

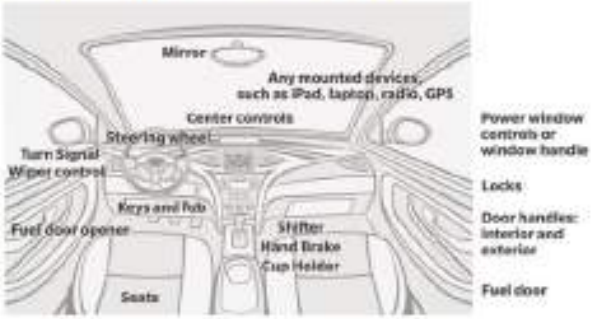
Here are some high-touch areas that should **never** be missed:

• Mirror • Center controls • Keys and fob • Wiper control • Climate control • Audio controls • Hand brake • Seats *(driver/passenger)*/Seatbelts • Fuel door opener • Windows • Headrests • Armrests	• All mounted devices *(any and all electronic devised used - i.e. iPad, laptop, radio, GPS, phone chargers)* • Steering wheel • Headlight switch • All cabin lighting controls • Shifter • Cup holder • Door handle*(inside and out)*/Window control/locks • Air vent • Sun visors

Use disinfectant wipes, diluted bleach solution, or damp soapy water wipes when cleaning all hard surfaces throughout the vehicle.

To guide your efforts when cleaning the vehicle, think about where droplets would fall when you sneeze or cough *(for example: do you turn your head to the side?) and remember to think about your own personal safety:*

- Be sure to wash your hands for **20 seconds** after completing the cleaning process.
- If you take your vehicle home at night, be sure to lock it to prevent it from being compromised.
- Make sure you have a mask and gloves (when/where appropriate).



Before you leave or enter the vehicle – here's a checklist to keep you safe and your team members safe as well:

Activity to Safeguard	✔
Keys / Fob	
Door Handles (interior/exterior)	
Steering Wheel, Shift Lever, Brake Lever, Wiper Stalk, Turn Signal Stalk	
Air Vents, Console, Dashboard, Cup Holder	
Exterior and Interior Fueling Latch, Cover, Cap	
Seats, Seatbelts, Headrests	
Mirrors, Windows, Window Controls	
Interior Lights	
Sun Visors	
Passenger and Driver Door Armrests, Grab Handles, Seat Adjusters	
All Electronic Devices used while in vehicle (iPads, Navigation Systems, Phone Chargers, Laptops, etc.)	

Additional considerations for crew trucks:

Handles on bin doors	
Equipment controls (bucket / digger)	

**** Please consider any other touch point identified by a crew member but not listed***



Contract Employees COVID-19 Reporting Process

Health Services does not typically manage the absences of our contract employees, "contractors". However, to protect our employees, we are screening sick/exposed contractors to determine if they have come into contact with National Grid employees, or if a facilities/vehicle deep cleaning is required. Contract employees are required to call Employee Services (ES) (888) 483-2123 directly. If the contractor does not call Employee Services, the National Grid supervisor may call ES to report the contractor out of work and to initiate contact tracing.

Contractors must be cleared to return to work (RTW) at National Grid by their employer. Per National Grid best practices, we are recommending a 14-day quarantine beginning on the date of notification for all contractors who are sick or believe they have been exposed to COVID-19.

Reporting Process:

1. Contractors call Employee Services **(888) 483-2123** for screening
2. Nurse Practitioner (NP) screens the contractor to determine National Grid close contacts, or if a National Grid facility or vehicle requires deep cleaning. NP obtains employer name and contact email from contractor
3. NP advises contractor to contact their doctor and their employer
4. An email will be sent to National Grid supervisor and the contractor's employer with quarantine start and end date (see email below)
5. Contractor must follow employer's RTW process and complete recommended quarantine (and be symptom free for 3 days)
6. NP will notify any National Grid close contacts to quarantine for 14 days and email National Grid supervisor(s)
7. After 14 days have elapsed, the contractor's employer must send an email to NP confirming that the contractor has returned to work, i.e., all RTW notifications and documentation must be forwarded to Mary Brown, NP Mary.Brown2@nationalgrid.com

Supervisor:

If you are calling Employee Services to report a contractor out of work so that we may initiate contact tracing, or a facilities deep cleaning, please be prepared to answer the following questions when speaking with the NP regarding your contractor:

- Contract employee name

- Contract Employer
- Contract Employer supervisor and email address
- Last date contractor was on National Grid worksite
- National Grid employees the contractor has been in close contact with
- Facilities/vehicle deep cleaning required

email sent to supervisor when contractor is taken out of work for quarantine:

RE: Quarantine Confidential

The contract employee "contractor" listed below has been quarantined and cannot report to a National Grid worksite until they have completed the recommended quarantine. This contractor will follow their employer's process for return to work. After the recommended quarantine has elapsed, and the contractor has been cleared to return to work by their employer, please send email to (Mary.Brown2@nationalgrid.com) to let us know the contractor is back on site.

Contract Employee Name:
Department/Contractor company:
National Grid Supervisor:
Quarantine start date:
End Date:

ORDER OF THE COMMISSIONER
OF HEALTH AND MENTAL HYGIENE
TO REQUIRE COVID-19 VACCINATION IN THE WORKPLACE

WHEREAS, on March 12, 2020, Mayor Bill de Blasio issued Emergency Executive Order No. 98 declaring a state of emergency in the City to address the threat posed by COVID-19 to the health and welfare of City residents, and such Order remains in effect; and

WHEREAS, on March 25, 2020, the New York City Commissioner of Health and Mental Hygiene declared the existence of a public health emergency within the City to address the continuing threat posed by COVID-19 to the health and welfare of City residents, and such declaration and public health emergency continue to be in effect; and

WHEREAS, the COVID-19 virus continues to spread and mutate, and on November 26, 2021, the World Health Organization ("WHO") declared a new variant of COVID-19, named Omicron, a variant of concern and preliminary evidence suggests an increased risk of reinfection and spread across the world, including to the United States; and

WHEREAS, on November 26, 2021, New York State Governor Kathy Hochul issued Executive Order No. 11 to address new emerging threats across the State posed by COVID-19, finding that New York is experiencing COVID-19 transmission at rates the State has not seen since April 2020 and that the rate of new COVID-19 hospital admissions has been increasing over the past month to over 300 new admissions a day; and

WHEREAS, COVID-19 spreads when an infected person exhales the virus and these are breathed in by other people or land on their eyes, noses, or mouth, with people closer than 6 feet from the infected person most likely to get infected, making the risk of COVID-19 transmission greater in workplace settings because of close proximity to others and the sharing of office space and facilities such as restrooms, elevators, lobbies, meeting and break rooms, and other common areas; and

WHEREAS, the WHO and the U.S. Centers for Disease Control and Prevention ("CDC") have advised all individuals to take measures to reduce their risk of COVID-19, especially the Delta and Omicron variants, including vaccination, which is an effective tool to prevent the spread of COVID-19 and benefits both vaccine recipients and those they come into contact with, including persons who for reasons of age, health, or other conditions cannot themselves be vaccinated; and

WHEREAS, a study by Yale University demonstrated that the City's vaccination campaign was estimated to have prevented about 250,000 COVID-19 cases, 44,000 hospitalizations and 8,300 deaths from COVID-19 infection since the start of vaccination through July 1, 2021, and the City believes the number of prevented cases, hospitalizations and death has risen since then; and that between January 1, 2021, and June 15, 2021, over 98% of hospitalizations and deaths from COVID-19 infection involved those who were not fully vaccinated;

WHEREAS, a system of vaccination that requires employers to implement vaccination policies for their employees will potentially save lives, protect public health, and promote public safety; and

WHEREAS, on September 9, 2021, President Biden issued an Executive Order stating that "It is essential that Federal employees take all available steps to protect themselves and avoid spreading COVID-19 to their co-workers and members of the public," and ordering each federal agency to "implement, to the extent consistent with applicable law, a program to require COVID-19 vaccination for all of its Federal employees, with exceptions only as required by law"; and

WHEREAS, on August 16, 2021, Mayor Bill de Blasio signed Emergency Executive Order No. 225, the "Key to NYC," which requires the employees, as well as patrons, of establishments providing indoor entertainment, dining, and fitness to show proof of at least one dose of an approved COVID-19 vaccine, and such Order, as reissued in Emergency Executive Order No. 316 on December 13, 2021, is still in effect; and

WHEREAS, on August 24, 2021, I issued an Order requiring that Department of Education employees, contractors, and visitors provide proof of COVID-19 vaccination before entering a DOE building or school setting, and such Order was re-issued on September 12 and 15, 2021, and subsequently amended on September 28, 2021, and such Orders and amendment were ratified by the Board of Health on September 17, 2021 and October 18, 2021; and

WHEREAS, on September 12, 2021, I issued an Order requiring that staff of early childhood programs or services provided under contract with the Department of Education or the Department of Youth and Community Development provide proof of COVID-19 vaccination, and that Order was ratified by the Board of Health on September 17, 2021; and

WHEREAS, on October 20, 2021, I issued an Order requiring that City employees provide proof of vaccination to their agencies or offices by October 29, 2021 or be excluded from their workplace, and on October 31, 2021, I issued a supplemental Order, and both Orders were ratified by the Board of Health on November 1, 2021; and

WHEREAS, on November 17, 2021, I issued an Order requiring COVID-19 vaccinations for staff of child care programs, as defined therein, and in early intervention programs, and such Order was ratified by the Board of Health on November 19, 2021; and

WHEREAS, on December 2, 2021, I issued an Order requiring COVID-19 vaccinations for all nonpublic school staff and volunteers; and

WHEREAS, pursuant to Section 558 of the New York City Charter (the "Charter"), the Board of Health may embrace in the Health Code all matters and subjects to which the power and authority of the Department of Health and Mental Hygiene ("the Department") extends; and

WHEREAS, pursuant to Section 556 of the Charter and Section 3.01(c) of the Health Code, the Department is authorized to supervise the control of communicable diseases and

conditions hazardous to life and health and take such actions as may be necessary to assure the maintenance and protection of public health; and

WHEREAS, Section 17-104 of the New York City Administrative Code ("Administrative Code") directs the Department to adopt prompt and effective measures to prevent the communication of infectious diseases such as COVID-19, and in accordance with Section 17-109(b) of Administrative Code, the Department may adopt vaccination measures to effectively prevent the spread of communicable diseases; and

WHEREAS, pursuant to Section 3.01(d) of the Health Code, I am authorized to issue orders and take actions that I deem necessary for the health and safety of the City and its residents when urgent public health action is needed to protect the public health against an existing threat and a public health emergency has been declared pursuant to such section; and

NOW THEREFORE, I, Dave A. Chokshi, MD, MSc, Commissioner of the Department of Health and Mental Hygiene, finding that a public health emergency within New York City continues, and that it is necessary for the health and safety of the City and its residents, do hereby exercise the power of the Board of Health to prevent, mitigate, control and abate the current emergency, and hereby order that:

1. Beginning December 27, 2021, workers must provide proof of vaccination against COVID-19 to a covered entity before entering the workplace, and a covered entity must exclude from the workplace any worker who has not provided such proof, except as provided in paragraph 5.

2. Covered entities shall verify workers' proof of vaccination. Covered entities shall:

    a. maintain a copy of each worker's proof of vaccination and, if applicable, a record of reasonable accommodation(s) as described in (b)(iv); *OR*

    b. maintain a record of such proof of vaccination, provided that such record shall include:

        i. the worker's name; and

        ii. whether the person is fully vaccinated; and

        iii. for a worker who submits proof of the first dose of a two-dose vaccine, the date by which proof of the second dose must be provided, which must be no later than 45 days after the proof of first dose was submitted; and

        iv. for a worker who does not submit proof of COVID-19 vaccination because of a reasonable accommodation, the record must indicate that such accommodation was provided, and the covered entity must separately maintain records stating the basis for such accommodation and any supporting documentation provided by such worker; *OR*

    c. check the proof of vaccination before allowing a worker to enter the workplace and maintain a record of the verification.

For a non-employee worker, such as a contractor, a covered entity may request that the worker's employer confirm the proof of vaccination in lieu of maintaining the above records. A covered entity shall maintain a record of such request and confirmation.

Records created or maintained pursuant to this section shall be treated as confidential.

A covered entity shall, upon request by a City agency, make available for inspection records required to be maintained by this section, consistent with applicable law.

3. No later than December 27, 2021, a covered entity shall affirm on a form provided by the Department compliance with the requirements of paragraph 2 of this Order and post the affirmation in a conspicuous location.

4. For purposes of this Order:

    a. "Covered entity" means:

        i. a non-governmental entity that employs more than one worker in New York City or maintains a workplace in New York City; or

        ii. a self-employed individual or a sole practitioner who works at a workplace or interacts with workers or the public in the course of their business.

    b. "Fully vaccinated" means at least two weeks have passed after an individual received a single dose of a COVID-19 vaccine that requires only one dose, or the second dose of a two-dose series of a COVID-19 vaccine approved or authorized for use by the Food and Drug Administration or World Health Organization, or any other circumstance defined by the Department in its guidance associated with this Order.

    c. "Proof of vaccination" means one of the following documents demonstrating that an individual has (1) been fully vaccinated against COVID-19; (2) received one dose of a single-dose COVID-19 vaccine; or (3) received the first dose of a two-dose COVID-19 vaccine, provided that a worker providing proof of only such first dose provides proof of receiving the second dose of that vaccine within 45 days after receiving the first dose:

        i. A CDC COVID-19 Vaccination Record Card or other official immunization record from the jurisdiction, city, state, or country where the vaccine was administered, or from a healthcare provider or other approved immunizer who administered the vaccine, that provides the person's name, vaccine brand, and date of administration. A digital photo or photocopy of such record is also acceptable.

        ii. New York City COVID Safe App showing a vaccination record;

        iii. A valid New York State Excelsior Pass/Excelsior Pass Plus;

        iv. CLEAR Health Pass; or

v. Any other method specified by the Commissioner as sufficient to demonstrate proof of vaccination.

d. "Worker" means an individual who works in-person in New York City at a workplace. Worker includes a full- or part-time staff member, employer, employee, intern, volunteer or contractor of a covered entity, as well as a self-employed individual or a sole practitioner.

Worker does not include:

i. an individual who works from their own home and whose employment does not involve interacting in-person with co-workers or members of the public;

ii. an individual who enters the workplace for a quick and limited purpose; or

iii. non-City residents who are performing artists, college or professional athletes, or individuals accompanying such performing artists or college or professional athletes who do not have to display proof of vaccination pursuant to the Key to NYC program, Emergency Executive Order No. 316 and successor Orders.

e. "Workplace" means any location, including a vehicle, where work is performed in the presence of another worker or member of the public.

5. Nothing in this Order shall be construed to prohibit reasonable accommodations for medical or religious reasons.

6. This Order shall not apply to covered entities or individuals who are already subject to another Order of the Commissioner of the Department, Board of Health, the Mayor, or a State or federal entity that is in effect and requires them to maintain or provide proof of full vaccination or to individuals who have been granted a reasonable accommodation pursuant to such requirement.

7. This Order shall take effect immediately, and remain in effect until rescinded, subject to the authority of the Board of Health to continue, rescind, alter, or modify this Order pursuant to Section3.01(d) of the Health Code.

Dated: December 13, 2021

Dave A. Chokshi, MD, MSc
Commissioner

Guidance for Employers on Equitable Implementation of COVID-19 Vaccine Requirements

The New York City Commission on Human Rights is a resource to help employers strengthen their business, become more inclusive employers, and conform their employment practices to the New York City Human Rights Law (NYCHRL).

As a result of the public health crisis posed by COVID-19 and the effectiveness of available vaccines against COVID-19 infection, many employers in New York City already require their employees to show proof of vaccination against COVID-19. Beginning December 27, 2021, most employees in New York City will be required to provide proof of vaccination against COVID-19 in order to enter their workplaces.

New York City employers with four or more employees are covered by the NYCHRL. This document provides guidance to covered employers on how to ensure equitable implementation of vaccine requirements for their employees, independent contractors, and interns.

1. PROHIBITION ON DISCRIMINATION

When implementing vaccine requirements, employers should take care that their policies and practices do not treat employees differently because of their race, national origin, disability, gender, religion/creed, age, or any other characteristic protected by the NYCHRL.

For example, employers should not:

- Scrutinize proof of vaccination more closely when it is provided by employees of a particular race, national origin, or religion based on the perception that people in those groups are less likely to be vaccinated;
- Require proof of vaccination only for older employees or employees with disabilities based on the belief that COVID-19 is more dangerous for them; or

Refuse to accept certain types of valid proof of vaccination, such as official immunization records from countries outside the United States or photographs of CDC vaccination cards.

2. REASONABLE ACCOMMODATIONS

When applying vaccine requirements, employers must consider requests for reasonable accommodations from employees who need them because of disability, pregnancy, childbirth, lactation, religious beliefs or observances, or status as a victim of domestic violence, stalking, or sex offenses. If an employee requests an exception to a vaccine requirement or additional time to provide their proof of vaccination for one of these reasons, their employer must engage with them in a cooperative dialogue, or a good faith discussion, to see if a reasonable accommodation is possible.

Reasonable accommodations can take many forms. For example, an unvaccinated employee could work remotely, submit to regular testing for COVID-19 infection and wear personal protective equipment, change their work station or work schedule to avoid close contact with coworkers or customers, and/or take a leave of absence. Employers do not have to grant any reasonable accommodation that would cause a direct threat to other employees or customers, or to the requester, or otherwise impose an undue hardship on the employer's business. Examples of accommodations that are likely to pose a direct threat include accommodations that would allow an unvaccinated employee to engage in a high-risk activity, such as yelling or exercising, while in close proximity to others, or to work in close proximity to high-risk individuals.

If there is no reasonable accommodation that would enable an unvaccinated employee to continue performing their job duties without posing a direct threat or an undue hardship, their employer can offer a leave of absence until the employee is able to provide proof of vaccination, or until it is otherwise safe for them to return to work. Employers do not need to pay employees during a leave of absence unless the employer pays other workers who are unable to work for similar reasons.

Employers responding to reasonable accommodation requests from employees regarding vaccine requirements should adhere to the following principles regarding whether and when to request supporting documentation:

- Employees who are seeking reasonable accommodations because of a disability, pregnancy, childbirth, or lactation can be asked to provide a note from their medical provider.
- Employees who are seeking reasonable accommodations because of their religious beliefs should not be required to submit supporting documentation unless their employer has an objective basis to question the sincerity of the religious basis for the employee's inability to show proof of vaccination. However, employees may be asked to explain the religious nature of their belief. Note that the NYCHRL protects not only employees who belong to organized religions, such as Buddhism, Christianity, Hinduism, Islam, and Judaism, but also employees who have religious, ethical, or moral beliefs that are sincerely held with the strength of religious views. The law does not protect social, political, or economic views, or personal preferences.

Employees who are seeking reasonable accommodations because of their status as a victim of domestic violence, sex offenses, or stalking can be asked to provide a note from a related service provider, such as a social worker, attorney, doctor, or clergy member, supporting their inability to show proof of vaccination.

3. RETALIATION

Employers are prohibited from retaliating against employees because they requested an accommodation, opposed discrimination, or filed or assisted with a claim under the NYCHRL. Retaliation includes any action that is likely to discourage employees from exercising their rights. It covers not only firing or demoting an employee, but also, for example, assigning them to less favorable shifts or subjecting them to harassment.

For additional information about your responsibilities as an employer under the NYCHRL, visit NYC.gov/HumanRights to learn more or sign up for a free workshop.

Universal Health & Safety Plan

National Grid Williamsburg
50 Kent Avenue
Brooklyn, New York
United States

Prepared For:

Client Name:	National Grid
Client Address:	One MetroTech Center, Brooklyn, NY 11201
Project #:	60601906

Prepared By:

AECOM
125 Broad Street, New York, NY 10004

Preparer:

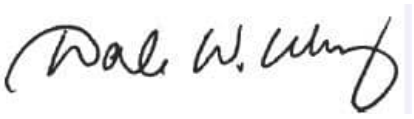
Name: Paul Tan
Title: Environmental Engineer
Date Prepared: June 29, 2022



Signature

Reviewer *(Office SHER; Area/Regional SHEM, or Business Line SHEM)*

Name: Dale “Pete” Wray, CSP, CHMM, STS
Title: SH&E Manager, AME ENV U.S. East
Date Reviewed: June 29, 2022



Signature

Approver: *(Project Manager, Project Director, or BL Lead)*

Name: Melissa Saunders
Title: Project Manager
Date Approved: June 29, 2022



Signature

Expiration:	**June 29, 2023**	Valid for one (1) year maximum or until the scope of work, subcontractor(s), methods and/or equipment change.

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HASP Summary

Note: This Summary is intended to provide key information only and cannot be substituted for reading, understanding and complying with the full HASP, including the Emergency response section. This summary may be continually updated as tasks and personnel change. Use Continuation Sheets if necessary.

Client Name:	National Grid
Site Name:	Williamsburg Works Former Manufactured Gas Plant
SH&E Incident Reporting	**SH&E Incident Hotline 1-800-348-5046** TOLL-FREE | 24 HOURS PER DAY | 7 DAYS PER WEEK Immediately report all incidents including any potential work-related injuries, illnesses, discomfort/pain, property damage, security issues, regulatory inspections and environmental impacts/spills.

Medical Treatment Resources

Identify the closest hospital to the site to be used in emergency situations. For non-emergency situations, identify the nearest Occupational Clinic to the site that accepts AECOM Workers Compensation Insurance (see **Attachment A** for instructions and to attach maps and directions).

AECOM Occupation Nurse:	**1-512-419-5016 |** *24 HOURS PER DAY | 7 DAYS PER WEEK*		
Nearest Occupational Clinic	City MD		
Address:	154 North 7th St. Brooklyn, NY 11249		
Clinic Hours of Operation:	8AM-8PM	**Phone Number:**	718-414-2013
Nearest Hospital:	Woodhull Medical Center		
Address:	760 Broadway, Brooklyn, NY 11249		
Hospital Hours of Operation:	24 hours per day/7 days per week	**Phone Number:**	718-963-8000

Key Personnel

Project Manager (PM):	Melissa Saunders	**Contact No.:**	206-502-7914
Site Supervisor (SS):	Megan Dascoli Mousa Zeidan Patrick Perry Paul Tan *Or other qualified on-Site personnel as directed by the Project Manager	**Contact No.:**	MD: 908-623-0145 MZ: 973-820-3257 PP: 315-447-4533 PT: 347-536-8660
Site Safety Officer (SSO):	Megan Dascoli Mousa Zeidan Patrick Perry Paul Tan *Or other qualified on-Site personnel as directed by the Project Manager	**Contact No.:**	MD: 908-623-0145 MZ: 973-820-3257 PP: 315-447-4533 PT: 347-536-8660
SH&E Director (East Region):	Tony Indorato	**Contact No.:**	757-298-1563
Area/Practice SH&E Manager:	Pete Wray (ENV East)	**Contact No.:**	302-660-9178
Client Contact:	Donald Campbell Cory Bierman	**Contact No.:**	DC: 347-452-5973 CB: 646-931-7931

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1. Introduction

This written Health and Safety Plan (HASP) is designed to identify, evaluate, and control safety and health hazards, and to outline emergency response actions for AECOM-managed activities. This HASP must be kept on site during work activities and made available to all workers including subcontractors and other site occupants for informational purposes. AECOM subcontractors are expected to independently characterize, assess and control site hazards created by their specific scope of work.

This section of the HASP summarizes important AECOM SH&E Procedures that apply to all DCS Americas jobs. See **Attachment C** for the project Task Hazard Assessment (THA) forms and **Attachment D** for a list of applicable field SH&E Procedures. These field SH&E procedures must be readily available to the field employees (i.e. PDF, electronically, etc.).

1.1 Applicable References

This HASP conforms to the regulatory requirements and guidelines established in the following documents:

- Federal Occupational Safety and Health Administration (OSHA) Code of Federal Regulation Title 29, Part 1910 (29 CFR Part 1910), Safety and Health Regulations for General Industry and 29 CFR 1926, Safety and Health Regulations for Construction.
- Title 8 of the California Code of Regulations (8 CCR), with special attention to Section 5192 Hazardous Waste Operations and Emergency Response, and Section 3202, Injury Illness Prevention Program and to Sub Chapter 4, Sections 1500 - 1938 Construction Safety Orders.
- National Institute for Occupational Safety and Health/Occupational Safety and Hazards Administration/U.S. Coast Guard/U.S. Environmental Protection Agency, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, Publication No. 85-115, 1985.
- The requirements in this HASP also conform to AECOM's Safety for Life Program requirements as specified in the AECOM Safety, Health and Environment (SH&E) Manual.
- The work plan provided in the document titled NAPL Recovery Plan for the 50 Kent Avenue Property, Brooklyn, Kings County, New York and dated February 2020 (AECOM, 2020).
- National Grid Safety Procedure, N-1402 Contractor Safety Requirements, Rev. No. 18 dated 5/4/2022.
- National Grid Safety Procedure, A-116 COVID-19 Health & Safety Plan, Rev. No. Initial dated 5/27/2021.
- National Grid Incident Reporting Requirements.

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2. Site Description

The Site, Williamsburg Works Former Manufactured Gas Plant (MGP), is located at 50 Kent Avenue, Brooklyn, NY 11249. The Site Location Map is provided as Figure 1-1 attached in the Figures section.

The Site is bordered by North 12th Street to the northeast, Kent Avenue to the southeast, North 11th Street to the southwest, and a vacant parcel owned by the New York City Parks to the northwest. Work covered by this HASP will be performed on the Site and on adjacent properties, such as the sidewalks next to the Site, which are currently owned by New York City Parks.

2.1 Site Background/History

The Williamsburg Works Former MGP operated from the 1860s to the 1930s, first by the Williamsburg Gas Light Company and later by The Brooklyn Union Gas Company (BUG), a predecessor to National Grid. The Williamsburg Works Former MGP was dismantled prior to 1941 and was subsequently divided into four parcels, sold to third parties, and redeveloped for commercial and industrial uses. During manufactured gas production, the 50 Kent Avenue parcel housed MGP production facilities, including three gas holders (Relief Holder, Holder No. 1, and Holder No. 2), purifying houses, saltwater condensers, and offices.

Following the closure of the MGP, the MGP structures were dismantled. However, the holder tanks and other underground structures remained. The 50 Kent Avenue parcel was temporarily leased by the United States Navy from July 1, 1945 and was sold by BUG on January 30, 1946. A warehouse/industrial building was constructed on the Interim Remedial Measure (IRM) Site prior to 1951 by the Site's then current owner and was occupied by the Ferro-Co. Corporation and used for sheet metal product manufacturing. By 1965, the building was occupied by Commercial Corrugated Container Corporation. By 1978, the property, and same building, was occupied by a New York City Department of Sanitation (NYCDOS) garage and gas station facility. This building was dismantled in 2009.

The 50 Kent Ave property was remediated through an IRM during the period of 2015 – 2017. The Site currently operates as a park under the management of the New York City Parks department.

2.2 Client and/or Third-Party Operations at Site

The Site has been redeveloped into a public park and is operated and owned by New York City Department of Parks and Recreation. Except for North 12th Street, the Site is open to the general public and activities such as walking, running, and cycling are expected. The entire North 12th Street section adjacent to the Site is closed off and subject to future redevelopment.

The current use of the Site and adjacent streets could lead to traffic hazards. It is noted that a bike lane runs along Kent Avenue, and care must be taken to look both left and right when entering the roadway.

2.3 Scope of Work

The purpose of the Site activities is to recover Non-Aqueous Phase Liquid (NAPL) from wells that were installed as part of the Site remedial approach. Whilst NAPL monitoring and recovery is the primary Site activity, additional activities that may be completed on an 'as needed' basis include recovery well performance rehabilitation potentially involving drilling, soil sampling, well repair and re-installation of recovery wells.

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Field activities covered by this HASP include the following:

- NAPL Monitoring and Recovery including:
  - NAPL gauging
  - NAPL recovery from all functioning NAPL recovery wells (refer Figure 1-2 in the Figures section)
  - Remediation-derived waste (RDW) characterization and disposal
  - Managing the National Grid waste transport and disposal contractor.
  - Recording activities.
- Non-routine 'as needed' activities may include Drilling/Soil Sampling/Well Installation and/or repair:
  - Soil sampling during drilling
  - Remediation-derived waste characterization and disposal
  - Manage the rehabilitation work including AECOM subcontractors
  - Engineering for well construction and/or repair
  - Recording activities

A Task Hazard Assessment (THA) for each operation being performed by AECOM must be included in **Attachment C**, while those performed by the managed subcontractors should be prepared by the subcontractor. In the event non-routine activities are required, task-specific THAs will be developed and appended to this HASP.

Task Name	Permit(s) Required		Primary Task Performed By		
			AECOM	SUB	Third-Party
Coronavirus Precautions Field Office Travel	☐ Yes	☒ No	☒	☐	☐
Driving To and From the Site	☐ Yes	☒ No	☒	☐	☐
NAPL Recovery THA	☒ Yes	☐ No	☒	☐	☐
Well Cover Replacement THA	☒ Yes	☐ No	☐	☒	☐
	☐ Yes	☐ No	☐	☐	☐

2.4 Key Dates

Project Start Date:	2014
Field Work Start Date:	2014
Project Completion Date:	Ongoing

2.5 High Potential Hazard Activities

In general, the following tasks are considered High Potential (HiPo) Hazard Activities, as identified in S3AM-209-PR1, Risk Assessment, based on the factors contributing to the severity and probability of credible outcomes resulting from ineffective mitigation of their hazards. Additional tasks or activities could be added to the list below based on a similar assessment of their hazards and associated control measures. The following HiPo tasks will be required to complete the approved scope of work.

High potential hazard activities may require additional documents such as: permit to work, site specific plans, task/equipment-specific training, pre-use inspections, a competent person, etc. These requirements are listed under the high potential hazard activities as a reminder that you must implement them prior to performing the activity.

All procedures referenced in the table below MUST be included in **Attachment D** for implementation into this HASP.

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☒	**Drilling, Boring and Direct Push Probing** – Qualified/trained operators, pre-use inspection (S3AM-321-FM1) and THA required. Follow requirements in S3AM-321-PR1.
☒	**Hand/Power Tools – Working with Power Tools/Equipment (drill, chainsaw, grinder, power saw, pressure washer, etc.)** – Qualified/trained operators, pre-use inspections (see inspection checklists in S3AM-305-FM2) and THA required. Follow the requirements in S3AM-305-PR1.
☒	**Hazardous Materials Communication** – Written hazardous materials communication program, chemical inventory list and SDSs required for all chemicals on site. Follow the requirements in S3AM-115-PR1.
☒	**Hazardous Waste Operations – Working with Hazardous Substances or Materials (including all HAZWOPER projects)** – Completion of this site-specific HASP required. Follow the requirements in S3AM-117-PR1.
☒	**Heavy Equipment – Working with/Operating or Working near Heavy Equipment, Mobile Equipment or Drill Rigs** – Qualified/trained operators, competent person, pre-use operations inspections (S3AM-309-FM02) and THA required. Follow the requirements in S3AM-309-PR1.
☒	**Highway and Road Work – Working On or Near Highways, Roadways, Driveways, Parking Lots** – Traffic control or protection plan, person knowledgeable of traffic control to review plan, review of safe work practices for roadway workers (S3AM-306-ATT3) and THA required. Follow the requirements in S3AM-306-PR1.
☒	**Newly Hired/Transferred Employees** – Employee identification required (i.e., green hard hat). Follow the requirements in S3AM-015-PR1.
☒	**Radiation – Work near Ionizing and Non-ionizing Radiation** – Permit to work for ionizing radiation (S3AM-218-PR1), competent person and THA required. Follow the requirements in S3AM-120-PR1 and S3AM-121-PR1.
☒	**Respiratory Protection – Work Involving Non-voluntary Use of Respiratory Protection** – Site-specific respiratory protection program, respiratory protection program administrator, competent person, pre-use inspections, respirator fit tests, medical surveillance and THA required. Follow the requirements in S3AM-123-PR1.
☒	**Underground Utilities** – Site walk, completion of the Underground Utilities and Subsurface Installations checklist (S3AM-331-FM1) and THA required. Follow the requirements in S3AM-331-PR1.
☒	**Working Alone – Lone Worker** – Site specific communication plan, rescue plan and THA required and complete the Table in Section 6.4 of this HASP. Follow the requirements in S3AM-314-PR1.

2.6 Physical and Biological Hazards

Physical and biological hazards are hazards that threaten the physical safety of an individual; contact with the hazard typically results in an incident or injury. The following table summarizes the physical and biological hazards present at the site and the associated procedures that address protection and prevention of harm.

If a there is a potential of physical or biological hazard when performing a specific task, it must be addressed in the THA.

All checked procedures MUST be included in **Attachment D** for implementation and reference. The following hazards and their site-specific description are anticipated based on the scope of work and project site:

Hazard/ Activity (Note: Text in this column links to procedure)		Site Specific Description (Where, What Phase of Work, Frequency, Etc.)	Applicable Procedure
☒	**Bloodborne Pathogens**	First aid providers	S3AM-111-PR1
☒	**Cold Stress**	Continuous exposure when ambient air temperature is below 32°F (0°C) **or** when ambient air	S3AM-112-PR1

	Hazard/ Activity (Note: Text in this column links to procedure)	Site Specific Description (Where, What Phase of Work, Frequency, Etc.)	Applicable Procedure
		temperature is below 50°F (10°C) with wet/damp conditions.	
☒	**Compressed Gases**	Calibration gas canisters	S3AM-114-PR1
☒	**Corrosive Reactive Materials**	Handling pre-preserved bottle ware for sampling	S3AM-125-PR1
☒	**Driving Safety**	Driving to and from site	S3AM-005-PR1
☒	**Flammable and Combustible Liquids**	Gasoline used in cars/trucks	S3AM-126-PR1
☒	**Hand Safety**	Manually opening covers	S3AM-317-PR1
☒	**Heat Stress**	Continuous exposure when ambient air temperature is above 80 °F (26.6 °C) and a standard work uniform is worn or when ambient air temperature is above 70 °F (21.1 °C) and impermeable chemical protective clothing is worn.	S3AM-113-PR1
☒	**Material Storage**	Storage of materials in field storage unit	S3AM-316-PR1
☒	**Noise** (Competent Person required)	Noise generated from heavy machinery and drill rig	S3AM-118-PR1
☒	**Non-Ionizing Radiation**	Frequent exposure to sunlight during daylight hours	S3AM-121-PR1
☒	**Pandemic Virus**	Potential exposure during travel and field task(s)	SR1-003-PR2
☒	**Slips, Trips, Falls**	Potential exposure while performing all tasks.	S3AM-013-PR1
☒	**Underground Utilities**	Manual preclearing prior to drilling	S3AM-331-PR1
☒	**Wildlife, Plants and Insects**	During fieldwork. Pay particular attention for ticks.	S3AM-313-PR1

2.6.1 COVID-19 Pandemic

COVID-19 is a disease that results from infection of the virus identified as SARS-CoV-2. SARS-CoV-2 is a Coronavirus, one of a large family of viruses found in both animals and humans, and one which has caused significant loss of life in the past year. As of early 2021, infection rates remain high, though several vaccines are now available and vaccination efforts are ongoing.

Key AECOM resources can be found at the AECOM Ecosystem Coronavirus Information Centre on the Ecosystem homepage or at this link, the Coronavirus Smart Card, and the AECOM Pandemic Procedure: SR1-003-PR2. Additional resources can be found at the following non-AECOM websites:

- Centre for Disease Control and Prevention (CDC).
- World Health Organization (WHO).

As of August 2021, AECOM's policies require a face covering for unvaccinated individuals unless they can maintain a social distance of 6 feet at all times. Unvaccinated individuals may forgo masks. However, many clients, cities, counties, regions, and states have stricter requirements. AECOM defaults to stricter requirements wherever mandates are in effect.

The National Grid Safety Procedure, *A-116 COVID-19 Health & Safety Plan, Rev. No. Initial* dated 5/27/2021 is provided in **Attachment H**.

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2.7 Hazards/ Constituents of Concern

Based on information obtained from historical investigations and other sources, the chemicals in the table below are known or suspected to be present at the site.

Summary of Hazardous Properties of Contaminant Exposure Hazards

***Notes: PEL** = Permissible Exposure Limit | **TLV** = Threshold Limit Value | **IP** = Ionization Potential | **eV** = Electron Volt*

Chemical Name	Media	Primary Routes of Exposure	PEL	TLV	IP (eV)
Metals					
Arsenic	☒ Soil ☒ Groundwater ☐ Vapor ☐ Other	Dermal	0.5 mg/m^3	0.2 mg/m^3	n/a
Cyanide	☒ Soil ☐ Groundwater ☐ Vapor ☐ Other	Dermal	5 mg/m^3	5 mg/m^3	n/a
Chromium VI	☒ Soil ☐ Groundwater ☐ Vapor ☐ Other	Dermal	0.005 mg/m^3	0.005 mg/m^3	n/a
Lead	☒ Soil ☐ Groundwater ☐ Vapor ☐ Other	Dermal	0.05 mg/m^3	0.05 mg/m^3	n/a
Mercury	☒ Soil ☒Groundwater ☐ Vapor ☐ Other	Dermal	0.1 mg/m^3	0.025 mg/m^3	n/a
Selenium	☒ Soil ☐ Groundwater ☐ Vapor ☐ Other	Dermal	0.2 mg/m^3	0.2 mg/m^3	n/a
Other Common Site COCs					
Benzene	☒ Soil ☒ Groundwater ☐ Vapor ☐ Other	Inhalation	1 ppm	0.5 ppm	9.25
Coal tar pitch hydrocarbons PAH	☒ Soil ☒ Groundwater ☐ Vapor ☐ Other	Inhalation	0.2 mg/m^3	0.2 mg/m^3	n/a
Dust	☒ Soil ☐ Groundwater ☐ Vapor ☐ Other	Inhalation	15 mg/m^3	10 mg/m^3	n/a
Ethylbenzene	☒ Soil ☒ Groundwater ☒ Vapor ☐ Other	Inhalation	100 ppm	20 ppm	8.77
Toluene	☒ Soil ☒ Groundwater ☐ Vapor ☐ Other	Inhalation	200 ppm	20 ppm	8.82
Xylene	☒ Soil ☒ Groundwater ☐ Vapor ☐ Other	Inhalation	100 ppm	100 ppm	8.45, 8.56

Notes: 1. Exposure limits based on DDT.
2. Exposure limits based on Chlordane. No PELs are set for alpha or gamma chlordane.

2.8 Decontamination

All possible and necessary steps shall be taken to reduce or minimize contact with chemicals and contaminated/impacted materials while performing field activities. Decontamination steps are outlined in the Hazardous Waste Operations procedure S3AM-117-PR1.

All decontaminated equipment shall be visually inspected for contamination prior to leaving the Contaminant Reduction Zone (CRZ).

Decontamination Procedures & Equipment	
Procedure	**Equipment Needed**
• Remove all equipment, sample containers, and field notes to the CRZ.	Alconox solution Deionized water

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• Obtain decontamination solutions and decontaminate the tools (shovels, auger flights, etc.) by brushing them under a water rinse. A high-pressure steam cleaner also may be used for decontamination. All waste and spent decontamination solutions will be properly contained. • Remove disposable booties, or scrub boots with a stiff bristle brush and water, when necessary. Washtubs and chairs will be provided. • Remove outer gloves (and boot covers, if used). • Remove Tyvek® coveralls; discard in provided container. • Remove hardhat and eye protection. • Remove respirator. • Remove inner gloves. • Wash hands and face.	Brushes Plastic sheeting

Equipment Decontamination Procedures

Type Equipment	Decontamination Solution	Procedure
Respirator	Alconox, solution and deionized water	• **Washing:** Disassemble and wash with an Alconox solution in deionized water. A stiff bristle (not wire) brush may be used. • **Rinsing:** Rinse in deionized water to remove all traces of detergent. This is important to prevent dermatitis. • **Disinfecting:** Thoroughly rinse or immerse in a sanitizer provided by the manufacturer. • **Final Rinsing:** Rinse thoroughly in clean water to remove all traces of disinfectant. • **Drying:** Drain and dry by hanging by the straps from racks or by towel drying with clean, soft cloths or paper towels.
Water quality probe, oil water interface probe, down-hole water sampling pumps, reusable sampling tools/equipment	Alconox solution and deionized water	• **Washing:** Disassemble and wash with an Alconox solution in deionized water. • **Rinsing:** Rinse in deionized water to remove all traces of detergent.
Drilling Equipment/Tools	High-pressure steam cleaner	Apply steam cleaner to used equipment/tools.
NAPL Recovery Equipment	All-Purpose Cleaning Product (Simple Green®)	Disassemble equipment (if required) and place on absorbent pads to prevent NAPL dripping. Wipe the equipment with paper towel with All-Purpose Cleaning Product (Simple Green®) solution.

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2.9 Air Monitoring

2.9.1 Real Time Exposure Measurements/Equipment

Monitoring shall be performed within the work area on site to detect the presence and relative levels of toxic substances. The data collected throughout monitoring shall be used to determine the appropriate levels of personal protective equipment (PPE). Monitoring shall be conducted as specified in the work permit and THA as work is performed. All instrumentation needs to be rated intrinsically safe to prevent fire or explosion.

Instrument		Manufacturer/Model	Substances Detected
☒	**Photo Ionization Detector (PID)**	■ RAE Systems mini-RAE ■ Photovac Microtip ■ HNu Model Hnu (min. 10.6 eV bulb)	■ Petroleum hydrocarbons ■ Organic Solvents
☒	**Particulate Monitor**	■ MIE Model PDM-3 mini-RAM	■ Aerosols, mist, dust, and fumes

2.9.2 Monitoring Procedures

The monitoring procedures shown below are general guidelines for sampling activities. In general, readings are considered actionable if sustained readings are observed for 5 minutes or more or if intermittent peaks are seen in excess of 1 time the action level. A reading in excess of action level outlined below will require additional ventilation (natural or mechanical) for 30 minutes, followed by re-monitoring.

A PID is required for work zone monitoring during NAPL monitoring and recovery activities. In instances where intrusive activities are to be completed (i.e. drilling), monitoring using a PID and Particulate Monitor is required.

Monitoring Procedures and Action Levels

	Parameter	Zone Location and Monitoring Interval	Action Level	Response Activity
☒	**Volatile Organic Compounds (VOCs) and Volatile Hydrocarbons** (total by PID)	Breathing zone, continuously during tasks where exposure to VOCs and volatile hydrocarbons is possible	< 5 ppm	■ Continue monitoring, may continue work in required PPE
			5- 25 ppm (sustained for 5 minutes)	■ **STOP WORK** and notify PM. Investigate the cause of elevated VOC measurements and identify measures to reduce concentrations (cover impacted soils, ventilation, etc.). Work activities shall only continue once levels have decreased to or below 5 units above background. If levels continue above 5 units, only individuals who are medically qualified to wear respiratory protection are permitted to continue work activities with Project Manager approval. Don Level C PPE (organic vapour respirator cartridges), continue monitoring, and initiate continuous air monitoring for benzene.

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Monitoring Procedures and Action Levels

	Parameter	Zone Location and Monitoring Interval	Action Level	Response Activity
			> 25 ppm (sustained for 5 minutes)	■ Cease work, exit, and contact the Site Safety Officer, Site Supervisor, and Project Manager.
☒	**Other:** Particulates (PM-10)	Breathing zone during intrusive activities	100 µg/m^3 above upwind level	■ Continue monitoring, modify work methods or implement dust control techniques. Continue work in the required PPE.
			150 µg/m^3 above upwind level	■ **STOP WORK** and exit the work area or confined space ■ Contact the Site Safety Officer, Site Supervisor, and Project Manager

3. Personnel Responsible for Safety

Enter the personnel responsible for safety:

Role	Person Assigned to Role	Contact No. Primary	Contact No. Alt
AECOM Project Manager:	Melissa Saunders	206-502-7914	--
AECOM Site Supervisor:	Megan Dascoli Mousa Zeidan Patrick Perry Paul Tan * Or other qualified on-Site personnel as directed by the Project Manager	MD: 908-623-0145 MZ: 973-820-3257 PP: 315-447-4533 PT: 347-536-8660	--
AECOM Site Safety Officer:	Megan Dascoli Mousa Zeidan Patrick Perry Paul Tan *Or other qualified on-Site personnel as directed by the Project Manager	MD: 908-623-0145 MZ: 973-820-3257 PP: 315-447-4533 PT: 347-536-8660	--
AECOM SH&E Manager:	Pete Wray	302-660-9178	--

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4. Subcontractor Management

4.1 Subcontractor Pre-Qualification

Ensure all subcontractors including lower tier subcontractors are prequalified to perform work for AECOM. SubPort is the preferred method for pre-qualifying subcontractors. If a subcontractor is conditionally approved, ensure the subcontractor meets all conditions of approval.

If a subcontractor requires a variance, complete the Subcontractor Variance form, S3AM-213-FM2.

Complete the table below, identifying all AECOM-Controlled subcontractors working in the field (any contractor paid directly by AECOM or otherwise under our responsibility is considered AECOM—Controlled, even if we do not directly control their day-to-day operations or supervise their work).

Subcontractor 1:	Aquifer Drilling & Testing Inc. (Provide exact Subcontractor name as listed in Subport)	
Scope of Work:	**High-Risk Tasks performed?**	**Contractor Site Safety Officer & Contacts:**
Describe Contractor's Scope of Field Work	**See SWP Cover Sheet for List of High-Risk Tasks**	**Provide Name and Cell Phone**
Well cover replacement	☒ Yes (List) Hand/Power Tools – Working with Power Tools/Equipment ☐ No	Shawn Miller: 631-902-1823

Required Subcontractor Documents: PM must verify that the following documents are in-place for each subcontractor; check to verify.		
☒ Copy of their Project/Site-specific health and safety plan	☒ Copy of task specific THAs/JHAs and inspection/tailgate forms	☒ Copy of the signed contract
☒ Copy of their business license and training certificates (task specific)	☒ Copy of their Corporate Safety Management Manual	☐ Other

Subport Review: ☐ Approved – Skip to next Subcontractor
☒ Conditionally Approved - Identify conditions and controls below.

Check 'common subport conditions' that apply, add additional conditions, and describe how the conditions will be met

Subport Conditions (check or add any that apply)	**How will the condition be met?**
☒ AECOM Safety Plan must cover Subcontractor's work, and Subcontractor must provide a THA for their tasks	Sub will use AECOM's QMS.
☒ PM must verify that Subcontractor adheres to AECOM safety plan	Sub will use AECOM's QMS.
☐ Subcontractor variance is required - the form can be found at this link: https://myecosystem.aecom.com/ppf/forms/Forms/S3NA_213_FM2_Subcontractor%20Variance%20Form.docx	
☒ Supervision required	PM/Site Safety Officer to provide oversight of field services.
☐ Special Conditions apply (related to Demolition, Diving, Underbridge Inspection Unit work, and Rope Access Work	
☐ Other conditions apply (Identify)	

Note Veolia (516-221-8300) is currently engaged by National Grid to transport and dispose of hazardous wastes generated through project activities.

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5. Training and Documentation

All personnel at this site must be qualified and experienced in the tasks they are assigned. SH&E Training Procedure S3AM-003-PR1 establishes the general training requirements for AECOM employees.

5.1 Site-Specific Training Requirements

Check all required training on the table below. Verify training records of employees and subcontractors.

Site Specific Training Requirements

	Training	Applies to
☒	**ERP/HASP and Site Orientation**	All Employees and Subcontractors
☒	**Vehicle/Driver Safety & Defensive Driving**	All Employees who drive on behalf of AECOM
☒	**Field Safety**	Employees visiting the field that does not require HAZWOPER
☒	**Speak Up/Listen Up (SULU)**	All AECOM field employees and supervisors
☒	**First Aid / CPR**	Designated employees or employees performing high risk activities and medical attention is more than 4 minutes away
☒	**Respiratory Protection & Fit Test**	Employees needing to wear respirators
☒	**OSHA 10-Hr. Construction Safety (or CSTS 2020 in Canada)**	All employees working on jobsites with construction type hazards
☒	**HAZWOPER 40-Hour and 8-Hr. Annual Refresher**	On HAZWOPER sites, in EZ, exposed to hazardous contamination
☒	**HAZWOPER Supervisor**	Employees managing others in HAZWOPER activities or at HAZWOPER Sites
☒	**Hazardous Materials Shipping (U.S.)**	Employee responsible for shipping HZM/HZW/DG and/or signing manifests
☒	**Hazardous Materials Communication**	When hazardous or toxic chemicals are being used on site.

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6. Site Control

6.1 Site Work Zones

Site layout and site control need to be coordinated to achieve a productive work environment and efficient work process while minimizing exposure of employees and the public to hazards associated with the work. Consider the following items when planning the site layout and controls. Check the description of the site controls **already** in place:

- ☐ Work area is within a facility/property with secure and restricted access provided by client or third party
- ☐ Work area is enclosed within a facility/property, but access is not restricted via locks, guards, or gates
- ☐ Work area is on a property that is open, but access by the public is unlikely
- ☒ Work area is on a property that is open and access by the public is likely
- ☐ Work area is in a roadway or right of way of a roadway (Traffic Control/Protection Plan required S3AM-306-PR1)
- ☐ Work area is in a parking lot or driveway
- ☐ Work area is on or near railroad, including right of way, active lines and crossings
- ☐ Other: N/A

Consider the following items when planning the site layout and controls:

- "Line of Fire" hazards- overhead utilities, falling/ tipping equipment, release of energy/ pressure, flying debris
- Noise, dust, odor suppression
- Contamination containment and decontamination area layout
- Traffic control for site vehicles/ equipment (public traffic control requires Traffic Control Plan)
- Restricted access for areas requiring special training, skills, or certifications
- Restriction of work near railroads
- Presence or creation of excavations
- Loading/unloading areas
- Portable restrooms
- Dumpsters and bins
- Equipment lay down
- Heavy equipment parking
- Overnight safety and security needs

Check and describe the site controls that need to be added to protect the public and the AECOM work team.

Control Item	Description of Type and Application
☒ **Fence**	There is a fence across North 12th St facing Kent Avenue to prevent general public access.
☒ **Locks**	The gate on North 12th St facing Kent Avenue is locked. AECOM accesses this portion of the site via a dedicated key.
☐ **Barricades**	N/A
☒ **Cones**	Traffic cones will be deployed to isolate the work area.
☒ **Tape**	Retractable bars will be installed in between cones to create a barrier around the work zone.
☒ **Hole Covers**	Boreholes left open overnight will be covered with a steel plate or other similar means.

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Control Item	Description of Type and Application
☐ **Other:**	N/A

6.2 Simultaneous Operations

Simultaneous and neighboring operations, including activities performed by the general public, our clients, and other workers or contractors working near our employees, often present a need for added co-ordination and communication to address hazards that are presented by multiple operations.

Simultaneous Operations – Within the Site

☒ Yes, see table below for details
☐ None, not applicable

Activity	Company	Contact Person (Activity Lead)	Contact's Phone Number	Addressed in THA(s)	
Park adjacent to work area is open to the general public; Construction activity on North 12th Street.	NYC Parks	Mary Salig	718-218-6130	☒ Yes	☐ No
Unable to access Site due to lock issue.	NYC Parks	Andre Stirling	914-841-4711	☐ Yes	☒ No
				☐ Yes	☐ No

Simultaneous Operations – Neighboring Sites

☐ Yes, see table below for details
☒ None, not applicable

Activity	Company	Contact Person (Activity Lead)	Contact's Phone Number	Addressed in THA(s)	
N/A				☐ Yes	☐ No
				☐ Yes	☐ No
				☐ Yes	☐ No

6.3 Site Control Maps/Diagrams

As individual tasks within the scope of work vary in location and scope (i.e., North. 12th St vs. North 11th St, etc.), a single diagram showing the EZ, CRZ,etc. is not practical. Such controls will be established on a location by location basis based on scope.

In the event of an emergency situation or imminent threat persons, property and/or environment, workers will report to the appropriate muster and/or shelter-in-place location. Workers will remain at the muster or shelter-in-place location until a headcount is completed and any "all clear" is issued by the proper authority for the site, unless it is unsafe to remain at that location. The primary and secondary muster points are described below and in Figure 1-2 in the Figures section:

- Primary Muster Point: corner of Kent Avenue and North 12th Street.
- Secondary Muster Point: corner of Kent Avenue and North 11th Street.

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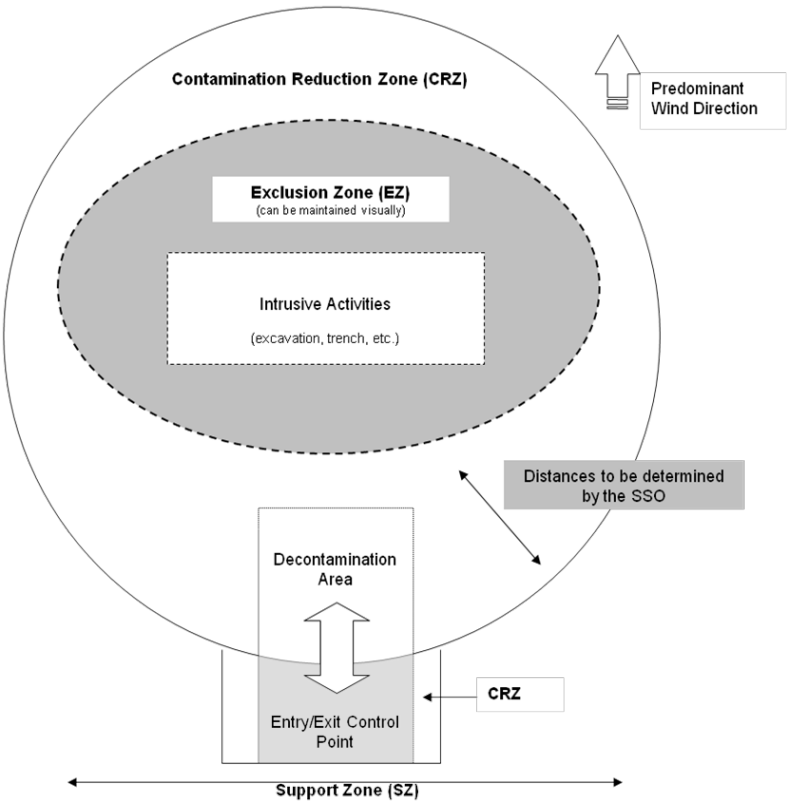
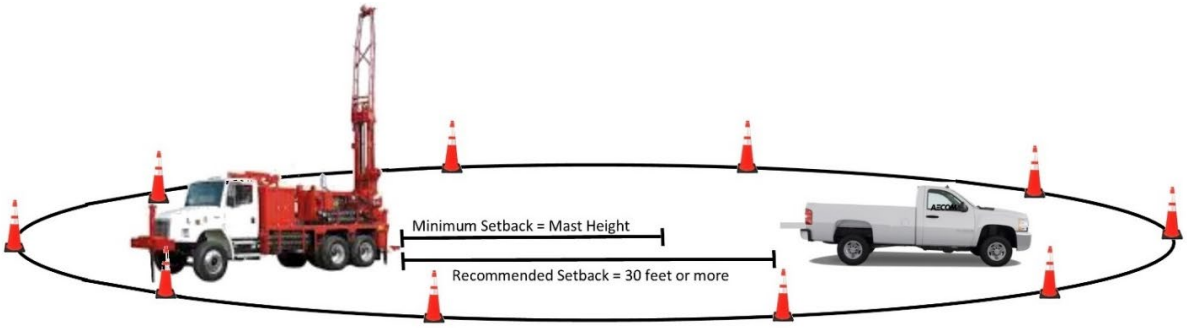


Example Exclusion Zone Layout



Example Work Area Layout

6.4 Lone Worker

AECOM discourages employees from working alone (i.e., where AECOM personnel are out of visual and audio range of others) when performing field tasks (see Working Alone SHE Procedure S3AM-314-PR). If lone work is to be performed, a communications/check-in plan must be developed and implemented using the table below.

Lone Worker:	Mousa Zeidan, Patrick Perry, Paul Tan MZ: 973-820-3257, PP: 315-447-4533, PT: 347-536-8660		
Justification:	The primary scope of work for this HASP is NAPL monitoring and recovery which only requires one worker on-Site to complete the required tasks.		
Check-In Contact:		**PRIMARY**	**ALTERNATE**
	Name:	Melissa Saunders	Peter Cox
	Contact Number:	206-502-7914	978-764-4257
	Title/Relationship:	Project Manager	Alternate AECOM Contact
Check-In Requirement:	Method(s):	☐ Voice ☒ Text ☐ Email ☐ In-Person ☐ Lone Worker App ☐ Other: [Specify]	
	Frequency/Time:	Within one hour of arrival and on departure	
	Recordkeeping:	Check-ins to be recorded in field notes	
Hazard Summary:	Traffic may present a potential hazard. The work area is to be demarcated with cones and tape. The worker is to make themself known to others doing work on the site. The worker will walk along the sidewalks bordering the Site and obey road rules.		
Response Plan:	Check-In Missed:	Check-in contact will attempt to reach lone worker again through voice call and follow-up with text.	
	1st Contact Attempt Fails:	A backup employee (TBD) will be dispatched.	
	2nd Contact Attempt Fails:	Emergency services (911) will be contacted.	

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7. Emergency Contact Information

For more information on emergency management, see the Emergency Contact Information in this HASP Summary.

7.1 Emergency Management

7.1.1 Emergency Response Plan

A Project Emergency Response Plan must be developed by the AECOM Project Manager for its staff as per the project location like remote areas, industrial areas, city areas, etc. This plan and any alterations to this plan will be communicated to all AECOM project staff, subcontractors and visitors. Depending on the duration of the project, AECOM shall perform mock drills accordingly.

Subcontractors will provide their own Project Emergency Plan to AECOM for review and acceptance. Any alterations to this plan must be communicated to all parties. Both AECOM and the subcontractor shall perform mock drills periodically in accordance with the length of the project.

Refer to the **AECOM Project Emergency Response Plan (Attachment I)**. For additional information on Emergency Response Planning, please review the Emergency Response Planning procedure, S3AM-010-PR1.

7.1.2 Emergency Planning

AECOM requires that all projects, plan for reasonably foreseeable emergencies. Prior to the start of site mobilization, all AECOM personnel shall review the site-specific information regarding evacuations, muster points, communication, and other site-specific emergency procedures.

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8. Personal Protective Equipment

The use of Personal Protective Equipment (PPE) forms the final barrier of protection between the employee and the hazard and applies to all employees at the work site, including Subcontractors, visitors and client or customer representatives. For additional information on PPE, please review the Personal Protective Equipment, S3AM-208-PR1.

The minimum PPE required on an AECOM project is as follows: hard hat, safety toe boots, high visibility vest, safety glasses, long pants and shirts with sleeves that cover the shoulders. If any materials are to be handled, then gloves shall be worn as well.

Specific PPE shall also be specified in Task Hazard Analyses (THAs) such as glove type (i.e. material, level of protection, etc.). Where possible, hazards will be eliminated or controlled to reduce the risk associated with a specific task.

These controls include:

- Elimination of the hazard
- Isolation of the hazard
- Engineering Controls
- Administrative Controls

With the exception of prescription safety eyewear and safety toed boots (there may be allowances for the purchase of these items), AECOM will make available all required PPE for its employees. All employees will receive training in the use, care, maintenance and storage of the PPE issued to them.

All personal protective equipment will meet the requirements of local, state, federal, client and AECOM SH&E regulations and procedures. Where site-specific PPE requirements exist, all AECOM employees, Subcontractors and visitors, who work on the Project, will follow those requirements.

PPE will **not** be modified or changed.

All PPE that is damaged or in need of service or repair will be removed from service immediately.

All PPE that has been removed from service will be tagged “OUT OF SERVICE” and will not be returned until repaired and inspected by a qualified person. Defective PPE must be removed from site to prevent it from being used.

8.1 SH&E Technology

At AECOM, we encourage the use of new technology to eliminate or reduce the risk our employees are exposed to. Mark the technology you will be using in this project (if any):

- ☐ **Wearable Technology/Smart PPEs** (e.g. clothes, helmets, glasses, harness)
- ☐ **Ergonomics Technology** (e.g. tracking or managing ergonomics data, use of technology to make a task safer ergonomically)
- ☑ **Site Sensors** (e.g. Movement, angle, noise, carbon monoxide, Dust)
- ☐ **Fatigue Monitoring**
- ☑ **Vehicle related Technology** (e.g. Telematics, Driver Training, backing cameras/sensors, collision avoidance)
- ☑ **Phone/Tablet Applications** or software: Daily Tailgate Meeting App

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- ☐ **Connected Worksites** (i.e., connection between employees or project elements to be successful)
- ☐ **Drones**
- ☐ **Virtual Reality (VR) or Augmented Reality (AR)**
- ☐ **GPS** – Location devices:
- ☐ **Radio Frequency Identification** (RFID)
- ☐ **Autonomous Equipment**
- ☐ **Other:**
- ☐ **None of these:** We will not use any technology in this project to reduce hazards

Find available tools and/or share the tools you will be using in the AECOM Technology Toolbox or let us know what would be interesting to assess by **clicking here**.

9. Safety, Health and Environment Program

9.1 AECOM SH&E Policy

AECOM's Safety, Health and Environment Policy, which establishes the framework to attain best-in-class Safety, Health and Environmental (SH&E) performance in the interest of benefitting AECOM's employees and stakeholder in the global marketplace, is available on AECOM's Ecosystem (intranet).

9.2 Safety for Life

"Safety for Life" is a comprehensive integrated AECOM Safety Management System that drives our employees toward AECOM's commitment to achieving zero work-related injuries and/or illnesses; preventing damage to property and the environment; and maintaining an environmentally friendly and sustainable workplace. Our Safety for Life program is supported by nine Life Preserving Principles that apply to all AECOM activities.

9.3 Life Preserving Principles

AECOM has adopted these "Life-Preserving Principles" to help demonstrate the commitment of our Safety for Life program. We firmly believe these "Life-Preserving Principles" will enable AECOM to achieve its goal of zero employee injuries, property damage and an environmentally friendly and sustainable workplace. The nine Life-Preserving Principles, along with their descriptions, can be found on AECOM's Ecosystem (intranet).

Commitment:
Managers will lead on safety, continuously demonstrating commitment to the highest standards.

Participation:
All employees are encouraged to engage in helping to control the risks we face.

Budgeting and Staffing for Safety:
The costs of managing SH&E are budgeted into every project. Our safety staff are fully trained to provide expert guidance.

Pre-planning:
We assess risks and produce detailed plans to control them during design, planning, and execution of work.

Contractor Management:
We carefully select and collaborate with all our partners to create a safe working environment.

Recognition and Rewards:
Employees are rewarded for safety excellence and we share best practices..

Orientation and Training:
Our employees will be provided with effective safety training in order to identify and mitigate hazards in the workplace to prevent injuries to themselves and others who may be affected by their actions.

Incident Investigation:
We investigate recordable incidents and serious near misses to understand the causes and take action to prevent recurrence.

Fit for Duty:
All staff come to work each day fit and well, so they do not pose a hazard to themselves or others.

9.4 Fitness for Duty

One of AECOM's nine Life-Preserving Principles is Fitness for Duty (see Fitness for Duty procedure (S3AM-008-PR1). Fitness for Duty means that individuals are in a state (physical, mental, and emotional) that enables them to perform assignments competently and in a manner that does not threaten the health and safety of themselves or others. On certain projects or for specific tasks, fit for duty certifications may be requested of medical providers by SH&E Managers or Human Resources (HR). Employees should ensure they are fit for duty prior to leaving home and unimpaired by substances or fatigue, and if necessary,

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contact your supervisor rather than attempting to report to work in unfit condition. Supervisors must observe their employees and work with the employee, SH&E staff, and HR to address deficiencies. AECOM will **NOT** tolerate retaliation against any employee for filing a complaint or concern regarding their fitness for duty or participating in any way in an investigation.

9.5 Proactive Health

AECOM is committed to promoting proactive health activities in addition to the planning for prevention of safety and environmental incidents. Proactive health activities will be completed on an on-going basis at AECOM on a corporate-wide basis (i.e., the wellness program associated with employee benefits), at offices, and at this project site. Management will be actively involved in providing and encouraging opportunities for health and wellness education and improvement. Health initiatives and education will be discussed periodically during office-based meetings as the safety moment or during the daily tailgate meeting as a toolbox talk. Topics may be related to, but are not limited to, the following:

- ✓ Heart health
- ✓ Stress management
- ✓ Smoking cessation
- ✓ Diabetes prevention
- ✓ Diet
- ✓ Exercise benefits

Topics and educational materials can be located on the AECOM Wellness page, National Institutes of Health website, Centers for Disease Control and Prevention website, and other reputable sources online.

In addition, the field team will be encouraged to participate in a daily stretch and flex routine (a standardized way to avoid soft tissue damage from work activities) to the best of their abilities, given their own personal limits. It is particularly beneficial to warm and loosen muscles before repetitive work, manual handling of loads, and when working in cold temperatures or with static postures. The Stretch and Flex manual and poster (**Attachment E**) serve as guidance for the leader to follow.

9.6 Fatigue

One aspect of fit for duty is fatigue management. AECOM has developed procedures that limit work periods or requires additional rest under certain circumstances, including during long-distance travel or when working at high altitudes. These procedures also set limits on extended work periods of 14 hours per day or 60 hours per week. A fatigue management plan is required if longer working hours are necessary (see Fatigue Management Procedure S3AM-009-PR1).

9.7 Driving and Vehicle Safety

The proper operation of vehicles is critical to protecting the safety of AECOM employees and subcontractors. Drivers face numerous hazards while operating vehicles. Some of the hazards include collision with another vehicle, collision with a fixed object, vehicle break down or failure, or falling asleep or becoming otherwise incapacitated while driving. All employees will adhere to Driving procedure S3AM-005-PR, which includes the following key practices:

1. **Authorized Drivers**
   Managers must authorize drivers following evaluation of driver criteria to drive and maintain an AECOM-owned, leased or rented vehicle, a client or customer-owned vehicle, or a personal vehicle operated in the course of conducting AECOM business.

2. **Electronic Devices Prohibited**
   AECOM prohibits use of all portable electronic devices while operating a motor vehicle/ equipment, which includes being stopped at a traffic light or stop sign. Electronic devices include, but are not limited to, all mobile phones, two-way radios, pagers, iPods, MP3s, GPS, DVD players, tablets laptops, and other portable electronic devices that can cause driver distraction. Hands-free device use is **NOT** allowed.

   - GPS units and devices used for navigation may only be used if factory installed or secured to the vehicle with a bracket that allows the driver to view the image without having to take their eyes off the road. Electronic devices shall be setup for operation prior to commencing driving activities and shall NOT be changed by the driver while driving.

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3. **Vehicle Inspections**
   The driver shall conduct pre-trip vehicle inspections prior to each trip. A vehicle inspection checklist, S3AM-005-FM2, can be used to guide and document the inspection process. Vehicle inspection is to include a 360-degree walk around and visual inspection under the vehicle for leaks and obstructions prior to moving the vehicle.

4. **Training**
   All drivers shall complete defensive driver training. Additional training (i.e., hands-on defensive driver training) may apply for medium and high-risk drivers; see Driving procedure S3AM-005-PR and SHE Training procedure S3AM-003-PR for more details.

5. **Journey Management Plan**
   Drivers who undertake trips in excess of 250 miles (400 kilometers) one way, drive in remote or hazardous areas, or when otherwise deemed necessary, shall develop and document a Journey Management Plan using S3AM-005-FM1 or equivalent.

6. **Secure Loads**
   Cargo is only to be carried within the passenger compartment of a vehicle when segregated and restrained to prevent objects from becoming distractions, obstructions, or projectiles to occupants should emergency vehicle maneuvers be required (e.g., harsh braking or crash). All goods transported on flatbed trucks or in pickup beds must be securely fastened to prevent them from becoming hazards. All applicable laws and regulations regarding securing of loads must be met. It is prudent to check the load after a few miles to ensure that load has not shifted or loosened prior to completing the remainder of the trip.

9.8 Fatigue and Driving Safety

The effect of fatigue is both physiological and psychological and can severely impair a driver's judgement. Fatigue can cause lapses in concentration which could prove fatal. Fatigue is not just a problem for drivers on long trips, as drivers can also suffer from fatigue on short trips.

- ✓ After strenuous fieldwork, consider overnight accommodation or vehicle sharing for staff who are not acclimatized to the type of work.
- ✓ Microsleep can occur with a limited warning, and may be linked to several factors, for example:
  - Microsleep is most likely to occur during times when the circadian rhythm dictates the body should be asleep, such as at dawn, late at night, or in the mid-afternoon (e.g., 1 and 4 am and 1 and 4 pm.).
  - Potential to feel drowsy after a meal.
  - Driving long distances (considered potentially monotonous) even with sufficient sleep.
  - Prolonged sitting and warm ambient temperature may also increase the feeling of sleepiness.
- ✓ If safe to do so, consider undertaking actions to disrupt the microsleep event while identifying a safe place to stop, e.g., open a vehicle window, listen to upbeat music/change music source or ask the passenger (if present) to engage in conversation.
- ✓ Ensure field staff are familiar with the signs of fatigue and mitigation factors.

The most common visible signs of microsleep include the following:

- Eyelid drooping
- Eyelid closure
- Head nodding
- Brief periods of snoring
- Wandering thoughts

If any of the above become apparent, immediately pull over to a safe location and contact your PM or SH&E representative.

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9.9 Hand Safety

The hands are exposed to hazards more than any body part. SH&E Hand Safety Procedure S3AM-317-PR describes requirements and best practices including these notable practices:

- **All personnel shall have gloves in their immediate possession 100%** of the time when in a shop or on a work site. Gloves that address the hazard shall be worn when employees work with or near any materials or equipment that present the potential for hand injury due to sharp edges, corrosives, flammable and irritating materials, extreme temperatures, splinters, etc. Use the Gloves Needs Assessment (S3AM-317-FM1) to help determine the appropriate glove for the hazard(s).
- **Fixed open-blade knives are prohibited** from use during the course of AECOM work. Examples of fixed open-blade knives include pocket-knives, multi-tools, hunting knives, and standard utility knives. For more information about cutting tools, see S3AM-317-ATT1 Safe Alternative Tools.

9.10 Substance Abuse

Drug and alcohol abuse pose a serious threat to the health and safety of employees, clients, and the general public as well as the security of our job sites, equipment and facilities. AECOM is committed to the elimination of illegal drug use and alcohol abuse in its workplace and regards any misuse of drugs or alcohol by employees to be unacceptable. AECOM Substance Abuse Prevention Procedure (S3AM-019-PR1) prohibits the use, possession, presence in the body, manufacture, concealment, transportation, promotion or sale of the following items or substances on company premises. Company premises refer to all property, offices, facilities, land, buildings, structures, fixtures, installations, aircraft, automobiles, vessels, trucks and all other vehicles and equipment - whether owned, leased, or used.

- Illegal drugs (or their metabolites), designer and synthetic drugs, mood or mind altering substances, and drug use related paraphernalia unless authorized for administering currently prescribed medication;
- Controlled substances that are not used in accordance with physician instructions or non-prescribed controlled substances; and
- Alcoholic beverages while at work or while on any customer- or AECOM-controlled property.

This policy does not prohibit lawful use and possession of current medication prescribed in the employee's name or over-the-counter medications. Employees must consult with their health care provider about any prescribed medication's effect on their ability to perform work safely and disclose any restrictions to their supervisor.

Although some states may pass laws legalizing medical or recreational marijuana use, the use, sale, distribution and possession of marijuana are violations of federal law and AECOM policy, and will subject an employee to disciplinary action up to and including termination in accordance with controlling law. In Canada, where medical and recreational marijuana use is legal, employees must still follow Federal and Provincial laws, and AECOM policy with regards to use and possession. Employees found to be in contravention of legal requirements or AECOM policy will be subject to disciplinary action up to and including termination.

9.11 Rewards and Recognition

One of AECOM's Life Preserving Principles is Recognition and Rewards for proactive safety, health and environmentally focused behaviors. All projects are expected to participate in the rewards and recognition programs available on the Corporate and DCS Americas SH&E ecosystem pages. Large, long term projects are encouraged to establish a project specific rewards and recognition program which incorporates project specific goals and activities (template available S3AM-020-FM1). ***All rewards and recognition programs must emphasize the 9 Life Preserving Principles and proactive SH&E activities NOT solely the achievement of lagging metrics ("injury/incident-free" hours, etc.) as those may discourage incident reporting.***

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There are several possible appropriate methods of rewarding and recognizing employees and contractors:

1. **Informal** – recognition via verbal acknowledgement, email, spot awards, luncheons, etc.

2. **Formal** – recognition via DCS Americas Programs:
   - AECOM Safety Star Recognition Program
   - AECOM Making a Difference (MAD) Award
   - Executive Challenge Coins





9.12 Stop Work Authority

AECOM empowers and expects all employees to exercise their Stop Work Authority (see Stop Work Authority Procedure (S3AM-002-PR1) if an incident appears imminent, or when hazardous behaviors or conditions are observed. A stop work request can be informal if the situation can be easily corrected or may require shutting down operations if revised procedures are necessary to mitigate the hazard. If an AECOM employee observes an imminently hazardous situation on a site controlled by others (i.e., a client-managed contractor), the employee can always stop work for themselves by removing themselves from the situation. Employees also may attempt to stop work to avoid allowing the contractor to come to harm by immediately notifying the contractor foreman or site engineer, or if necessary, the client or party managing the contractor.



No employee should object to the issuance of a stop-work request, nor can any disciplinary action be levied against the employee. All employees must agree that the situation has been mitigated before resuming work. No employee will be disciplined for refusing to work if they feel it is unsafe.

10. Roles and Responsibilities

10.1 AECOM Project Manager

The Project Manager (PM) has overall management authority and responsibility for all site operations, including safety. The PM will provide the site supervisor with work plans, staff, and budgetary resources, which are appropriate to meet the safety needs of the project operations. Some of the PM's specific responsibilities include:

- Develop a defined scope of work and project schedule with clear objectives and reasonable milestones.
- Budget and allocate the appropriate resources to safely and efficiently complete the work, including technical, safety and quality reviews.
- Prepare a project risk register to support project planning and risk management.
- Identify requirements and expectations applicable to the scope of work, site access, client and host facility.
- Assemble qualified project and field teams, including subcontractors, with the appropriate training, education and experience.
- Ensure subcontractors are approved in subport and obtain variances for those that have been conditionally approved.
- Review and approve the AECOM safe work plan (SWP) or health and safety plan (HASP) and task hazard assessments (THAs).
- Obtain and review subcontractor SWP/HASP and THAs or equivalent task risk assessment documents.
- Conduct a project kick-off meeting to convey information, requirements, and expectations to the field team.
- Ensure the field team has all the tools, equipment, instruments, and supplies, including PPE, to perform the work safely.
- Coordinate field activities with the client and/or host facility.
- Be visible to and maintain regular communication with the field team.
- Verify that technical, safety, and quality reviews are completed as planned.
- Verify that AECOM's SH&E policies and procedures are fully implemented.
- Coordinate the management of changes identified by the field team.
- Address and correct unsafe acts/behaviors and conditions.
- Confirm observation, near miss and incident notification and reporting are completed internally, to site and client, as required.
- Conduct a post project review.
- Lead by example – walk the talk.

10.2 AECOM Site Supervisor

The Site Supervisor has the overall responsibility and authority to direct work operations at the job site according to the provided work plans and HASP. The Project Manager may act as the Site Supervisor while on site. The Site Supervisor's responsibilities include:

- Verify the personnel, equipment/machinery and instruments anticipated to mobilize to site.
- Communicate project roles and responsibilities.
- Discuss planned activities for the day and any potential simultaneous operations (SIMOPs).
- Establish staging and work areas for planned activities.
- Confirm crews have reviewed and updated, as necessary, task hazard assessments prior to beginning the task.

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- Coordinate and document project activities.
- Monitor for deviations and changes in scope, personnel, methods, materials, equipment/machinery, instrumentation, and site conditions.
- Notify the AECOM project manager of changes and coordinate change management.
- Escort or delegate the escorting of site visitors.
- Serve as AECOM's point of contact with the host facility and person-in-charge for simultaneous operations (SIMOPs).
- Delegate stop work authority to all project employees and report all unsafe acts/behaviors and conditions, near misses and incidents to the AECOM project manager.
- Lead by example – walk the talk.

10.3 AECOM Site Safety Officer

The Site Safety Officer supports the Site Supervisor in providing a safe work environment. Not all sites will have a designated Site Safety Officer; the decision should be made by the Project Manager and SH&E Manager taking into consideration the complexity and risks of the scope of work. The Site Supervisor may act as the Site Safety Officer on sites without one. The Site Safety Officer's responsibilities include:

- Conduct the site safety orientation for the entire field team, including subcontractors, and site visitors.
- Lead the tailgate safety meeting.
- Discuss hazards present at the site and/or within environmental media and their control measures.
- Communicate air monitoring methods and action levels.
- Explain emergency response and reporting procedures, including emergency contacts and muster and shelter-in-place locations.
- Establish exclusion and contamination reduction zones, as needed.
- Verify SWP/HASP, THA and safety requirements and expectations are being met.
- Confirm hazard control measures are in-place and effective.
- Perform housekeeping and site inspections to ensure a safe working environment.
- Engage outside safety, health & environment resources, as needed, to allow for the safe performance of the work.
- Assist in incident investigations and identification and implementation of corrective actions.
- Lead by example – walk the talk.

10.4 AECOM SH&E Manager

Responsibilities of the SH&E manager is to:

- Promote the AECOM Safety for Life Program and our Nine Life Preserving Principles.
- Understand the application of SH&E regulatory requirements relevant to SH&E in the company's operations and be aware of changes in regulations which may affect the company.
- Be formally trained, licensed or certified where the regulations require.
- Assist with the budgeting and staffing process to ensure project teams have the knowledge and resources needed to perform their work safely.
- Be aware of all incidents, near misses, observations, unsafe acts and unsafe conditions that are reported and participate in the investigation process where required.
- Verify incidents are reported to regulatory bodies in accordance with local legislation.
- Review investigation findings to confirm identified corrective actions are appropriate and subsequently implemented.

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- Review and accept site-specific SH&E Plans and Task Hazard Analyses (THAs).
- Assist in the preparation of risk assessments.
- Assist in the review of SH&E training needs.
- Verify necessary training as required by AECOM policies and procedures and/or the regulations.
- Assist in the setting of SH&E expectations at project level and review them periodically.
- Perform project SH&E audits on a periodic basis.
- Monitor the corrective actions taken, where audits identify non-conformance or opportunities for improvement, for confirmation of their completion and effectiveness.
- Lead by example, walk the talk.

10.5 AECOM Employees

Responsibilities of employees associated with this project include, but are not limited to:

- Arrive onsite fit for duty and dressed for weather conditions.
- Actively participate in tailgate safety meetings and crew THA reviews.
- Perform only assigned tasks consistent with training & competency.
- Follow SWP/HASP, THA and safety requirements & control measures.
- Use 4-sight as a last-minute risk assessment tool.
- Notify the AECOM site supervisor prior to any deviation from the planned activity (i.e., change in personnel, methods, materials, equipment, etc.).
- Use stop work authority and report all unsafe acts/behaviors and conditions, near misses and incidents to the AECOM site supervisor.
- Always conduct yourself in a professional and ethical manner.

10.6 Visitors

Authorized visitors (e.g., client representatives, regulators, AECOM management staff, etc.) requiring entry to any work location on the site will be briefed by the Project Manager, Site Supervisor, or Site Safety Officer on the hazards present at that location, and sign onto the daily THA as a visitor. Visitors will be escorted at all times at the work location and will be responsible for compliance with their employer's health and safety policies. In addition, this HASP specifies the minimum acceptable qualifications, training and PPE that are required for entry to any controlled work area; visitors must comply with these requirements at all times.

If the site visitor requires entry to any exclusion zone (EZ), but does not comply with the above requirements, the visitor will be denied access to the EZ. If the visitor disregards instructions to remain outside the EZ, work activities will be immediately suspended, and the situation reported and documented.

Unauthorized visitors, and visitors not meeting the specified qualifications, will **NOT** be permitted within established controlled work areas. If unauthorized visitors and/or visitors not meeting the specified qualifications enter a controlled work area and/or EZ, work activities will be immediately suspended, and the situation reported and documented.

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11. Subcontractor Management

11.1 AECOM Roles/Responsibilities for Sub Management

When managing an AECOM Subcontractor of any tier, AECOM management and supervision will follow the requirements in S3AM-213-PR1 and are responsible for the following:

- Direct all activities of the facility, site, or project location.
- Ensure appropriate training and experience of AECOM personnel responsible for overseeing subcontractor work.
- Verify subcontractors have the appropriate trained and competent personnel to perform their activities in a safe, healthful, and environmentally responsible manner.
- Pre-qualification of Subcontractor – Prior to performing work on an AECOM project, management and supervision must verify the Subcontractor has been pre-qualified. AECOM's preferred method of prequalification is Subport, but there are other ways to prequalify a subcontractor.
- Ensure all subcontractor employees attend the AECOM daily tailgate safety meeting.
- If you have any questions about subcontractor pre-qualification, reach out to an AECOM SH&E professional.

11.2 Subcontractor Roles/Responsibilities for Safety

Subcontractors must provide AECOM with a designated Subcontractor Safety Representative (SSR). Their responsibilities are as follows:

- Direct employees' means and methods of work and how to work safely.
- Be knowledgeable of and understand the safety requirements of the subcontractor's activities.
- Staff the project with employees that are trained and knowledgeable of the tasks they will be performing.
- Have the ability to recognize hazards and the authority to take prompt corrective actions.
- Implement the subcontractor safety program.
- Serve as the direct contact with AECOM regarding resolution of SH&E issues.
- Immediately report all work-related injuries/illnesses/incidents, environmental incidents and regulatory inspections/violations to AECOM according to AECOM procedures and/or client requirements.

11.3 Subcontractor HASP/THAs

If the subcontractor's scope of work includes hazards that are not covered by the AECOM Health and Safety Plan (HASP), the subcontractor will need to provide AECOM with their site-specific HASP and task-specific Task Hazard Analyses (THAs). All subcontractor procedures must at a minimum comply with client and AECOM requirements to ensure that hazards associated with the performance of their work activities are properly controlled. Copies of any required safety documentation for a subcontractor's work activities will be provided to AECOM for review prior mobilization to the site.

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12. Training and Documentation

The following sections describe the standard practices or programs that AECOM will establish to prepare employees to perform work safely and consistent with AECOM policy and Procedures. For additional information on SH&E Training, review the Safety, Health and Environment Training, S3AM-003-PR1.

12.1 HASP/Site Safety Orientation

The Project Manager shall conduct a project/site-specific HASP orientation prior to the start of field operations, with support as needed by the SH&E Manager, Site Safety Officer, or Site Supervisor. This meeting will involve representatives from all organizations with a direct contractual relationship with AECOM on the job site. Minimum items to be covered are listed in **Attachment F**. Participants will then sign the HASP Personnel Acknowledgement register at the end of the HASP.

12.2 Worker Training and Qualifications

All personnel at this site must be qualified and experienced in the tasks they are assigned. SH&E Training Procedure S3AM-003-PR1 establishes the general training requirements for AECOM employees.

See **Section 5.1** of this HASP for site-specific required safety training and documentation.

12.3 Competent Person(s)

A competent person is an employee who, through education, training, and experience, has knowledge of applicable regulatory requirements, is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

AECOM's Competent Person Designation Procedure, S3AM-202-PR1, explains the roles, responsibilities and procedures of naming a competent person. Review **Attachment L** of this HASP for a list of site-specific competent person(s) required for this scope of work.

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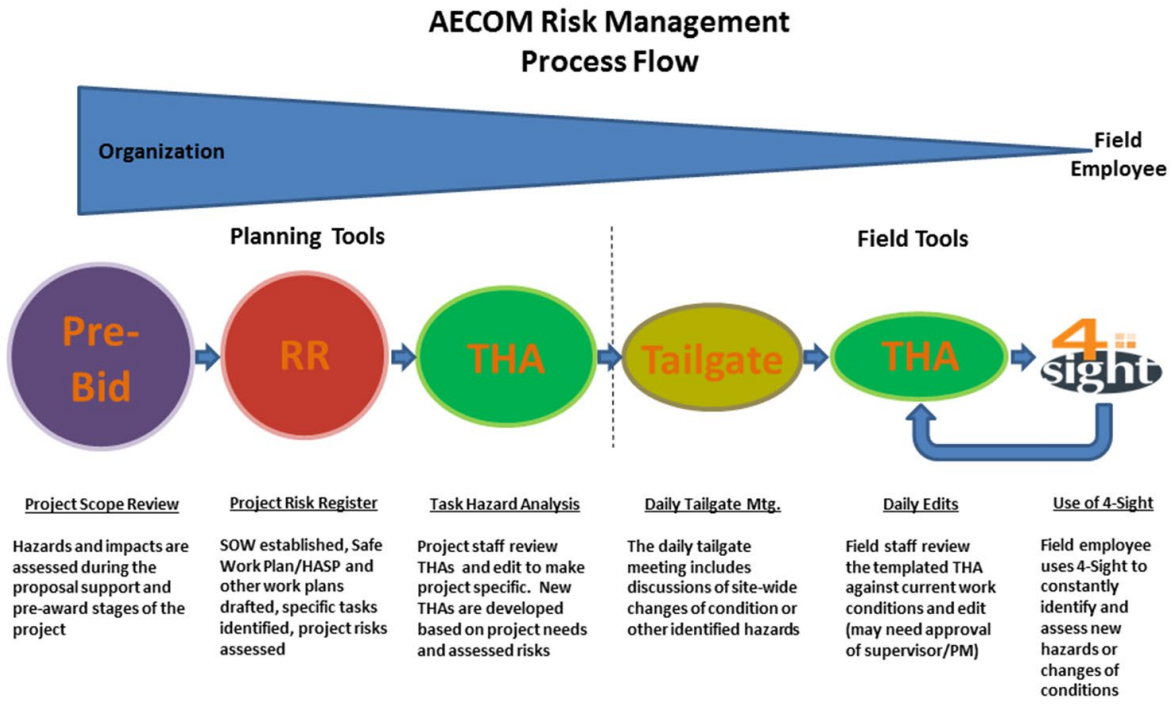
13. Hazard Assessment and Control

AECOM has adopted an approach to hazard assessment and control that incorporates both qualitative and quantitative methods to identify hazards and the degree to which they may impact employees and AECOM operations. See S3AM-209-PR1, Risk Assessment and Management, for details regarding AECOM's process. This approach is illustrated below and described in the following section.



AECOM has adopted an approach to hazard assessment and control that incorporates both qualitative and quantitative methods to identify hazards and the degree to which they may impact employees and AECOM operations. See S3AM-209-PR1, Risk Assessment and Management, for details regarding AECOM's process. This approach is illustrated below and described in the following section.

13.1 SH&E Procedures

All AECOM SH&E procedures, in their controlled copy version, are available on the internal SH&E Policy and Procedures ecosystem page. Programmatic procedures referenced in this document (for example SH&E Training) do no need to be printed for inclusion in this HASP. The applicable field procedures checklist is in the Physical Hazards section below and procedures are included in **Attachment D**.

13.2 Task Hazard Assessments and Daily Tailgate Meetings

THA forms (a blank version is located in S3AM-209-PR1) shall be prepared for each task to be performed as part of the scope of work. This includes driving to the site, parking, and walking as well as the hazards, associated risk, and appropriate controls for all other work activities. The DCS Americas Templated THA Library may also be used to find previously approved THAs, though these should be modified to be project and site-specific. The preparer shall have one THA form for each task in the Scope of Work found in this work plan (**Attachment C**) and shall also include blank copies.

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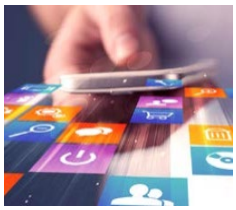
In the field, all employees and visitors shall review the daily THAs and conduct and attend the daily tailgate meeting. When employees arrive on site, conditions may be different than originally planned or additional job steps may be required. The THA requires workers to update or 'dirty up' the THA in the 'On-Site Edits' rows to assess the risks presented by the changed condition(s) and requires the worker to describe steps to reduce the risk. If the hazard(s) cannot be successfully mitigated, the work will **NOT** proceed.

A Site Safety Officer (SSO) or field supervisor shall conduct a daily tailgate meeting to review the specific requirements of this HASP prior to the commencement of daily project activities. Attendance at the daily tailgate meeting is mandatory for all employees and subcontractors at the site covered by this HASP. Simultaneous operations are encouraged to attend each other's tailgate meetings or at the very least the supervisors shall discuss the coordination of activities and associated hazards of each other's tasks. The tailgate meeting must be documented by the field Supervisor or SSO, using the New Daily Tailgate Meeting App. Use the appropriate QR code to download the App and/or go to the Daily Tailgate Meeting App Ecosystem page for details, guides, training sessions and/or other information:



iOS

Android

As an alternative you can also use or the Daily Tailgate Meeting form (S3AM-209-FM5), a blank copy of which is included in **Attachment C**.

13.3 Hazard Categories

THAs should include consideration of the following hazard categories when identifying hazards and task specific controls:

Category	Definition
Biological	A biological hazard is any living organism that could cause irritation, allergic reaction, bites, stings, illness, infection, or other injury.
Chemical	A chemical hazard is any chemical substance that could potentially cause harm to humans, equipment, or the environment either through contact, ingestion, absorption, inhalation, or reaction.
Electrical	Electrical hazards are present whenever there is potential for contact with an electric charge.
Gravity	Gravitational force can cause tools, equipment, materials, and people to fall either to the same level or from heights to the earth or a lower surface.
Mechanical	A mechanical hazard when there is energy within the components of a mechanical system within an otherwise stationary piece of equipment/machinery.
Motion	Objects or substances that can move or are moving not due to gravity create a motion hazard. Motion hazards also include body motions and positioning such as bending, stretching, kneeling, etc.

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Category	Definition
Noise	Noise hazards are sounds that may prevent effective communication or cause hearing loss.
Pressure	Any physical matter such as gases, liquids, and springs that is compressed or under a vacuum creates a pressure hazard.
Radiation	Radiation hazards include both ionizing and non-ionizing energy emitted from radioactive elements or sources.
Thermal	Thermal hazards can cause injury or damage due to their temperature.

13.4 4-Sight

When preparing hazard assessments and throughout the day workers should use 4-Sight. This is a mental process through which workers ask themselves (and each other) four questions designed to effectively assess hazards. Using these questions during each task, especially those without established THAs, will help workers identify hazards and condition changes so that they can control them or stop work to seek assistance.

- **What am I about to do?**
- **What could go wrong?**
- **What could be done to make it safer?**
- **What have I done to communicate the hazard?**

13.5 Speak Up/Listen Up

All AECOM employees have a responsibility to help create the environment where the expectation is Safety for Life. Speak Up/Listen Up (SULU) is a technique to steward jobsite safety by utilizing 4-Sight as a basis for safety feedback conversations. SULU has two main parts:

- **Speak Up** where employees use three simple steps when providing feedback to others about unsafe acts:
  - Ask to discuss their hazard assessment or 4-Sight for the task;
  - Get a commitment from the employee to apply the hazard controls and perform the task according to the accepted procedures; and
  - Follow up to ensure the employee is working safely
- **Listen Up** where employees use two simple steps when responding to safety feedback:
  - Listen – Focus on the message, not the messenger; and
  - Commit to performing the task the safer way

SULU conversations should happen consistently throughout the workday to create clear expectations of how work should be performed. All employees should recognize safe work behaviors in order to reinforce them and keep them going. An occasional correction is much more effective when employees are frequently encouraged and positively recognized for their safe actions. Managers and supervisors should be having SULU conversations during site visits and ensure peer to peer and site supervisor to crew SULU conversations are being held.

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14. Incident Reporting

14.1 Incident Notifications and Reporting

NOTE! In the event of a life-threatening emergency, call 911 FIRST. A life-threatening emergency can include:

- Loss of consciousness
- Head or spinal cord injury
- Cardiac arrest
- Seizures
- Severe allergic reaction
- Broken bones
- Uncontrolled loss of blood
- Abdominal trauma
- Heat Stroke
- Difficulty breathing

Once immediate actions have been taken, if safe to do so, notifications (verbal) must be completed immediately and the involved employee, site supervisor or site safety officer most call the AECOM Incident Reporting Hotline at 1-800-348-5046. Notifications serve to engage additional resources in the management of the emergency and initiate additional processes such as medical case management, spill response, incident investigation, etc. Reporting initiates the formal documentation process and supports the development of key learnings to prevent a reoccurrence.

14.1.1 AECOM Internal Notifications

For any incident or near miss, the involved employee must notify their site supervisor or site safety office. The site supervisor or site safety officer must notify their Project Manager. Depending on the severity of the incident, the Project Manager may need to notify the following individuals:

- Regional, area, business line, practice group or account SH&E manager.
- Program Manager or Client Account Manager
- Senior Leaders

14.1.2 Client Specific Notifications

Notify National Grid of incidents in accordance with their incident notification requirements (refer National Grid Incident Reporting Requirements **Attachment B**).

See client contact information in the Key Personnel table at the bottom of the **HASP Summary** on Page i.

14.1.3 Incident Investigation

All incidents and near misses will be investigated and documented to determine the contributing and root causes. The investigation will verify the need for corrective actions and identify opportunities for Lessons Learned and continuous improvement. For more information in incident investigations, please review the Incident reporting, Notifications and Investigation procedure, S3AM-004-PR1.

As soon as it is safe to do so after an incident occurs, the following information will be gathered:

- An incident timeline;
- Witness statements;
- Police reports, if applicable;
- Any additional information that will assist in the investigation; and

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- Photos of the incident;
- Copies of daily safety documentation and/or field notes.

14.2 Incident and Near Miss Reporting

Per the National Grid Incident Reporting Requirements and flow chart in **Attachment B**, "The Incident Reporter will notify the Project-Specific National Grid Project Manager verbally within 1 hour of the incident". This is for all incidents, not just "significant" ones.

All incidents and near misses (i.e., incidents without consequences), regardless of type and perceived severity, must be reported in accordance with the Incident Reporting, Notifications and Investigation, S3AM-004-PR1 and entered into **IndustrySafe** (AECOM's SH&E Database) within the timeframes listed below:

Incident Type	IndustrySafe Reporting Timeframe
Significant Incident, including any injury to an AECOM employee or Subcontractor	Within **4 hours**
All Other Incidents	Within **24 Hours**

Note: Only the basic facts, who, what, when, where and how, are needed to complete the initial IndustrySafe report. SH&E Managers will assist you in updating the report as additional information becomes available.

Significant incidents include:

- Fatality;
- Amputation;
- Hospitalization for treatment for more than 24 hours (admission);
- Any single event resulting in more than one employee requiring medical treatment or more than one employee being away from work for more than 3 days;
- Any SH&E-related Consent Agreement/Order/Lawsuit or enforcement action seeking more than $10,000 or alleging criminal activity;
- Any spill or release of a hazardous material that is reportable to a regulatory agency. In determining whether a spill or release must be reported to a regulatory agency, the Site Supervisor or qualified worker will assess the quantity of the spill or release and evaluate the reporting criteria against the state-specific reporting requirements, applicable regulatory permit, and/or client-specific reporting procedures. Reporting to the regulating agency may be done by National Grid. If reporting to a US state or Federal regulatory agency is required, AECOM has 15 minutes from the time of the spill/release to officially report it. Employees should review the local regulatory requirement, document it in this plan and communicate it to all personnel.
- Any Notices of Violation resulting from not operating within a regulatory agency permit/license or consent;
- Any incident resulting in property damage expected to exceed $10,000 United States dollars (USD);
- Any security-related incident that could have caused significant harm to an AECOM employee; and/or
- Any near miss event that may have resulted in any of the above consequences, but because of "luck" did not result in harm to persons, property or the environment.

Other incidents include:

- Any injury or illness to an AECOM employee or subcontractor, even if it does not require medical attention, including non-work-related injuries/illnesses that have become significantly aggravated by the work environment;
- An injury to a member of the public or client representative occurring on an AECOM-controlled work site;

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- Re-occurring conditions such as back pain or cumulative trauma disorders (e.g., carpal tunnel syndrome);
- Fire, explosion or flash that is not an intended result of a planned event (e.g., remediation process, laboratory procedure);
- Any incident involving company-owned, rented or leased vehicles (including personal vehicles used for company business); and/or
- Any failure to comply with requirements of a regulatory permit issued to AECOM.

14.2.1 Motor Vehicle Incidents

Collisions: All vehicles should be rented through Trip Actions (accessible via Ecosystem) to ensure that AECOM insurance is included in the rental rate. All other insurances should be declined. AECOM's rental vehicle insurance policy for National/Enterprise or Avis can be found on the DCS Americas United States or Canada travel pages. **Drivers MUST print and carry the applicable insurance policy for the rental. For company owned vehicles, drivers MUST also print and carry proof of insurance.**

Breakdowns: If safe to do so, remove the car from the traveled way. To the extent possible, AECOM personnel should **NOT** change flat tires or perform similar repairs.

- For rental vehicles, contact the rental company
- For fleet vehicles, contact **ARI Fleet Management: 1-800-422-7647**
  - Prompt 1 – Roadside Assistance
  - Prompt 3 – Maintenance Management
- For personal vehicles used on AECOM business, contact an emergency provider.

14.2.2 Safety Observation Reporting

All safety observations must be entered into **IndustrySafe™ or Lifeguard™** (AECOM's SH&E Databases).

14.2.3 SH&E Database Access

Incidents, near misses, and audits/inspections must be entered into **IndustrySafe™**, which is one of AECOM's SH&E Databases. Safety observations may also be entered into **IndustrySafe™** at the AECOM Project Manager's discretion. **IndustrySafe™** can be accessed via the SH&E Page on Ecosystem when you are in the office or connected to the AECOM network via VPN. IndustrySafe may also be accessed from your smartphone/device, if equipped with a QR Code Reader App, using the QR Code to the right.

Incidents, Near Misses, Audits/Inspections and Safety Observations

Safety observations may also be entered into **Lifeguard™**, which is one of AECOM's SH&E Databases, at the AECOM Project Manager's discretion. **Lifeguard™** can be accessed via the SH&E Page on Ecosystem when you are in the office or connected to the AECOM network via VPN. **Lifeguard™** may also be accessed from your smartphone/device, if equipped with a QR Code Reader App, using the QR Code to the right.

14.2.4 Reporting Assistance

If your field schedule, access to internet, and/or limited cellular phone coverage have the potential to impact timely incident, near miss, and/or safety observation reporting, please contact your AECOM Project Manager and/or SH&E Manager for assistance.

15. Environmental Management

15.1 Scope

AECOM implements policies and procedures to reduce risk of land and/or water pollution and other environmental concerns during the life of the project. The AECOM Project Manager will ensure compliance with all local, state, federal and client environmental laws and/or regulations. For additional information on Environmental Management, please review the Environmental Compliance procedure, S3AM-204-PR1.

15.2 Roles and Responsibilities

All AECOM staff through the leadership of the AECOM Project Manager are responsible for reducing or eliminating environmental impacts by AECOM personnel. The site supervisor and/or the site safety officer will be immediately notified of any spills, leaks, or other impacts to the ground and/or water, or other environmental emergencies, after emergency respondents have been called, if necessary. The Project Manager will be responsible for making any further notifications as required.

15.3 Staffing and Awareness

AECOM staff will receive relevant awareness training to ensure proper knowledge and training when performing activities with the potential to impact the environment, as well as the requirement of this plan for proper preparedness and response.

15.4 Pollution Prevention

Pollution/impact to the environment could be caused by the following sources:

- Air emissions
- Wastewater
- Hazardous materials
- Solid waste
- Hydrocarbons
- Storm water and sediment/erosion

AECOM will employ prevention and control measures to prevent impacts to the environment. In addition, a spill kit consisting of sorbent socks, pads, shovels and personal protective equipment (PPE) will be maintained on site by AECOM and each subcontractor.

All environmental spills or releases of hazardous materials (e.g., fuels, solvents, etc.)will be reported according to the incident reporting procedure. Spills should be reported to National Grid per the National Grid Incident Reporting Requirements and flow chart in **Attachment B**.

Spills that cannot be managed safely by on-site personnel will require support from National Grid's emergency contractor, Miller Environmental. If this is the case, call the National Grid Project Manager and the AECOM Project Manager to organize additional help.

Solid waste will be collected, segregated (recyclable, non-flammable, and flammable) and removed on a regular basis. All hazardous wastes generated during site activities are to be contained in appropriately labelled 55-gallon drums, sealed and staged in a temporary location pending transport off-Site for treatment/ disposal. A drum pick-up is to be scheduled with National Grid's waste transport and disposal contractor for each day of waste generation. Waste drums are not to be left on-site overnight.

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Detail regarding hazardous waste containers, transport and disposal is provided in the document titled NAPL Recovery Plan for the 50 Kent Avenue Property, Brooklyn, Kings County, New York and dated February 2020 (AECOM, 2020).

It is noted that AECOM is not authorized to sign shipping papers for the work covered by this HASP.

15.4.1 NYSDEC Petroleum Spill Requirements

All petroleum spills that occur at the site must be reported to National Grid first. National Grid may report the spill to the NYSDEC Spill Hotline (1-800-457-7362) within 2 hours of discovery, except spills which meet all of the following criteria:

- The quantity is known to be less than 5 gallons; and
- The spill is contained and under the control of the spiller; and
- The spill has not and will not reach the State's water or any land; and
- The spill is cleaned up within 2 hours of discovery.

A spill is considered to have not impacted land if it occurs on a paved surface such as asphalt or concrete. A spill in a dirt or gravel parking lot is considered to have impacted land and is reportable.

NYSDEC's Spill Regulations/Guidelines can be found at: https://www.dec.ny.gov/chemical/8692.html

The spill containment program addresses the following site-specific information:

- Potential hazardous substance spills and available controls;
- Initial notification and response;
- Spill evaluation and response; and
- Post-spill evaluation.

15.4.2 Post Spill Evaluation

As part of the incident investigation and reporting documentation, a written spill response report shall be prepared at the conclusion of clean-up operations. Additional report information required by National Grid is outlined in **Attachment H**. The report will include, at a minimum, the following information:

- Date of spill incident;
- Cause of incident;
- Spill response actions;
- Any outside agencies involved, including their incident reports; and
- Lessons learned or suggested improvements.

The spill area is inspected to ensure the area has been satisfactorily cleaned. The use of surface and air sampling is utilized in this determination as necessary. The root cause of the spill shall be examined, and corrective steps taken to ensure the engineering and control measures in place have performed, as required. If alternative precautions or measures are needed, they are made available and implemented.

All durable equipment placed into use during clean-up activities is decontaminated for future utilization. All spill response equipment and supplies are re-stocked as required.

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16. AECOM Audits and Inspections

The AECOM audit and inspection process establishes the protocol for the assessment the Safety, Health and Environment (SH&E) program and its application, as well as the process to identify and monitor corrective actions. The goal is to minimize risk and enhance operational SH&E performance. For more information on audits and inspections, please review the Compliance Assurance procedure, S3AM-216-PR1.

16.1 Project Manager Self Assessments

AECOM Project Managers will perform quarterly SH&E site audits using the DCSA Project Manager Self-Assessment form (available in IndustrySafe.

16.2 Senior Management Activities (SMAs)

AECOM Senior Managers will perform Senior Management Activity inspections on the projects under their area of responsibility. These SMAs will be entered into Lifeguard.

16.3 Project Safety Reviews (PSRs)

AECOM SH&E Managers will perform periodic Project Safety Reviews on projects in their area of responsibility. These PSRs will be entered into IndustrySafe.

16.4 Site Safety Inspections (OSHA Type)

AECOM Project Managers and SH&E Managers will perform periodic site safety inspections (OSHA type) on projects in their area of responsibility as required. These site safety inspections will be entered into IndustrySafe.

16.5 External Regulatory Inspections

If a regulatory inspector shows up on site, AECOM will follow the requirements in our Regulatory Inspections procedure S3AM-211-PR1.

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17. Project Closeout

Completing a project requires procedures to close out Project Contractual and Administrative activities. The closeout process ensures all documentation is finalized and any Contractual Obligations are met. The Project is ready for close-out once it has been accepted by the end user organization. Project close-out is complete after all physical, regulatory, contractual, and financial close-out activities are complete.

17.1 Health and Safety File

The Health and Safety File will normally include:

- Brief description of the work carried out.
- Residual hazards which remain and how they have been dealt with (e.g. surveys, or information on asbestos, contaminated land, water bearing strata, buried services etc.).
- Key structural principles incorporated in the design (e.g. bracing) safe working loads etc.
- Any hazards associated with the materials used.
- Nature, location and markings of significant services including underground cables, gas supplies, firefighting etc.
- Information and ‘as built’ drawings including safe access to and from confined spaces etc.
- Daily Tailgate Meeting Forms
- Lessons Learned

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18. Personal Acknowledgement

By signing below, the undersigned acknowledges that he/she has reviewed the AECOM Health and Safety Plan for the Williamsburg Works Former Manufactured Gas Plant site. The undersigned also acknowledges that he/she has been instructed in the contents of this document and understands the information pertaining to the specified work and will comply with the provisions contained therein. The employee understands that they are **NOT** to perform any work that they have not been adequately trained for and that they are to stop work if it is unsafe to proceed. Finally, the employee understands to notify the Site Supervisor and the **Incident Hotline at 800-348-5046** for any incident, ***including ANY injury even if no first aid or medical treatment is required.***

Print Name Clearly	Signature	Organization	Date

18.1 Disclaimer

This HASP, and each of its provisions, is applicable only to, and for use only by, AECOM, its affiliates, and its subcontractors. Any use of this Plan by other parties, including, without limitation, third-party contractors on industrial sites or projects where AECOM is providing engineering, construction management, or similar services, without the express written permission of AECOM, will be at that party's sole risk, and AECOM Corporation shall have no responsibility. The existence and use of this Plan by AECOM shall not be deemed an admission or evidence of any acceptance of any safety responsibility by AECOM for other parties unless such responsibility is expressly assumed in writing by AECOM in a specific project contract.

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Figures



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APPROXIMATE SCALE IN FEET

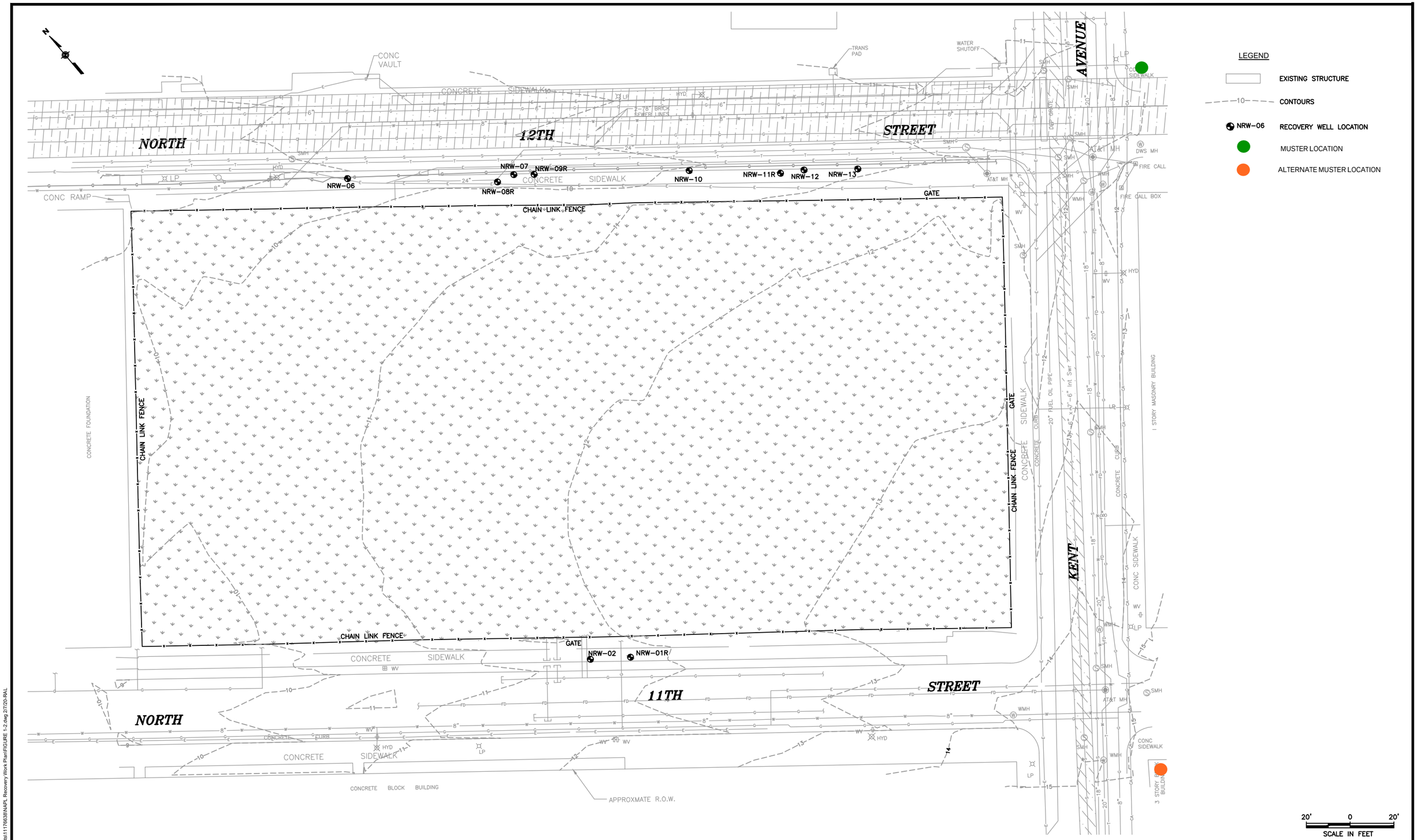
2000 0 2000

AG20745-111176638-071812-GCM

AECOM

50 KENT AVENUE PARCEL OF THE
WILLIAMSBURG WORKS FORMER MGP SITE
BOROUGH OF BROOKLYN, NEW YORK
SITE LOCATION MAP

FIGURE 1-1



AECOM	NATIONAL GRID FORMER WILLIAMSBURG MGP SITE BROOKLYN, KINGS COUNTY, NEW YORK	HEALTH & SAFETY PLAN	NAPL RECOVERY WELL & MUSTER LOCATIONS DATE: FEBRUARY 2020 FIGURE 1-2

\\URSBuffalo.us.ic.ursBuffaloProjects\11176638\NAPL Recovery Work Plan\FIGURE 1-2.dwg 2/7/20-RAL

AECOM

Attachment A

Hospital/Clinic Maps

Attachment A: Hospital/Clinic Maps

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A-1: NEAREST HOSPITAL

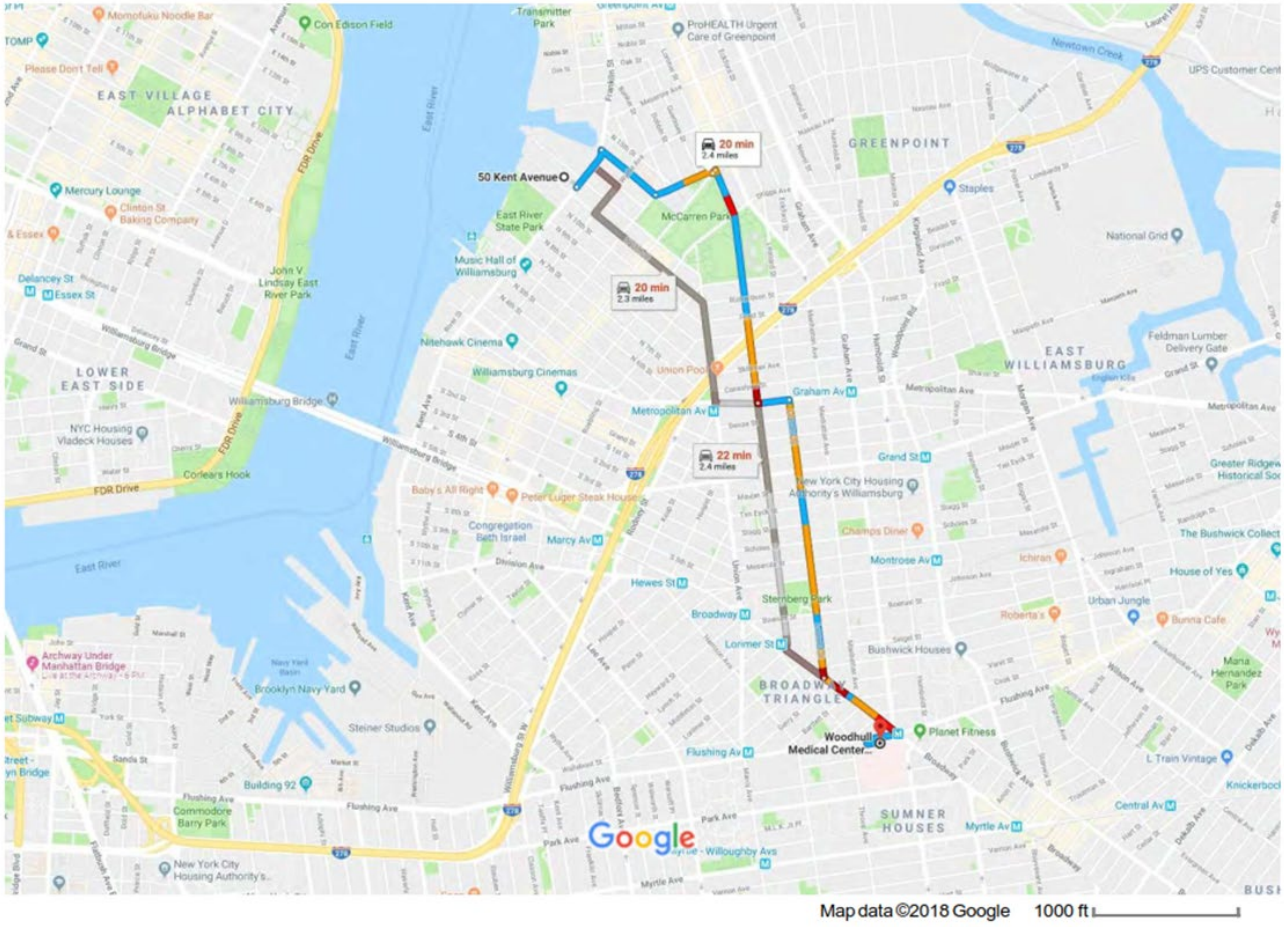
Woodhull Medical Center, Ph: 1-718-963-8000

Address:	760 Broadway		
City:	Brooklyn		
State/Province:	NY	**Postal/Zip Code:**	11206
Estimated Travel Time:	20 minutes	**Distance:**	2.4 miles

DRIVING DIRECTIONS

- Head northeast on Kent Ave toward North 12th St
- Take Lorimer St to Metropolitan Ave
- Turn right onto North 14th St
- North 14th St turns left and becomes Nassau Ave
- Turn left onto Bedford Ave
- Turn right onto Lorimer St
- Turn left onto Metropolitan Ave
- Turn right at the first cross street onto Leonard St
- Turn left onto Broadway (pass McDonalds on the right)
- Turn right onto Flushing Ave
- Turn left, arrived at destination

MAP TO HOSPITAL



A-2: NEAREST OCCUPATIONAL CLINIC

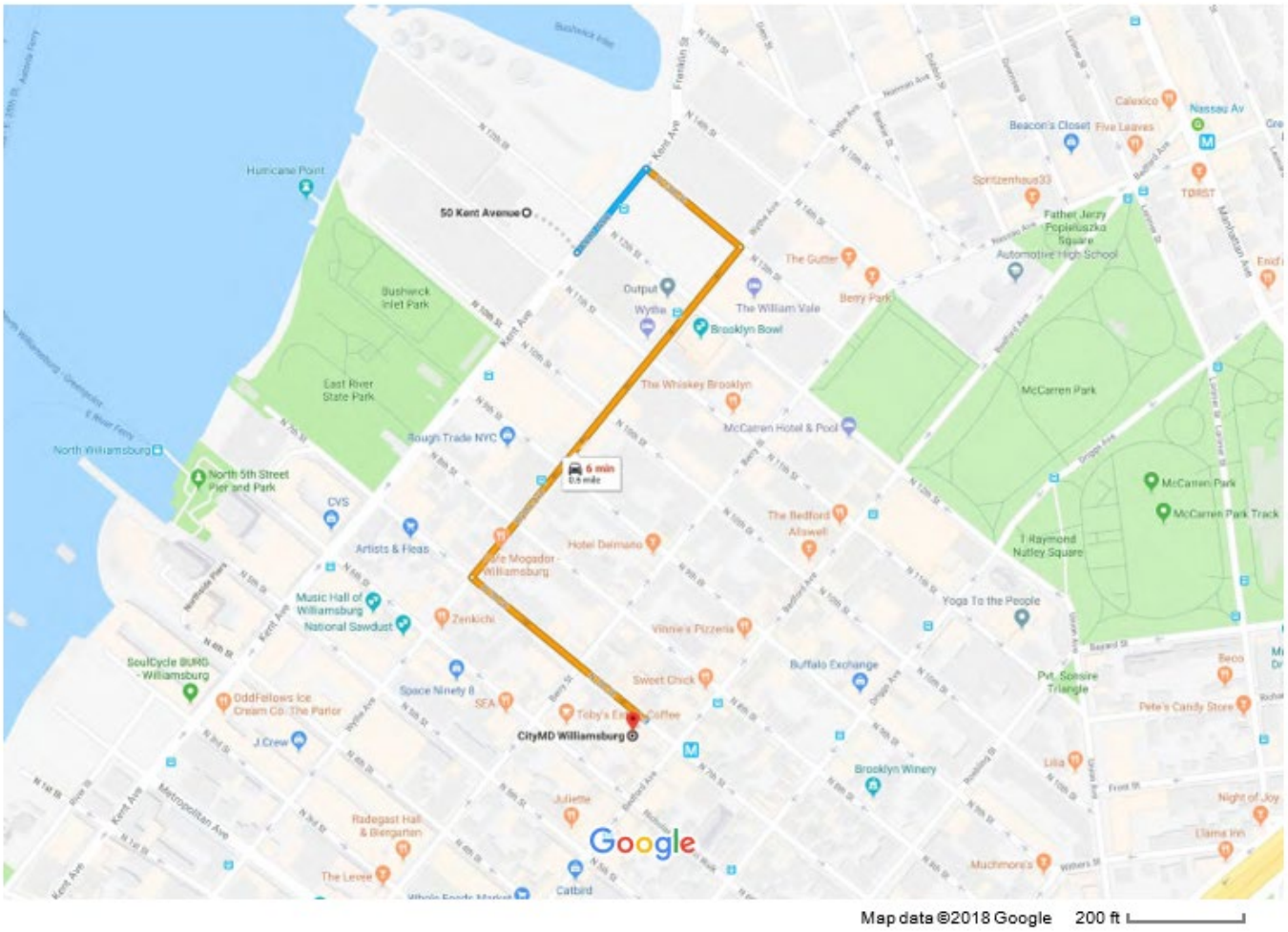
CityMD, Ph: 1-718-414-2013

Address:	154 North 7th St		
City:	Brooklyn		
State/Province:	NY	**Postal/Zip Code:**	11249
Estimated Travel Time:	6 minutes	**Distance:**	0.6 miles
Business Hours:	7 days a week, 8AM-8PM		

DRIVING DIRECTIONS

- Head northeast on Kent Ave toward North 12th St
- Turn right onto North 13th St
- Turn right at the first cross street onto Wythe Ave
- Turn left onto North 7th St
- Arrived at destination on right.

MAP TO OCCUPATIONAL CLINIC


50 Kent Avenue
CityMD Williamsburg
6 min
0.6 mile
Hurricane Point
Bushwick Inlet Park
East River State Park
North 5th Street Pier and Park
North Williamsburg
Kent Ave
Franklin St
Nassau Av
Calexico
Beacon's Closet
Five Leaves
Spritzenhaus33
TØRST
Father Jerzy Popieluszko Square
Automotive High School
The Gutter
Berry Park
Output
Wythe
The William Vale
Brooklyn Bowl
The Whiskey Brooklyn
McCarren Hotel & Pool
McCarren Park
McCarren Park Track
T Raymond Nutley Square
Rough Trade NYC
CVS
Artists & Fleas
Hotel Delmano
The Bedford
Allswell
Yoga To the People
Music Hall of Williamsburg
National Sawdust
Zenkichi
Vinnie's Pizzeria
Buffalo Exchange
Pvt. Sonsire Triangle
Pete's Candy Store
SoulCycle BURG - Williamsburg
Oddfellows Ice Cream Co. The Parlor
Space Ninety 8
Sweet Chick
J.Crew
Brooklyn Winery
Lilia
Night of Joy
Radegast Hall & Biergarten
The Levee
Juliette
Catbird
Llama Inn
Muchmore's
Google
Map data ©2018 Google
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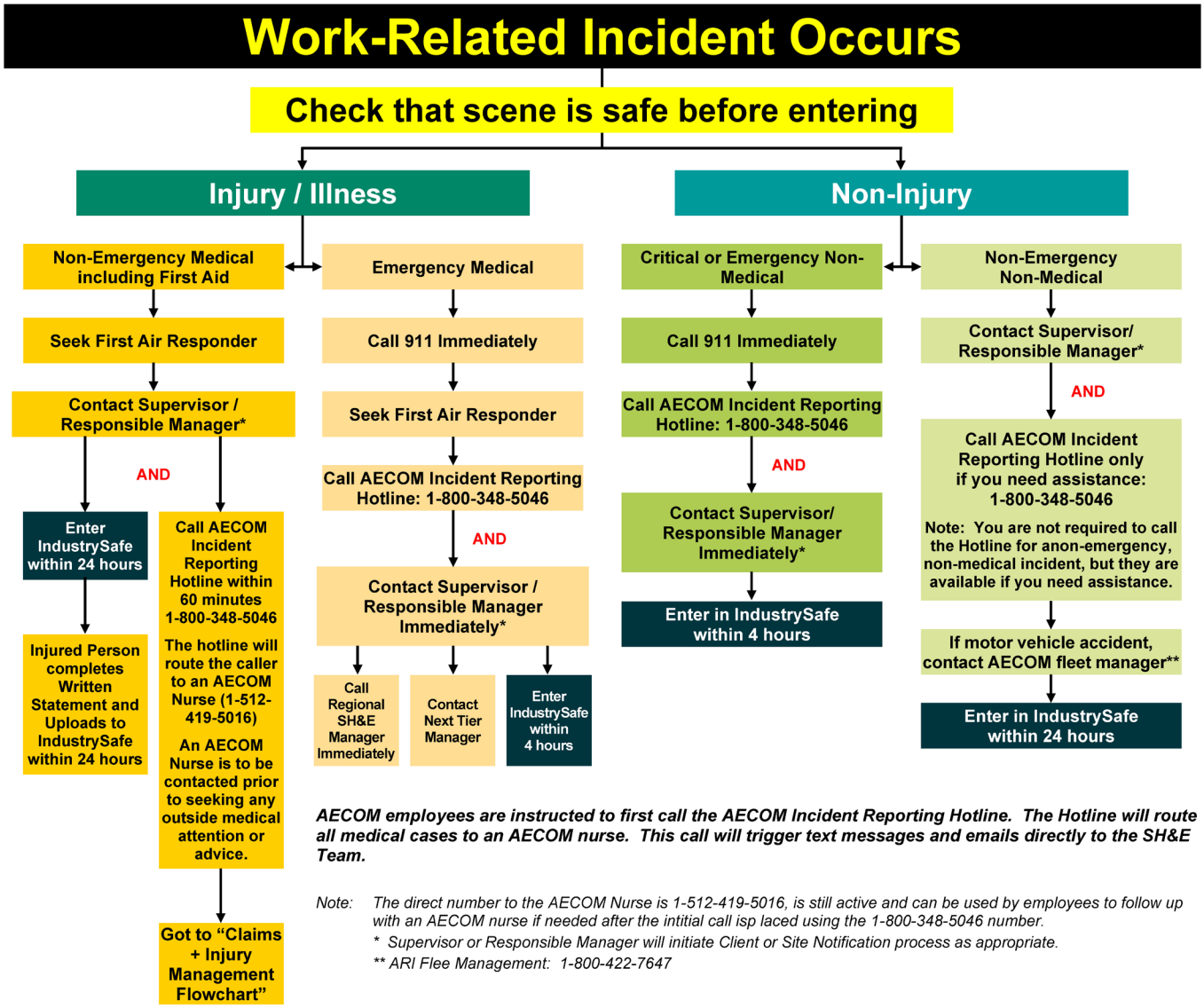
Attachment B

Incident Reporting Flow Chart

Attachment B: Incident Reporting Flow Chart



AECOM employees are instructed to first call the AECOM Incident Reporting Hotline. The Hotline will route all medical cases to an AECOM nurse. This call will trigger text messages and emails directly to the SH&E Team.

Note: The direct number to the AECOM Nurse is 1-512-419-5016, is still active and can be used by employees to follow up with an AECOM nurse if needed after the intitial call isp laced using the 1-800-348-5046 number.

** Supervisor or Responsible Manager will initiate Client or Site Notification process as appropriate.*

*** ARI Flee Management: 1-800-422-7647*

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National Grid Incident Reporting Requirements

All contractors and consultants working on National Grid projects hired either by National Grid or its representative will report incidents involving their personnel or subcontractor personnel to National Grid. Incidents include but are not limited to injuries, illnesses, near misses, motor vehicle incidents, environmental releases, fires, incidents involving the public, and property damage. The person reporting the incident is the Incident Reporter.

The Incident Reporter will notify the Project-Specific National Grid Project Manager (PM) **verbally** within **1 hour** of the incident. All work will be suspended until contact is made with the Project-Specific PM so that National Grid can assess if continued work suspension or if a stand down is necessary. If the National Grid PM cannot be reached, contact the National Grid SIR Regional Safety Lead as noted in the table below.

Name	Region	Phone Numbers	E-Mail
William Ryan	Downstate NY	W- (516) 545-2586 C - (516) 790-1660	William.Ryan@nationalgrid.com
Brian Stearns	Upstate NY	W- (315) 428-5731 C - (315) 461-7892	Brian.Stearns@nationalgrid.com
Elizabeth Greene	MA/RI	W- (781) 907-3656 C- (781) 248-6469	Elizabeth.Greene@nationalgrid.com

A DRAFT written Incident Report and/or email summary must be completed and submitted by the Incident Reporter to the Project-Specific National Grid PM, National Grid SIR Safety Lead, and/or other designated National Grid representative **within 4 hours** of the incident.

The Incident Reporter will provide a FINAL Incident Report within **24 hours** via e-mail to the Project-Specific National Grid PM, National Grid Regional Safety Lead, and/or the person to whom the verbal notification was initially provided.

Figures, photographs and/or sketches should be included within the Incident Report. Photographs of the incident area and/or vehicle (not of the personal injury) should be included. For vehicle incidents and cases of damaged or stolen property, a police report should be filed and a copy provided to the Project-Specific PM. A representative with knowledge of the incident should be available to provide incident information until the investigation is completed by National Grid. In some municipalities police will not be dispatched to a non-injury accident, but every effort needs to be made to try and obtain the report.

All personnel must be made aware that preventing or promptly addressing accidents and injuries takes precedence over completing field work. In addition, if any worker believes that working

conditions pose a risk of harm to on-site personnel or members of the public, work must stop and the situation must be addressed.

Incident Report Information

The following information should be included when reporting the incident to National Grid.

1. Incident Date and time

2. Date/Time National Grid PM was initially notified. Record different times and methods of notification (Call cell, Call office, Left message, e mail, text, etc.).

3. Employee type (regular, temp, contractor, consultant), company, company address, and what position held. Name, DOB, sex, full/part time.

4. Incident Type
    a. Injury/Illness to Employee (NG employee, temporary, consultant, contractor)
    b. Injury/Illness to Contractor
    c. Near Miss
    d. Motor Vehicle
    e. Public Incident
    f. Hazardous Condition
    g. Company property Damage/Equipment Damage/Equipment Failure
    h. Switching/Relay Incident
    i. Environmental

5. Incident location. Address where incident happened, site name/Owner.

6. Description of what happened, number people injured, fatalities, voltage, pressure (if applicable). Type of activity/task being performed.

7. Medical attention received

8. Spills (if applicable) - material, source, quantity, weather conditions, cause, responsible party for cleanup, PCB level, environmental media (land, water, and/or air) impacted. Clean up and Corrective actions.

9. Equipment details (if applicable) - type, number, size, unit, manufacturer

10. Witness Detail (name, address, statement).

11. OSHA severity

12. Name and address of medical care facility/doctor (if treated by a doctor or hospital). Was employee treated overnight? In the emergency room?

13. Nature of injury - part injured. Be specific.

14. Object that caused injury. Be specific.

15. What was employee doing just prior to injury?

16. How could this incident been prevented?

17. List any unsafe acts / unsafe conditions

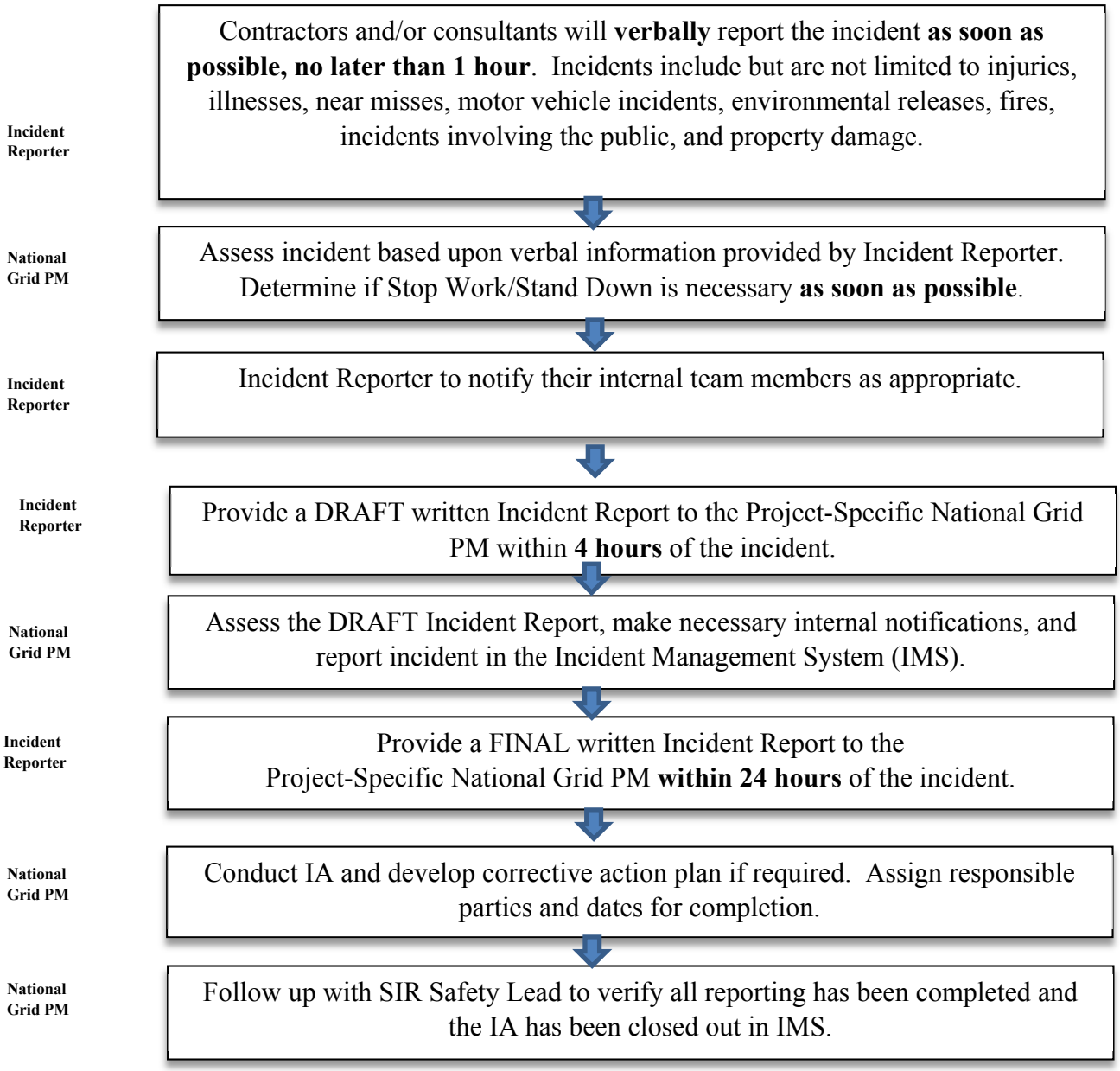
18. Were safety rules, work methods, procedures violated?

19. Was proper protective equipment worn?

20. List any prior accidents with dates that this employee has experienced

21. Lessons Learned

Flow Chart for Accident Reporting



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Attachment C

THA Forms, and Tailgate Safety Meeting Form

Attachment C: THA Forms, and Tailgate Safety Meeting Form

Task Hazard Assessment Instructions:

Each unique task or work group should have their own THAs. If workers have a THA for their task(s) in hand, they should simply review it and document the site-specific edits in the appropriate section. If workers do ***not*** have a THA for all tasks to be performed, a THA must be obtained or drafted *prior to starting work* on that task. Use additional pages as needed.

- Identify the basic steps of the task that must be performed in order and their associated hazards. Identify controls or barriers to mitigate each identified hazard.
- Clearly identify any **STOP WORK** triggers.
- Document stop work and change management if conditions/ scope changes.
- Use 4-Sight to identify and mitigate site-specific hazards throughout the day. Modify the THA as needed. Contact site supervisors or the PM for any significant scope changes or changes of expected conditions.
- All THAs shall be 3 pages (maximum) or less (preferred). If they are longer, the task is too broad.
- All hazards will use standardized nomenclature (Hazard Wheel), should be specific, detail how someone could be hurt and what the outcome could be.
- All actions to mitigate hazards must be specific, clearly aligned with its respective hazard and not generic. Avoid words such as "*proper", "correct*", or "*appropriate*"). Use specifics and numerical values (i.e., wear disposable nitrile gloves, stand back 6 feet/1.8 meters, take a 10-minute break every hour).
- PPE cannot be the only line of defense - PPE is always the last line of defense, so think through what other controls (engineering, administrative, etc.) could mitigate hazards.

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Discuss as Applicable and Modify THA as Needed

Check ☑ if reviewed or mark N/A

- ☐ *Biological / Chemical / Electrical Hazards*
- ☐ *Decontamination Procedures*
- ☐ *Ergonomics – Lifting, Body Position*
- ☐ *Lock Out / Tag Out*
- ☐ *Short Service Employees – visual identifier and mentor / oversight assignment*
- ☐ *Simultaneous / Neighboring Operations*
- ☐ *Slip / Trip / Fall Hazards*
- ☐ *Specialized PPE Needs*
- ☐ *Traffic Control*
- ☐ *Waste Management / Decontamination*
- ☐ *Weather Hazards / Heat Stress / Cold Stress*
- ☐ *Work Permit Requirements:* Click here to Identify OR type N/A
- ☐ *Other:* Click here to Describe OR type N/A

Probability	Severity				
	5 - Catastrophic	4 – Critical	3 – Major	2 – Moderate	1 - Minor
5 – Frequent	25	20	15	10	5
4 – Probable	20	16	12	8	4
3 – Occasional	15	12	9	6	3
2 – Remote	10	8	6	4	2
1 - Improbable	5	4	3	2	1

Risk Rating (Probability x Severity)	Risk Acceptance Authority
1 to 4 (Low)	Risk is tolerable, manage at local level
5 to 9 (Medium)	Risk requires approval by Operations Lead/Supervisor & Safety Manager
10 to 25 (High)	Risk requires the approval of the Operations Manager & Safety Director

Severity – Potential Consequences				
	People	Property Damage	Environmental Impact	Public Image/Reputation
Catastrophic	Fatality, Multiple Major Incidents	>$1M USD, Structural collapse	Offsite impact requiring remediation	Government intervention
Critical	Permanent impairment, Long term injury/illness	>$250K to $1M USD	Onsite impact requiring remediation	Media intervention
Major	Lost/Restricted Work	> $10K to $250K USD	Release at/above reportable limit	Owner intervention
Moderate	Medical Treatment	> $1K to $10K USD	Release below reportable limit	Community or local attention
Minor	First Aid	</=$1K USD	Small chemical release contained onsite	Individual complaint

Probability		
Frequent	Expected to occur during task/activity	9/10
Probable	Likely to occur during task/activity	1/10
Occasional	May occur during the task/activity	1/100
Remote	Unlikely to occur during task/activity	1/1,000
Improbable	Highly unlikely to occur, but possible during task/activity	1/10,000

Using the Matrix:

1. Identify basic steps of the task and associated hazards.
2. Calculate the initial risk rating.
3. Identify control measure to eliminate or reduce the hazard's risk and calculate the residual risk rating.
4. If the risk rating (after controls are implemented) cannot be reduced to 4 or lower, additional approvals are needed before the activity can begin.

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Task Hazard Assessment

AECOM

Task Name:	Coronavirus Precautions – Field, Office, and Travel	**Control #:**	Rev #1 (08/01/2021)

Project Name:	National Grid Williamsburg	**Client:**	National Grid	**Date:**	Click to enter date.
Permits Required? (list):	No	**Work Location:**	50 Kent Avenue, Williamsburg, Brooklyn		

THIS THA MUST BE FULLY REVIEWED AND ACKNOWLEDGED DAILY BY ALL AECOM STAFF and AECOM SUBS ON-SITE

All job steps, hazards, work practices & PPE are to be clearly understood and implemented. All necessary revisions have been written on the THA.

Required PPE:	☐ Hard Hat ☐ Safety Glasses ☐ HiVis Vest ☐ Safety Toe Boots ☐ Hearing Protection ☒ Gloves: Click for Glove Type ☒ Other: See list below
	Additional materials and supplies required: ■ Potable water and soap (preferable) or hand sanitizer w/ 70% alcohol ■ Disinfectant wipes ■ Tissues ■ Disposable gloves ■ Face coverings/face masks ■ One Gallon Zip Lock Bags ■ Safety goggles ■ Disinfectant spray List of Cleaning Products to Kill Coronavirus
Tools & Equipment:	■

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions to Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
1. Fitness for Duty check (performed at home prior to work)	1a. Being unfit for duty – impacted by illness including coronavirus	4	1a. Ensure you are fit for duty Are you or have you been in any of these situations? – I am unvaccinated and have had close contact with a confirmed case or a symptomatic person under investigation for coronavirus in the last 14 days. – A doctor requested me to be tested for coronavirus or instructed me to self-quarantine? – A member of my household or someone I was in close contact within the last 14 days experienced some of the following symptoms: fever, cough, shortness of breath, fatigue, sore throat, chills, gastro-intestinal disease or diarrhea, loss of taste/smell. – I have or previously had some of the following symptoms in the last 7 days: fever or chills, cough, shortness of breath or difficulty breathing, fatigue, muscle or body ache, headache, new loss of taste/smell, sore throat, congestion or runny nose, nausea or vomiting, or diarrhea.. – Where required, my temperature check today shows a fever, without the use of fever reducing medications in the last 24 hours? (100.4 F [37.8C] or above or exceeding criteria required by local order or client requirements). **If response is a YES, then do not access the workplace**. If AECOM employee, contact your Supervisor and the AECOM Nurse at **512-419-5016** for advice. **If response is a NO or Yes, but released by AECOM nurse, you can proceed to work**. You may be asked to check your temperature again when you arrive to your workplace.	2
On-Site Edits:				
2. Planning the trip	2a. Potential exposure to Coronavirus	4	2a. Map route in advance to minimize the potential for exposure and utilize the least populated route of travel where feasible. Avoid entering public places whenever possible. Review vaccination, mask mandate requirements, etc, at destination and for any likely stops along the way and plan to adhere to these requirements. If traveling to an AECOM office, complete Voluntary Vaccine Declaration Form (if you are vaccinated) to be permitted in offices without face coverings where legally permitted .	2
On-Site Edits:				

Task Hazard Assessment

AECOM

Task Name:	Coronavirus Precautions – Field, Office, and Travel	Control #:	Rev #1 (08/01/2021)

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	Potential Hazards *How could you be hurt? What would the injury be?*	Risk *(initial)*	Critical Actions to Mitigate Hazards *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	Risk *(final)*
3. Hazards from travel (via vehicle, air travel, public transit, etc)	3a. Possible exposure from vehicle passengers.	8	3a. Carpooling is permitted if users voluntarily share that they are both vaccinated; if not, limit to one person per vehicle whenever possible. If an unvaccinated passenger must ride with you, limit to one passenger and have them sit in the rear passenger side seat. Unvaccinated individuals must wear face coverings. Crack and/or open windows and use fan to recirculate air.	4
	3b. Possible exposure from airline/transit agency travel	8	3b. Review airline or transit agency guidelines for additional safety precautions that may be applicable. When possible, consider traveling during non-peak hours when there are likely to be fewer people. Follow social distancing guidelines by staying at least 6 feet (2 meters) from people who are not from your household. In enclosed spaces with other passengers, unvaccinated individuals must wear a face covering and others should consider wearing one as well.	
On-Site Edits:				
4. Stopping for restroom breaks and food, fueling, supplies, etc	4a. Possible exposure due to contact with members of the general public at gas stations, convenience stores, restrooms, etc.	**12**	4a. Plan trip to reduce the need to stop for food or restroom breaks. Bring your own food/water/snacks if possible. If you must stop, try avoid entering public places (use drive through services if possible). If you must enter public places, practice social distancing and wear a face covering if unvaccinated. Wash hands with soap and water for at least 20 seconds or use a hand sanitizer before and after entering public places and restrooms. Have soap and water, antibacterial hand wipes or spray, 70% + alcohol hand sanitizer available.	4
On-Site Edits:				
5. Field Work	5a. Working Around Others	**12**	5a. **Unvaccinated personnel must maintain at least 6-foot distance from others to the extent possible and wear face coverings.** All employees should practice social distancing at tailgate meetings, in break rooms and job trailers. Limit the number of people in job trailers and other confined areas at any one time so that this distance can be maintained. If possible, hold meetings outside. If indoors, open window(s) for circulation. Clean all surfaces of your hands often with soap and water for at least 20 seconds. Where available, also use a hand sanitizer that contains at least 60% alcohol. When using hand sanitizer, be sure your hands are completely dry prior to touching any objects or surfaces. Wear safety glasses or goggles and avoid contact/touching of face, eyes, nose, and mouth. Cover your mouth and nose with a tissue when you cough or sneeze or use the inside of your elbow. Throw used tissues in the trash. Immediately wash or sanitize your hands. If the need arises to enter a personal residence, **prepare a separate task specific THA** for this task	4
On-Site Edits:				
6. Office Work	6a. Working Around Others	**12**	6a. AECOM recommends all employees obtain a Coronavirus vaccine. To work in AECOM offices after being fully vaccinated without the requirement to wear a mask or socially distance, please complete the AECOM voluntary vaccination self-attestation form on Workday. For a step-by-step guide to using the Voluntary Vaccination Declaration tool in Workday, click here.. **Unvaccinated personnel must maintain at least 6-foot distance from others to the extent possible and wear face coverings when not at your personal, socially-distanced work station.** Adhere to office-specific Workplace Readiness Plans where available (or the AECOM US Offices Workplace Readiness Plan where site-specific plans are no longer required). This plan may be reviewed at the following link: US DCS Office Workplace Readiness Plan	4
On-Site Edits:				

Task Hazard Assessment

AECOM

Task Name:	Coronavirus Precautions – Field, Office, and Travel	Control #:	Rev #1 (08/01/2021)

Additional Notes:

Where required, supplies (i.e., disinfectant spray/wipes, soap/hand sanitizer, nitrile gloves) should be made available prior to starting work. Request re-supply if stock runs low.

- Use disinfectant products that contain at least 70% alcohol. Use alcohol-based hand sanitizer that contains at least 60% alcohol. Wash hands with soap and water whenever available.
- If any staff are showing any possible symptoms of or have been in recent direct contact with others showing symptoms of CORONAVIRUS, STOP WORK. Notify the site supervisor and the project manager and go home and/or stay home. Notify your AECOM Regional or Area SH&E Manager.
- A list of approved disinfectants for use against SARS-CoV-2, the cause of CORONAVIRUS, is available here: US EPA List of Disinfectants Effective Against Coronaviruses

Revision Log

Version	Issued / Revised By	Date	Revision Summary
THA Revisions			
1	Patrick Walz	August 1, 2021	Consolidated and replaced previous, separate THAs for Field/Field Office work, travel, etc. Takes into account changes to CDC, AECOM, etc requirements related to Covid as the pandemic has progressed and vaccines have been rolled-out.
Project-Specific Revisions			

Task Hazard Assessment

AECOM

Task Name:	Coronavirus Precautions – Field, Office, and Travel	Control #:	Rev #1 (08/01/2021)

All Employees:

STOP WORK if uncertain about safety or if a hazard or additional precaution is not recorded on the THA.

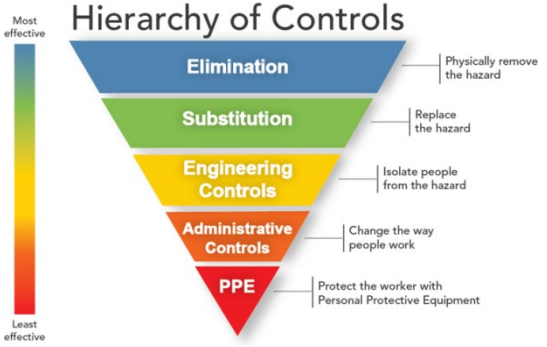
Be alert, recognize and communicate any changes in scope, personnel or conditions at the worksite to the supervisor.

Use **4-Sight**, AECOM's last-minute risk assessment process continuously throughout the day by asking yourself and your co-workers to assess your task, hazards, and mitigations. Amend the THA when needed.

- ***What am I about to do?***
- ***What can go wrong?***
- ***What can be done to make it safer?***
- ***What have I done to communicate the hazards?***

For a more thorough identification of hazards, ask "What else could go wrong?" using the Hazard Categories





- ***Most hazards need more than one control***
- ***What should you do? Stack your controls***
- ***PPE can NEVER be your only means of protection***

Worker Sign On	
I participated in the on-site review and fully understand the content of this Task Hazard Assessment.	
Printed Name	**Signature**
1. Supervisor:	
2.	
3.	
4.	
5.	
6.	
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9.	
10.	

Visitor Acknowledgement
Visitors review task hazards and acknowledge understanding
1.
2.
3.
4.
5.
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8.
9.
10.

Submit a new THA for addition to the DCSA THA Library or send THA improvement suggestions to DCSA.THA.Library@AECOM.com
Include a copy of the new THA or a photo of the THA modifications as appropriate.

Task Hazard Assessment

AECOM Imagine it. Delivered.

Task Name:	Driving to and From Site	**Control #:**	01-01-12-02

Project Name:		**Client:**		**Date:**	
Permits Required? (list):		**Work Location:**			

This THA must be fully reviewed with all staff members. All job steps, hazards, work practices, and PPE are clearly understood and have been implemented. All necessary revisions have been written on the THA.

Required PPE:	☐ Hard Hat ☐ Safety Glasses ☐ HiVis Vest ☐ Safety Toe Boots ☐ Gloves: Leather / Nitrile ☐ Hearing Protection ☐ Other:
Tools & Equipment:	Emergency kit Communication device (cell phone) Navigation system

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
1. Trip Planning	1a. Unauthorized driving	9	1a. You must be an AECOM authorized driver to drive for AECOM business purposes. Consult the requirements of S3AM-005-PR1. Authorized Drivers shall maintain a current driver's license with full privileges applicable to the vehicle to be operated. Develop a Journey Management Plan if applicable.	4
	1b. Inclement weather	6	1b. Evaluate weather conditions prior to beginning the travel to determine if travel should proceed. Verify your vehicle is equipped to travel in poor weather. Have supplies on hand in the event that you become stranded, including a communication device to call for help.	4
	1c. Getting Lost	6	1c. Review route in advance and program GPS prior to leaving	3
	1d. Inadequate vehicle for the site/trip	7	1d. Understand what type of vehicle is necessary to transport tools & equipment to the site. Know site conditions before departure and obtain proper vehicle, 4-Wheel drive if necessary	4
	1e. Vehicle malfunction	8	1e. Inspect vehicle prior to leaving. Verify that maintenance records are current.	4
On-Site Edits:				
2. Driving	2a. Fatigue	**15**	2a. Start trip well rested & take breaks when needed. Share driving responsibilities where possible. **STOP DRIVING AND PULL OVER** in a safe place if you begin nodding off or showing other signs of fatigue.	4

Task Hazard Analysis

AECOM Imagine it. Delivered.

Task Name:	Driving to and From Site	Control #:	01-01-12-02

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	Potential Hazards *How could you be hurt? What would the injury be?*	Risk *(initial)*	Critical Actions To Mitigate Hazards *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	Risk *(final)*
	2b. Risky driving practices	15	2b. Practice defensive driving techniques and avoid bad driving habits • Allow for adequate time to make the trip • Do not speed or attempt to multi-task • Do not use cell phone or text or attempt to program GPS while driving	4
On-Site Edits:				
3. Stops/breaks during transit	3a. Theft of equipment/materials	6	3a. Place any likely theft items out of sight and lock vehicle when leaving it. Do not leave vehicle unattended for longer than necessary. If at all possible, avoid leaving packed vehicles in public parking areas overnight, unload if possible. Park in well lighted areas.	4
	3b. Personal security risk	10	3b. Be alert and aware of surroundings when making stops. Stop at areas which are well lit and have security if possible.	3
On-Site Edits:				
4.	4a.		4a.	
On-Site Edits:				

Additional Notes:

Task Hazard Assessment

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All Employees:

STOP WORK if uncertain about safety or if a hazard or additional precaution is not recorded on the THA.

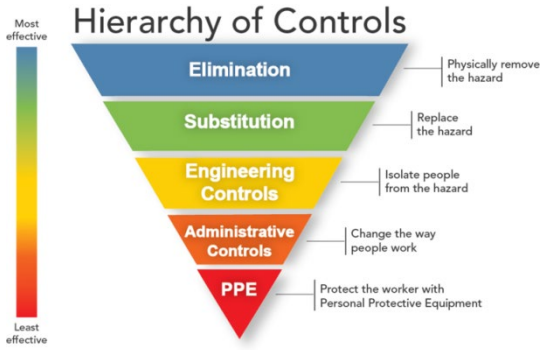
Be alert, recognize and communicate any changes in scope, personnel or conditions at the worksite to the supervisor.

Use **4-Sight**, AECOM's last minute risk assessment process continuously throughout the day by asking yourself and your co-workers to assess your task, hazards, and mitigations. Amend the THA when needed.

- ***What am I about to do?***
- ***What can go wrong?***
- ***What can be done to make it safer?***
- ***What have I done to communicate the hazards?***

For a more thorough identification of hazards, ask "What else could go wrong?" using the Hazard Categories





- ***Most hazards need more than one control***
- ***What should you do? Stack your controls***
- ***PPE can NEVER be your only means of protection***

Worker Sign On	
I participated in the on-site review and fully understand the content of this Task Hazard Assessment.	
Printed Name	**Signature**
1. Supervisor:	
2.	
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Visitor Acknowledgement
Visitors review task hazards and acknowledge understanding
1.
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Submit a new THA for addition to the DCSA THA Library or send THA improvement suggestions to DCSA.THA.Library@AECOM.com
Include a copy of the new THA or a photo of the THA modifications as appropriate.

Task Hazard Assessment – DCSA

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Task Name:	NAPL Recovery	**Control #:**	01

Project Name:	National Grid Williamsburg	**Client:**	National Grid	**Date:**	June 6, 2021
Permits Required? (list):	Note: NYC Parks Access Agreement Required	**Work Location:**	50 Kent Ave, Williamsburg, Brooklyn		

This THA must be fully reviewed with all staff members. All job steps, hazards, work practices, and PPE are clearly understood and have been implemented. All necessary revisions have been written on the THA.

Required PPE:	☒ Hard Hat ☒ Safety Glasses ☒ HiVis Vest ☒ Safety Toe Boots ☒ Gloves: ☐ Hearing Protection ☒ Other: Long pants and shirts with sleeves; Tyvek® coveralls; Face covering. Tychem® Sleeve Chemical Protective Apron for summer
Tools & Equipment:	PID; Weighted Measuring Tape; Pump (Peristaltic or Inertial Hydrolift [i.e. Waterra]) and Battery; Hand Tools for Well Access; Absorbent Pads and Plastic Liner; Traffic Cones and Barricades; All-Purpose Cleaning Product (Simple Green®); Drums for Waste Disposal

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
1. Travel to and from Site	1a. Simultaneous Operations (50 Kent Ave construction and work on N 12th Street)	10	1a. If construction workers are on-site, make presence known to the construction workers. Discuss AECOM work for the day and confirm work areas.	4
	1b. Car accident/ property damage	10	1b. Plan route prior to travel; Allow adequate travel time; Be mindful of pedestrians and bikers; Follow road rules; Be aware of road conditions and surroundings; Note the bike lane running along Kent Ave when entering and exiting the site and look both ways.	4
	1c. Fatigue/fitness to work	10	1c. Ensure fit to work and well rested.	4
	1d. Lone Worker - personal injury, security risk	10	1d. Check in with PM within 1hr of arrival to Site and on departure.	4

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Task Hazard Assessment – DCSA

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Task Name: NAPL Recovery	**Control #:** 01

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
On-Site Edits:				
2. Unloading Equipment and Set Up Work Area	2a. Traffic	8	2a. Secure suitable parking location to safely unload equipment; Only move equipment between the parked vehicle and the adjacent sidewalk; Do not cross the road carrying equipment. 2a. Demarcate work area within the sidewalk with traffic cones; Keep work area as far away from curb as possible.	4
	2b. Slips, trips and falls	6	2b. Keep walking route free of trip hazards; Place equipment in work area demarcated with traffic cones.	2
	2c. Back or body strain from improper lifting	6	2c. Bend knees when lifting and keep load close to body; Refer Manual Handling Procedure.	2
On-Site Edits:				
3. NAPL Gauging	3a. Traffic	8	3a. Demarcate work area within the sidewalk with traffic cones; Keep work area as far away from curb as possible; Do not stand on edge of curb, work from within the sidewalk.	4
	3b. Slips, trips and falls	6	3b. Set up work area and demarcate work area with traffic cones; Keep work area free of trip hazards; Maintain good housekeeping during works. 3b. Identify construction materials stockpiled on-site, be mindful of loose objects near the work area. 3b. If apron is used, stand up slowly and push apron aside.	2
	3c. Spill/ground protection	4	3c. Lay down plastic liner and absorbent pads around wells to catch dripping from measuring tape.	2

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Task Hazard Assessment – DCSA

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Task Name: NAPL Recovery	**Control #:** 01

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
	3d. Back or body strain from bending down	6	3d. Bend knees when lifting and keep load close to body; Refer Manual Handling Procedure.	2
	3e. Exposure to NAPL and vapors	4	3e. Ensure PPE is worn; Stand up-wind of well; Monitor work area with PID continuously; **STOP WORK** if reading exceeds 5- 25 ppm sustained for 5 minutes (refer Section 2.9.2 of HASP)	2
On-Site Edits:				
4. Pumping NAPL	4a. Traffic	8	4a. Demarcate work area within the sidewalk with traffic cones; Keep work area as far away from curb as possible; Do not stand on edge of curb, work from within the sidewalk.	4
	4b. Slips, trips and falls	6	4b. Set up work area and demarcate work area with traffic cones; Keep work area free of trip hazards; Maintain good housekeeping during works. 4b. If apron is used, stand up slowly and push apron aside.	2
	4c. Back or body strain from bending down.	6	4c. Bend knees when lifting and keep load close to body; Refer Manual Handling Procedure.	2
	4d. Spill from tubing	4	4d. Lay down plastic liner and absorbent pads around wells to contain any releases. 4d. Double check all connections before pumping NAPL. 4d. Keep the pump within the spill tray during the NAPL recovery duration. 4d. Reverse the flow using the pump dial before disconnecting the tubing for about 3 to 5 seconds. Hold absorbent pads while the pump is in the spill tray to disconnet the tubing. 4d. Clean up any spilled liquid from the pump and tubing.	2
	4e. Exposure from splashes during pumping	4	4e. Ensure PPE is worn; Be mindful of potential for splashes and keep face away.	2

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Task Hazard Assessment – DCSA

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Task Name: NAPL Recovery	**Control #:** 01

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
	4f. Exposure to odors and vapor from NAPL	4	4f. Ensure PPE is worn; Stand up-wind of well; Monitor work area with PID continuously; Cover drum with lid at all times; **STOP WORK** if reading exceeds 5- 25 ppm sustained for 5 minutes (refer Section 2.9.2 of HASP).	2
	4g. Spill or release of contaminated water	3	4g. Have spill pads available and ready to contain any releases.	2
On-Site Edits:				
5. Breakdown of Work Area	5a. Traffic	8	5a. Do not stand on edge of curb, work from within the sidewalk.	4
	5b. Slips, trips and falls	6	5b. Keep work area free of trip hazards; Make sure area is free of all equipment prior to moving to next location.	2
	5c. Back or body strain from bending down.	6	5c. Bend knees when lifting and keep load close to body; Refer Manual Handling Procedure.	2
	5d. Spill or release of contaminated water	3	5d. Use absorbent pads to clean up contaminated water around wells or pump. Carefully fold the plastic liner and move to next location.	2
	5e. Drum handling	6	5e. Use a drum dolly when moving a loaded drum. 5e. Close lids and bungholes before moving a loaded drum.	2
On-Site Edits:				

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Task Name:	NAPL Recovery	Control #:	01

Additional Notes:

NAPL recovery is performed as a Lone Worker. Ensure compliance with Section 6.4 of the HASP (Lone Worker).

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Task Hazard Assessment – DCSA

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Task Name:	NAPL Recovery	Control #:	01

All Employees:

STOP WORK if uncertain about safety or if a hazard or additional precaution is not recorded on the THA.

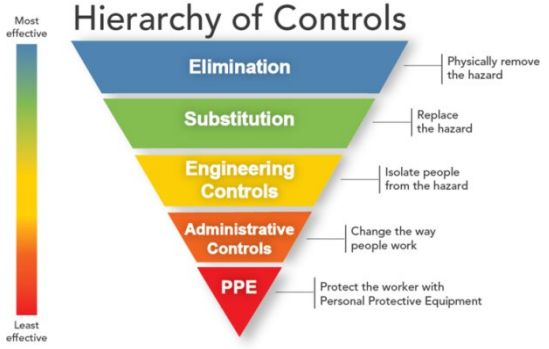
Be alert, recognize and communicate any changes in scope, personnel or conditions at the worksite to the supervisor.

Use **4-Sight**, AECOM's last minute risk assessment process continuously throughout the day by asking yourself and your co-workers to assess your task, hazards, and mitigations. Amend the THA when needed.

- ***What am I about to do?***
- ***What can go wrong?***
- ***What can be done to make it safer?***
- ***What have I done to communicate the hazards?***

For a more thorough identification of hazards, ask "What else could go wrong?" using the Hazard Categories





- ***Most hazards need more than one control***
- ***What should you do? Stack your controls***
- ***PPE can NEVER be your only means of protection***

Worker Sign On	
I participated in the on-site review and fully understand the content of this Task Hazard Assessment.	
Printed Name	**Signature**
1. Supervisor:	
2.	
3.	
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10.	

Visitor Acknowledgement
Visitors review task hazards and acknowledge understanding
1.
2.
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Submit a new THA for addition to the DCSA THA Library or send THA improvement suggestions to DCSA.THA.Library@AECOM.com
Include a copy of the new THA or a photo of the THA modifications as appropriate.

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Task Hazard Assessment

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Task Name:	**Well Cover Replacement**	**Control #:**	**01-01-10-01**

Project Name:	National Grid Williamsburg	**Client:**	National Grid	**Date:**	
Permits Required? (list):	DOT Sidewalk Permit (Contractor to obtain)	**Work Location:**	50 Kent Avenue, Williamsburg, Brooklyn		

This THA must be fully reviewed with all staff members. All job steps, hazards, work practices, and PPE are clearly understood and have been implemented. All necessary revisions have been written on the THA.

Required PPE:	☒ Hard Hat ☒ Safety Glasses ☒ HiVis Vest ☒ Safety Toe Boots ☒ Gloves: leather ☒ Hearing Protection ☐ Other:
Tools & Equipment:	PID DustTrak

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
1. Preparation	1a. Not having proper PPE	4	1a. Determine what the basic PPE requirements are in advance and have available or know that they will be available to you to borrow once on site.	4
	1b. Inappropriate vehicle for site	4	1b. Determine what type of vehicle is needed for site conditions (4-wheel drive, truck or car).	4
	1c. Inadequate materials/supplies		1c. Determine what materials and supplies you must bring versus what is available on site such as insect spray, sunscreen, drinking water, food, etc.	4
	1d. Lack of site escort if needed	4	1d. Prearrange trip in advance where possible, determine who will be meeting you on site and when.	4
	1e. Inclement weather	4	1e. Plan for the anticipated weather conditions. Check the predicted weather for the worksite prior to departing. Reschedule site visit if severe weather such as lightning storms, sleet/ice storms, blizzards, etc., are predicted.	6
On-Site Edits:				
2. Arriving at site	2a. Parking in inappropriate areas subjecting you and/or vehicle to construction hazards	6	2a. Know where you are supposed to park prior to arrival or check in at site so that you do not subject yourself or your vehicle to site hazards such as construction vehicle traffic, wet/muddy conditions, poor walking surfaces, etc.	2
On-Site Edits:				

Task Hazard Analysis

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Task Name:	Well Cover Replacement	Control #:	01-01-10-01

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	Potential Hazards *How could you be hurt? What would the injury be?*	Risk *(initial)*	Critical Actions To Mitigate Hazards *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	Risk *(final)*
3. Site Set Up and Observing Work	3a. Set up work area	6	3a. Isolate work area with demarcation to prevent public from access. Keep work area free of trip hazards.	3
	3b. Heat stress	6	3b. Know the signs and symptoms of heat stress (refer to the procedure S3AM-113-PR1 for information. Have adequate drinking water available and drink frequently. Arrive at the site well hydrated and physically fit.	3
	3c. Cold stress	6	3c. Know the health concerns associated with working in cold weather including hypothermia, frost bite, etc. (see S3AM-112-PR1). Dress in layers and take warming breaks.	4
	3d. Sunburn	6	3d. Have sunblock available and apply and reapply as per directions. Avoid direct solar exposure when possible. Seek breaks in shaded areas.	3
	3e. Slips/trips/falls	6	3e. Be aware of walking surfaces at all times, wear footwear with good tread and ankle support, avoid walking in muddy or wet areas when possible, identify and mark or have removed any obstructions that may be present in predicted walking paths.	4
	3f. Noise	6	3f. Wear ear protection during jackhammering.	6
On-Site Edits:				
4. Air Monitoring	4a. Exposure to fume/dust/particles	6	4a. Set up monitoring location prior to work begins. Maintain a reasonable distance between the work area and observation point. Be mindful of the wind direction and avoid staying in the downwind area. Address activities that produce undesirable release of fume/dust/particles immediately. Monitor work area with PID continuously; **STOP WORK** if reading exceeds 5- 25 ppm sustained for 5 minutes. Should visible fugitive dust be generated, the AECOM representative will instruct the Contractor to mitigate the dust (i.e. via watering the work area). If mitigation is not effective, work stoppage shall be issued until the fugitive dust is no longer present.	3
On-Site Edits:				

Task Hazard Analysis

AECOM Imagine it. Delivered.

Task Name:	Well Cover Replacement	Control #:	01-01-10-01

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	Potential Hazards *How could you be hurt? What would the injury be?*	Risk *(initial)*	Critical Actions To Mitigate Hazards *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	Risk *(final)*
5. Leaving the site	5a. Transporting hazards into vehicle	4	5a. Inspect self for debris before entering vehicle. If necessary, store dirty clothing or personal items in containers or bags until appropriate treatment is available.	2
	5b. Hitting object when leaving	6	5b. Before moving the vehicle, perform a 360° walk-around of the vehicle to verify that no changes or obstruction have been made that may impact exit.	4
On-Site Edits:				
6.	6a.		6a.	
On-Site Edits:				
7.	7a.		7a.	
On-Site Edits:				

Additional Notes:

Task Hazard Analysis

AECOM Imagine it. Delivered.

Task Name:	Well Cover Replacement	Control #:	01-01-10-01

All Employees:

STOP WORK if uncertain about safety or if a hazard or additional precaution is not recorded on the THA.

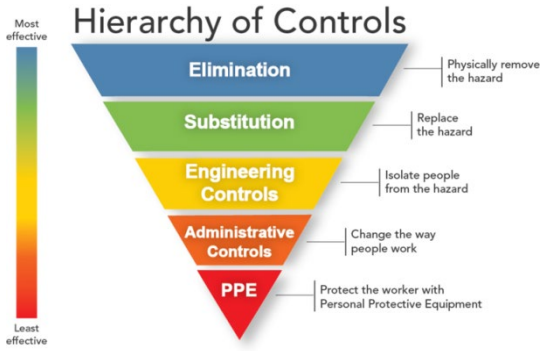
Be alert, recognize and communicate any changes in scope, personnel or conditions at the worksite to the supervisor.

Use **4-Sight**, AECOM's last minute risk assessment process continuously throughout the day by asking yourself and your co-workers to assess your task, hazards, and mitigations. Amend the THA when needed.

- ***What am I about to do?***
- ***What can go wrong?***
- ***What can be done to make it safer?***
- ***What have I done to communicate the hazards?***

For a more thorough identification of hazards, ask "What else could go wrong?" using the Hazard Categories





- ***Most hazards need more than one control***
- ***What should you do? Stack your controls***
- ***PPE can NEVER be your only means of protection***

Worker Sign On	
I participated in the on-site review and fully understand the content of this Task Hazard Assessment.	
Printed Name	**Signature**
1. Supervisor:	
2.	
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10.	

Visitor Acknowledgement
Visitors review task hazards and acknowledge understanding
1.
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Submit a new THA for addition to the DCSA THA Library or send THA improvement suggestions to DCSA.THA.Library@AECOM.com

Task Hazard Assessment – DCSA

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Task Name:		**Control #:**	

Project Name:	National Grid Williamsburg	**Client:**	National Grid	**Date:**	
Permits Required? (list):		**Work Location:**	50 Kent Ave, Williamsburg, Brooklyn		

This THA must be fully reviewed with all staff members. All job steps, hazards, work practices, and PPE are clearly understood and have been implemented. All necessary revisions have been written on the THA.

Required PPE:	☒ Hard Hat ☒ Safety Glasses ☒ HiVis Vest ☒ Safety Toe Boots ☒ Gloves: _____ ☐ Hearing Protection ☐ Other: _____
Tools & Equipment:	

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
1.	1a.		1a.	
On-Site Edits:				
2.	2a.		2a.	
On-Site Edits:				
3.	3a.		3a.	
On-Site Edits:				

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Task Hazard Assessment – DCSA

AECOM Imagine it. Delivered.

Task Name:		Control #:	

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4.	4a.		4a.	
On-Site Edits:				
5.	5a.		5a.	
On-Site Edits:				
6.	6a.		6a.	
On-Site Edits:				
7.	7a.		7a.	
On-Site Edits:				

Additional Notes:

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Task Hazard Assessment – DCSA

AECOM Imagine it. Delivered.

Task Name:		Control #:	

All Employees:

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Use **4-Sight**, AECOM's last minute risk assessment process continuously throughout the day by asking yourself and your co-workers to assess your task, hazards, and mitigations. Amend the THA when needed.

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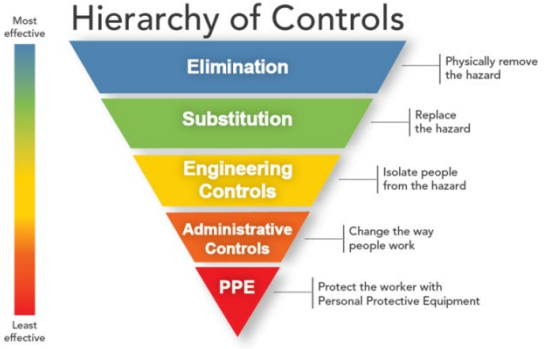

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Include a copy of the new THA or a photo of the THA modifications as appropriate.

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Americas

Daily Tailgate Meeting

S3AM-209-FM5

Instructions: Conduct meeting prior to sending crews to individual tasks. Require attendance of all AECOM employees and subcontractors. Invite personnel from simultaneous operations for coordination purposes. Review scope of work and briefly discuss required and applicable topics**. This meeting is a daily refresher, not a full orientation**. Task-specific discussions associated with Task Hazard Assessment (THA) follow this meeting at the task location immediately before individual task is started.

AECOM Supervisor Name: **Phone Number:**	
AECOM SH&E Rep. Name: **Phone Number:**	
Meeting Leader:	

DCS Americas - This form may be replaced by the electronic Daily Tailgate Meeting Tool. Link - Ecosystem Daily Tailgate Meeting App Site

Date:	**Project Name/Location:**	**Project Number:**
Today's Scope of Work:		

Muster Point Location:	**First Aid Kit Location:**	**Fire Extinguisher Location:**	**Spill Kit Location:**

1. Required Topics

- ☐ Fitness for Duty requirements, all sign in / sign out
- ☐ Required training (incl. task specific) completed and current
- ☐ SH&E Plan onsite - understood, reviewed, signed by all (incl. scope, preplanning hazard assessments / risk registers, controls, procedures, requirements, etc.)
- ☐ Task Hazard Assessments (THAs) are to be reviewed and completed for each task immediately prior to conducting
- ☐ STOP WORK Right & Responsibility- all task changes/changed conditions re-assess with THA
- ☐ Requirement to report to supervisor any injury, illness, damage, near miss, unsafe act / condition
- ☐ Emergency Response Plan – including muster point, first aid kit, fire extinguisher, clinic/hospital location
- ☐ Personal Protective Equipment (PPE) - Required items per hazard assessments in good condition / in use by all
- ☐ Equipment/machinery inspected (documented as required) and in good condition - operators properly trained/certified
- ☐ Work area set up and demarcation/ barricades in place to protect workers, site staff, and the public
- ☐ Required checklists/records available, understood (describe):
- ☐ Lessons Learned / SH&E improvements (describe):

2. Discuss if Applicable to Today's Work

☑ ■ **Check ☑ as reviewed or mark ■ as not applicable**

- ☐ ☐ Biological/ Chemical / Electrical Hazards
- ☐ ☐ Ergonomics - Lifting, Body Position
- ☐ ☐ Lock Out/ Tag Out
- ☐ ☐ Short Service Employees - visual identifier and mentor/ oversight assignment
- ☐ ☐ Simultaneous/ Neighbouring Operations
- ☐ ☐ Slip/ Trip/ Fall Hazards
- ☐ ☐ Specialized PPE Needs
- ☐ ☐ Traffic Control
- ☐ ☐ Waste Management/ Decontamination
- ☐ ☐ Weather Hazards / Heat Stress / Cold Stress
- ☐ ☐ Subcontractor Requirements (e.g., JHAs, THAs, procedures, reporting, etc.)
- ☐ ☐ Work Permits / Plans required (e.g., Fall Protection, Confined Space, Hot Work, Critical Lifts, etc.); in place, understood (identify/attach):
- ☐ ☐ Other Topics (describe/attach):
- ☐ ☐ Client specific requirements (describe):

3. Daily Check Out by Site Supervisor

Describe incidents, near misses, observations or Stop Work interventions from today:	Describe Lessons Learned/ Improvement Areas from today:

The site is being left in a safe condition and work crew checked out as fit unless otherwise specified as above.

Site Supervisor Name	**Signature**	**Date** **Time** (at end of day / shift)

Worker Acknowledgement / Sign In Sign Out sheets applicable to this meeting are on reverse and, if applicable, attached.

All employees:

- **STOP WORK if concerned / uncertain about safety / hazard or additional precaution is not recorded on the THA.**
- **Be alert and communicate any changes in personnel or conditions at the worksite to the supervisor.**
- **Reassess task, hazards, & mitigations on an ongoing basis; amend the THA if needed.**

SITE WORKERS (including AECOM Contractors and Subcontractors): Your signature below means that you understand:

* The requirement to participate in creating, reviewing, & updating hazard assessments (THA) applicable to your task(s).
* The hazards & control measures associated with each task you are about to perform.
* The permit to work requirements applicable to the work you are about to perform (if it includes permitted activities).
* That no tasks or work is to be performed without a hazard assessment.
* Your authority & obligation to "Stop Work" intervene, speak up/ listen up.

Your initials (right columns) certify that you arrived & departed fit for duty, & have reported all incidents/near misses; meaning:

* You are physically and mentally fit for duty and have inspected your required PPE to ensure satisfactory condition.
* You are not under the influence of any type of medication, drugs, or alcohol that could affect your ability to work safely.
* You are aware of your responsibility to immediately report any illness, injury (regardless of where or when it occurred), or impairment/fatigue issue to the AECOM Supervisor.
* You signed out as fit / uninjured unless you have otherwise informed the AECOM Supervisor.

Print Name & Company	Signature	Initials & Sign In Time	Initials & Sign Out Time
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit

(Attach additional Site Worker sign-in/out sheets if needed) Identify number of attached sheets: _____

SITE VISITOR / SITE REPRESENTATIVE

Name	Company Name	Arrival Time	Departure Time	Signature

AECOM

Attachment D

Applicable AECOM SHE Procedures

Attachment D: Applicable AECOM SHE Procedures

	Hazard/ Activity (Note: Text in this column links to procedure)	Applicable Procedure		Hazard / Activity (Note: Text in this column links to procedure)	Applicable Procedure
☐	Abrasive Blasting	S3AM-335-PR1	☒	Highway and Road Work	S3AM-306-PR1
☐	Aerial Work Platforms	S3AM-323-PR1	☐	Hoists Elevators and Conveyors	S3AM-343-PR1
☐	All-Terrain Vehicles	S3AM-319-PR1	☐	Hot Work	S3AM-332-PR1
☐	Blasting and Explosives	S3AM-336-PR1	☐	Ladders	S3AM-312-PR1
☒	Bloodborne Pathogens	S3AM-111-PR1	☐	Lockout Tagout	S3AM-325-PR1
☐	Cofferdams	S3AM-344-PR1	☐	Machine Guarding Safe Work Practice	S3AM-326-PR1
☒	Cold Stress	S3AM-112-PR1	☐	Marine Safety and Vessel Operations	S3AM-333-PR1
☐	Compressed Air Systems & Testing	S3AM-337-PR1	☒	Material Storage	S3AM-316-PR1
☒	Compressed Gases	S3AM-114-PR1	☐	Mine Site Activities	S3AM-341-PR1
☐	Concrete Work	S3AM-338-PR1	☐	Mining Operations	S3AM-345-PR1
☐	Confined Spaces	S3AM-301-PR1	☒	Non Ionizing Radiation	S3AM-121-PR1
☒	Corrosive Reactive Materials	S3AM-125-PR1	☐	Overhead Lines	S3AM-322-PR1
☐	Cranes and Lifting Devices	S3AM-310-PR1	☐	Powder-Actuated Tools	S3AM-327-PR1
☐	Demolition	S3AM-339-PR1	☐	Powered Industrial Trucks	S3AM-324-PR1
☐	Diving (scientific and commercial)	S3AM-334-PR1	☐	Radiation	S3AM-120-PR1
☒	Drilling, Boring & Direct Push Probing	S3AM-321-PR1	☐	Railroad Safety	S3AM-329-PR1
☐	Electrical Safety	S3AM-302-PR1	☒	Respiratory Protection	S3AM-123-PR1
☐	Excavation	S3AM-303-PR1	☐	Scaffolding	S3AM-311-PR1
☐	Fall Protection	S3AM-304-PR1	☐	Steel Erection	S3AM-340-PR1
☒	Flammable and Combustible Liquids	S3AM-126-PR1	☐	Temp. Floors, Stairs, Railings, Toe-boards	S3AM-342-PR1
☐	Gauge Source Radiation	S3AM-122-PR1	☒	Underground Utilities	S3AM-331-PR1
☒	Hand and Power Tools	S3AM-305-PR1	☒	Underground Work	S3AM-330-PR1
☒	Hazardous Waste Operations	S3AM-117-PR1	☒	Wildlife, Plants and Insects	S3AM-313-PR1
☒	Heat Stress	S3AM-113-PR1	☒	Working Alone	S3AM-314-PR1
☒	Heavy Equipment	S3AM-309-PR1	☐	Working On and Near Water	S3AM-315-PR1
☐	High Altitude	S3AM-124-PR1			

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AECOM Global

Pandemic Procedure

SR1-003-PR2

1. Purpose and Scope

Providing the requirements for preparation and planning for potential pandemic emergencies that may occur while AECOM staff are working.

Applies to all AECOM staff working inside and outside an AECOM office, including location and project environments as well as business related travel.

2. Background

2.1 Pandemic

A pandemic virus emerges because of a process called antigenic shift, which causes an abrupt or sudden and major change in flu-like viruses. Public health officials closely monitor the movement of flu-like viruses through avian and swine populations. The public health fear is that the virus may obtain the ability to shift and incorporate the ability to infect humans directly through human-to-human contact. At that point, the threat of a regional epidemic, or a global pandemic may be realized.

Flu-like viruses can weaken the immune system, making the person more vulnerable to serious infections such as pneumonia, or can worsen chronic medical conditions. Public health officials watch both avian and swine flu outbreaks closely to monitor potential for an antigen shift and progression to a human transmissible disease.

Government health agencies continually monitor flu-like viruses and other diseases worldwide. Human cases are reported and updated by the World Health Organization (WHO) and U.S. Centers for Disease Control (CDC). This information is used by responsible government agencies for planning and response actions as required to minimize the spread and effects of disease outbreaks. It is important that information provided by CDC or WHO is made available to employees when there is potential for impact on work conditions or local community health.

2.1.1 Swine Influenza

Influenza A (H1N1) is a flu virus of swine origin that first caused illness in March and April, 2009. Influenza A (H1N1) flu spreads in the same way that regular seasonal influenza viruses spread, mainly through the coughs and sneezes of people who are sick with the virus, but it may also be spread by touching infected objects and then touching your nose or mouth. Influenza A (H1N1) is now established in human populations as a seasonal influenza virus. There is an Influenza A vaccine available for humans.

2.1.2 Avian Influenza

Avian influenza (bird flu) occurs mainly in wild birds but can spread to domestic birds and can cause outbreaks. Human cases are rare but have occurred from direct close contact with infected birds and poultry or contaminated materials. There is no vaccine available for humans related to this virus at this time.

2.1.3 Coronavirus

Coronavirus (COVID-19) is the result of a virus identified as SARS-CoV-2. Coronaviruses are large family of viruses found in both animals and humans. Some infect people and are known to cause illness ranging from the common cold to more severe diseases such as Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS) with symptoms such as fever, cough and shortness of breath. There currently is no human vaccine available for this virus.

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2.2 Flu-Like Contingency Planning

2.2.1 Roles & Responsibilities of Governing Agencies

2.2.1.1 Global Health Monitoring

The WHO coordinates health issues for the United Nations and provides leadership on global health matters. The WHO assists member nations with recommendations regarding global pandemics and declares global pandemic phases to help organizations to plan for the impacts. The major phases are:

a. Phase 1:	No viruses circulating among animals have been reported to cause infections in humans.
b. Phase 2:	An animal influenza virus circulating among domesticated or wild animals is known to have caused infection in humans and is therefore considered a potential pandemic threat.
c. Phase 3:	An animal or human-animal flu-like reassortment virus (the process by which viruses swap gene segments) has caused sporadic cases or small clusters of disease in people but has not resulted in human-to-human transmission sufficient to sustain community-level outbreaks. Limited human-to-human transmission may occur under some circumstances, for example, when there is close contact between an infected person and an unprotected caregiver.
d. Phase 4:	There is verified human-to-human transmission of an animal or human-animal flu-like reassortment virus able to cause “community-level outbreaks.” The ability to cause sustained disease outbreaks in a community marks a significant upwards shift in the risk for a pandemic. Any country that suspects or has verified such an event should urgently consult with WHO so that the situation can be jointly assessed, and a decision made by the affected country if implementation of a rapid pandemic containment operation is warranted. Phase 4 indicates a significant increase in risk of a pandemic but does not necessarily mean that a pandemic is a forgone conclusion.
e. Phase 5:	There is human-to-human spread of the virus into at least two countries in one WHO region. While most countries will not be affected at this stage, the declaration of Phase 5 is a strong signal that a pandemic is imminent and that the time to finalize the organization, communication, and implementation of the planned mitigation measures is short.
f. Phase 6:	The pandemic phase is characterized by community level outbreaks in at least one other country in a different WHO region in addition to the criteria defined in Phase 5. Designation of this phase will indicate that a global pandemic is under way.
g. Post-peak period:	During the post-peak period, pandemic disease levels in most countries with adequate surveillance will have dropped below peak observed levels. The post-peak period signifies that pandemic activity appears to be decreasing; however, it is uncertain if additional waves will occur and countries will need to be prepared for a second wave.
h. Post-pandemic period:	Flu-like disease activity will have returned to levels normally seen for seasonal flu-like illness. At this stage, it is important to maintain surveillance and update pandemic preparedness and response plans accordingly. An intensive phase of recovery and evaluation may be required.

2.2.1.2 Country Specific Pandemic Plans

Most nations have developed pandemic plans that include monitoring the regional spread of disease, the recommended medical practices, and related guidance. AECOM operations outside the US must keep abreast of country specific requirements and recommendations.

2.2.1.3 United States

The federal government is responsible for coordinating a nationwide flu-like pandemic response.

a. The U.S. Department of Homeland Security coordinates all non-medical support and response actions.

b. The Department of Health and Human Services (HHS) coordinates overall public health and medical emergency response. Under Executive Order 13295 (revised April 1, 2005), the Secretary of Health and Human Services has the authority for apprehension, detention and conditional release of individuals to prevent the spread of a flu-like illness caused by a novel or re-emergent flu-like virus that causes or has the potential to cause a pandemic. Under HHS, the CDC is responsible for controlling the introduction and spread of infectious diseases and provides information to help health care providers, public health officials and the public. CDC's Division of the Strategic National Stockpile (SNS) distributes antiviral drugs, personal protective equipment, and respiratory protection devices to all 50 states and U.S. territories to help them respond to outbreaks.

c. Under the Department of Defence (DOD) Directive 6200.3, military facilities require identification of a Public Health Emergency Officer who coordinates Military Treatment Facilities emergency response plans with local emergency planning.

2.2.1.4 State and Local Governments

Each state has authority to manage and respond to pandemic conditions. It is important that projects and offices contact their local and state governments for emergency contact information.

3. Procedure and Responsibilities

AECOM Managers, HR (Human Resources), SH&E (Safety, Health and Environment) including Occupational Health, Legal Counsel, and Resilience Coordinators will collaborate and drive efforts to plan for, respond to, manage and recover from pandemic disruption to the business. This collaboration may also require input and cooperation from various other support functions who should be consulted in a timely fashion in order to expedite a return to normal business operations or to provide alternate solutions such as remote work. In the event of a declared Stage 5 or Stage 6 of a Pandemic event, the AECOM Managers, HR, SH&E, Occupational Health, Legal Counsel and Resilience Coordinators will make decisions and take necessary steps to protect the business from the pandemic, up to, and including, travel bans to/from certain areas, telecommuting, and other decisions as needed for business continuity with a focus on the health and welfare of the employee. Local Resilience Teams will take the lead in responding to pandemic-related business disruptions with overarching guidance provided by Global Resilience.

3.1 Corporate Roles and Responsibilities

AECOM offices will be prepared to respond to either a global, national or regional pandemic condition in accordance with the Organizational Resilience Standard - AECOM Global. The standard provides the common platform to organize mission-critical, Resilience Teams to prepare for, actively navigate and / or recover from significant business disruptions. It also provides the context for plans and procedures to minimize any impact on AECOM's business in terms of severity and duration.

3.1.1 Prevention and Containment

a. If a pandemic condition exists or is imminent within a local office or field location, consult the location specific Emergency Response Plan (ERP) or Business Continuity Plan for immediate response guidelines.

b. Upon notification from State Emergency Planning agency that a national or regional pandemic condition exists or is reasonably expected to occur, the facilities and administration teams working with the SH&E Department will provide sufficient and accessible infection control supplies in all local affected business locations in keeping with AECOM's Infectious Disease and Pandemic Cleaning Instruction - AECOM Global.

c. Face masks may be supplied, if recommended by WHO/CDC. Supplies of anti-viral medications will not be stockpiled, distributed, or administered unless specified by community health administrators.

d. Annual influenza vaccinations are encouraged.

e. As applicable, communications through email or intranet, training programs, or work place postings may be utilized to provide information concerning prevention and containment. Information may include, but is not limited to:

   i. Initial symptoms of the disease, disease prevention techniques, how to respond if an individual suspects infection and when return to work is appropriate after the illness.

   ii. Personal practices and habits for minimizing exposure, such as: frequent hand washing, avoiding exposing other employees when sick, annual flu vaccinations if appropriate, and consulting a personal physician to determine personal risk.

   iii. Social distancing techniques such as minimizing large group gatherings, reducing employee face-to-face meetings through the use of video / phone conferencing/ Microsoft Teams, and eliminating unnecessary travel during severe outbreaks.

   iv. Flexible worksite and flexible work hours options should be implemented as appropriate.

   v. Employees shall notify their supervisor if they are going to miss work because of illness. Information concerning sick leave and health benefits can be obtained through the employee's HR representative, by consulting applicable policies and procedures specific located on the AECOM Integrated Management Systems (IMS) platform, and through MyHR.

   vi. As applicable, business and meeting travel may be limited to "business essential" only.

   vii. Management will notify any applicable clients or suppliers of potential business impacts that may be experienced as a result of a pandemic. Management will update clients/suppliers once operations are restored to full capacity.

3.1.2 Anti-Viral Medication

a. Media coverage of flu-like outbreaks has focused on the availability of oral anti-viral medications (not vaccines). These prescription medications are known to help with treating uncomplicated flu-like virus effects in limited applications. There are potential side effects of the drugs, and some viruses have shown resistance to the drug.

b. Based on this information, unless legally mandated by a country's government, AECOM will not attempt to stockpile sources of anti-viral drugs to be used for employees in the event of a pandemic. Resources of these drugs may be maintained by a country's National Strategic Stockpile.

c. Employees should contact their personal health care provider regarding recommendations for support medications that may be necessary in the event of a flu pandemic.

3.2 General AECOM Employee Guidelines

3.2.1 Employee Illness

a. Employees should report the illness to your Supervisor immediately.

b. Employees who are ill with flu-like symptoms (Fever >100.4 F/38 C, cough, shortness of breath0 should stay home. If they have a fever, they should stay home until at least 24 hours after they are free of fever without the use of fever reducing medications.

c. Employees should not travel if they are ill.

d. Employees who become sick during work hours should immediately go home.

e. Employees at higher risk of complications, or who become seriously ill, should contact their health care provider immediately.

3.2.2 Employee Family Member Illness

a. Employees who are well but who have a family member at home with the flu may choose to stay home or can go to work as usual. Employees with ill family members should monitor their health daily before coming to work and stay home if they become ill.

b. Employees who choose to stay home to care for ill family members should contact their supervisor or HR representative to discuss flu-related issues such as using sick time/paid time off or if telecommuting is an option.

c. Employees should not bring an ill family member with them to the office, even for brief periods.

3.2.3 Supervisors

a. If an employee calls in sick because of the flu or a flu-like illness, the supervisor is to advise them to stay home. Expect employees to be out of work for 3-5 days (in most cases). Additional quarantine may be required based on the recommendations of CDC / WHO.

b. Should the supervisor be informed by the employee that he/she has the flu or flu-like symptoms, the supervisor should report the employee illness to HR and SH&E representative only, maintaining the employee's privacy.

c. Because symptoms may not appear until after an incubation period, (24 hours prior to symptoms), the supervisor should try to account for any close contacts (3ft/1m for 30 minutes) the affected employee might have had in order to evaluate if co-workers may have been exposed. Report the potential exposure of co-workers to your HR or SH&E representative.

d. Do not allow employees with the flu or flu-like symptoms to remain at work. In-office quarantine (isolation) of an employee with flu-like symptoms (e.g., work in a secluded office area) is not permitted.

Important Reminder: **The names of employees who are ill with the flu are CONFIDENTIAL and can only be discussed with HR representatives or company nurses.**

3.2.4 HR or SH&E Representatives

a. During Phase 5 and 6 of a potential / actual Pandemic, the SH&E representative will track cases of flu illness at your location using the Coronavirus Affected Employee Form obtained from the AECOM Occupational Health Nurse and submit to nurse@aecom.com upon identification of employee/s who are confirmed positive for the virus, exhibiting symptoms of the virus or on self-quarantine and provide updates at least weekly. These numbers also to be reported to your Local Resilience Coordinator (LRC) to allow Resilience Teams (RT) to assess appropriate responses in accordance with the Disruptive Event Response Instruction - AECOM Global. Each state/country has specific resilience reporting contacts located on the Global Resilience Team contact list.

b. Inform fellow employees if a co-worker possibly exposed them to a flu-like illness, while maintaining strict confidentially regarding the identity of the co-worker, so that employees can self-monitor for symptoms and stay home if they become sick. (Sample notification: We have been notified that there has been a potential exposure to the coronavirus in this office/building. As a precaution, it is recommended that all employees potentially affected begin self-monitoring for symptoms and to stay home if you become ill. Ensure that you follow the office procedure for notification of management of unexpected absences). For additional information, refer to the AECOM Global update through the Ecosystem

c. A medical release of a clearance to return to work (following an extended absence) may not be available because of a busy health care system. Requiring a physician's release to return to work should be considered in cases of hospitalization or medical leave of absence in line with local HR protocols.

d. Address staff rumours immediately through investigation and follow-up, then inform management of communication with employee and onward reporting to the Local Resilience Coordinator.

3.2.5 HR Representative

a. Advise employees and supervisors regarding sick time or paid time off options.

b. Discuss with supervisors if telecommuting is an option for the employee.

3.2.6 Managers/SH&E Representative

a. Provide information to staff regarding good hygiene, including cough and sneeze etiquette and proper hand washing. Hold periodic meetings to refresh awareness of prevention measures.

b. Remind employees to check with their health care provider to determine if flu inoculations are recommended.

c. Follow-up with facilities and office managers to provide tissues, disinfectant wipes, hand sanitizers and no-touch receptacles for disposal.

d. Coordinate with facilities managers to arrange for commonly touched surfaces such as doorknobs and countertops to be cleaned frequently in accordance with AECOM's Infectious Disease and Pandemic Cleaning Instruction - AECOM Global.

3.3 Travel Worldwide to Areas Affected by a Pandemic

AECOM's Global Security & Resilience (GSR) shall be consulted to obtain advice, approvals or restrictions, and support, for employees traveling worldwide to and returning from areas affected by a pandemic or potential pandemic. Travel to high risk locations as defined by the Country Risk Score Index will also require approval. AECOM's Corporate guidance can be found on the Ecosystem and is updated weekly.

Persons visiting areas with reports of outbreaks of concern can reduce their risk of infection by observing the following measures:

3.3.1 Before Traveling to an Affected Area

a. Educate yourself and others who may be traveling with you through consultation with AECOM's GSR Travel Security Portal (Drum Cussac) and AECOM's policies and procedures located on the AECOM Integrated Management Systems (IMS) platform.

b. Confirm applicable and routine vaccinations are current. See your doctor or health-care provider, or (for employees) follow the international business and travel requirements on the International Travel Procedure. When traveling from the US, contact our travel resource, WorkCare Travel Consultant directly at 800-455-6155 and outside the US, contact iSOS (International SOS) at +1 215 942 8226 (Membership # 11BMMS000147), ideally 4-6 weeks before travel, to get any additional vaccination medications or information you may need. In many cases, a medical examination may be required prior to travel.

c. Assemble a travel health kit containing basic first aid and medical supplies. Be sure to include a thermometer and alcohol-based hand gel or wipes for hand hygiene. See the AECOM Travel Health- Pack Smart Checklist.

d. Identify in-country health-care resources in advance of your trip. Employees may contact iSOS, HR or WorkCare for assistance in identifying available resources.

3.3.2 During Travel to an Affected Area

a. As with other infectious illnesses, one of the most important preventive practices is careful and frequent hand washing for at least 20 seconds. Cleaning hands often with soap and water removes potentially infectious material from skin and helps prevent disease transmission. Waterless alcohol-based hand gels or wipes may be used when soap is not available, and hands are not visibly soiled.

b. If an employee becomes sick with symptoms such as a fever accompanied by cough and sore throat, or difficulty breathing or if they develop any illness that requires prompt medical attention, a consular officer (refer to the country's representatives on the GSR Travel Portal-Drum Cussac) or iSOS can assist you in locating approved medical services and informing your family or friends. The employee should defer any further travel until they are free of symptoms, unless traveling locally for medical care or instructed to evacuate by your project management, security, or upon advice of occupational health nurses. AECOM employees on foreign travel should notify their HR representative of any serious illness. Local employees should contact their supervisor according to their specified reporting policy.

c. In the event of a flu outbreak, avoid all direct contact with birds or swine and avoid farms and markets. There is the possibility that other animal groups may become reservoirs of the infection in the future so current information from WHO/CDC should be checked for updated guidance.

3.3.3 After Return from Travel

a. Monitor your health for 14 days after return for any fever or breathing difficulties.

b. If you become ill with a fever plus a cough and sore throat, or trouble breathing during this 14-day period, consult your primary care physician. Do not come into work until advised by your primary care physician that it is safe to do so. Communicate the following:

   i. your symptoms;

   ii. where you travelled; and

   iii. if you have had direct contact with animals, birds, or severely ill persons.

c. Do not travel while ill, unless you are seeking medical care. Limiting close physical contact (<3ft/1 meter) with others as much as possible can help prevent the spread of an infectious illness.

4. Help & Training

The following resources provide an overview of AECOM's Organizational Resilience framework and process (titles also available at AECOM University).

a. Global Resilience Team Framework

b. Organizational Resilience: Redefining What's Possible

c. Powering Organizational Resilience through Functional Readiness

d. Resilience Coordinator Overview

e. Resilience Readiness: Disruptive Event Guidance

5. Terms and Definitions

a.	Local Resilience Coordinator	A manager designated as the Office or Worksite lead for local level organizational resilience who may or may not be the emergency response coordinator. The LRC is the point of contact with the Region Resilience Team in determining further action, including notifications, following an initial emergency response.
b.	Pandemic	An epidemic occurring worldwide, or over a very wide area, crossing international boundaries and usually affecting a large number of people as declared by the World Health Organization

c.	Resilience Team (RT)	Interdependent networks of necessary and essential business functions collaborating at the enterprise, region and/or local levels to achieve organizational resiliency. Functions include but are not limited to communications, facilities, finance, human resources (HR), information technology, legal, procurement, safety, health, and environment, and security. Refer to the Organizational Resilience Standard - AECOM Global

6. References

This procedure forms a sub-set of AECOM's overall Organizational Resilience framework and should be read and executed as such. This procedure is to be applied in conjunction with the following Procedures and Instructions.

a. Organizational Resilience Standard - AECOM Global – SR1-003-PR1

b. Disruptive Event Response Instruction - AECOM Global – SR1-003-WI2

c. Infectious Disease and Pandemic Cleaning Instruction – AECOM Global - SR1-003-WI4

7. Appendices

The following appendices are designed to assist business leads, people managers, HR partners, SH&E representatives and Resilience Coordinators assess processes to follow when presented with potentially symptomatic employees, visitors, locations and provide useful resources for communicating prevention methods in the workplace.

a. Appendix 1 – Manager Resilience Checklist.

b. Appendix 2 – Virus Prevention Posters and Flyers

8. Change Log

Rev #	Change Date	Description of Change	Location of Change
0	March 11, 2020	Initial Release as SR1-003-PR2	

Appendix 1 – Manager Resilience Checklist

AECOM Managers Guideline on 2019-nCoV Scenarios						
	CASE	**SUB-CASE**	**What Business Leader should ask the "Case" Employee to do**	**What Business Leader should ask other employees potentially affected by "Case" Employee**	**What Admin should do to the Office**	**Notice and Announcement (To ensure privacy, any notifications/announcements regarding specific cases must be approved by AECOM Legal)**
1	Employee confirmed to have contracted COVID-19.		Employee to stay away from the office and seek medical treatment. Employee may not return to work without medical clearance.	Without disclosing the identity of the infected employee, persons with workstations within 1m/ 3 ft of the "Case" Employee are to observe 14-day quarantine or as recommended by the governing health agency.	Sanitization of whole floor.	• Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions. • Use the Tracking Form to communicate information to Corporate Occupational Injury Management Team by submitting to nurse@aecom.com. • Business Leaders to inform stakeholders who may have employees in contact with a confirmed case.
2A	Employee having close contacts (2) with a person of a clinically diagnosed/confirmed case.	Not feeling well/ Exhibiting Sign/symptoms (5).	Employee to not attend work and seek medical attention and observe any quarantine as instructed by governing health agency.	Persons with workstations within 1m/ 3 ft of the "Case" Employee to observe 14-day quarantine in accordance with governing health agency recommendations or provide medical clearance to return to work prior to the end of the quarantine period.	Sanitization of the whole floor.	• Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions. • Use the Tracking Form to communicate information to Corporate Occupational Injury Management Team by submitting to nurse@aecom.com. • Business Leaders to inform stakeholders who may have employees in contact with a confirmed case.
2B		Feeling Well/ not exhibiting any signs/symptoms.	Employee to observe 14-day quarantine or as instructed by governing health agency.	Persons with close contact with the "Case" employee to self-monitor. If begin having any symptoms see 2A.	Sanitization over an area of 6m (18 ft) radius from the workstation of the "Case" Employee.	• Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions. • Use the Tracking Form to communicate information to Corporate Occupational Injury Management Team by submitting to nurse@aecom.com. • Business Leaders to inform stakeholders who may have employees in contact with a confirmed case.

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AECOM Managers Guideline on 2019-nCoV Scenarios

	CASE	SUB-CASE	What Business Leader should ask the "Case" Employee to do	What Business Leader should ask other employees potentially affected by "Case" Employee	What Admin should do to the Office	Notice and Announcement (To ensure privacy, any notifications/announcements regarding specific cases must be approved by AECOM Legal)
3	Employee being a suspected case (1).		Employee to seek medical attention and observe 14-day quarantine. If at work they should obtain a suitable face-mask as available, notify their supervisor and leave straight away.	Persons with close contact with the "Case" Employee are to observe 14-day quarantine in accordance with governing health agency recommendations or provide medical clearance to return to work prior to the end of the quarantine period.	Sanitization over an area of 6m (18 ft) radius from the workstation of the "Case" Employee.	• Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions. • Use the Tracking Form to communicate information to Corporate Occupational Injury Management Team by submitting to nurse@aecom.com. • Business Leaders to inform stakeholders who may have employees in contact with a confirmed case.
4A	Employee visited a location (3) of a confirmed case but had no contact with the confirmed person.	Not feeling well/ Exhibiting Sign/symptoms (5).	Employee to seek medical attention and observe 14-day quarantine or provide medical clearance to return to work prior to end of the quarantine period.	Persons in close contact with the "Case" Employee put under observation – self-observe for COVID-19 Symptoms (6).	Sanitization of the work stations of the "Case" Employee and of persons with close contact.	• Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions. • Use the Tracking Form to communicate information to Corporate Occupational Injury Management Team by submitting to nurse@aecom.com. • Business Leaders to inform stakeholders who may have employees in contact with a confirmed case.
4B		Feeling Well/ not exhibiting any signs/symptoms.	Employee put under observation – self-observe for COVID-19 Symptoms.	Persons in close contact with the "Case" Employee put under observation – self-observe for COVID-19 Symptoms.	Sanitization of the work stations of the "Case" Employee and of persons with close contact.	• Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions.

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AECOM Managers Guideline on 2019-nCoV Scenarios

	CASE	SUB-CASE	What Business Leader should ask the "Case" Employee to do	What Business Leader should ask other employees potentially affected by "Case" Employee	What Admin should do to the Office	Notice and Announcement (To ensure privacy, any notifications/announcements regarding specific cases must be approved by AECOM Legal)
5A	Employee having close contact with a suspected case, i.e. with a person having symptoms of COVID-19.	Not feeling well/ Exhibiting Sign/symptoms (5).	Employee to seek medical attention and observe self-quarantine until outcome of the suspected case is confirmed and symptoms resolved.	Persons in close contact with the "Case" Employee put under observation – self-observe for COVID-19 Symptoms.	Sanitization of the work station of the "Case" Employee, and of those persons in close contact with the "Case" Employee.	• Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions. • Use the Tracking Form to communicate information to Corporate Occupational Injury Management Team by submitting to nurse@aecom.com. • Business Leaders to inform stakeholders who may have employees in contact with a confirmed case.
5B		Feeling Well/ not exhibiting any signs/symptoms.	Employee observes self-quarantine until outcome of the suspected case is confirmed.	Persons in close contact with the "Case" Employee put under observation – self-observe for COVID-19 Symptoms.	Sanitization of the work station of the "Case" Employee.	• Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions.
6A	Employee having visited a location of a suspected case.	Not feeling well/ Exhibiting Sign/symptoms (5).	Employee to seek medical attention and stay home until symptoms resolved.	Persons in close contact with the "Case" Employee put under observation – self-observe for COVID-19 Symptoms or until outcome of the suspected case is confirmed as negative. If "Case" employee confirmed positive, refer to 5A.	Sanitization of the work station of the "Case" Employee.	• *Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions. • Use the Tracking Form to communicate information to Corporate Occupational Injury Management Team by submitting to nurse@aecom.com. • Business Leaders to inform stakeholders who may have employees in contact with a confirmed case.
6B		Feeling Well/ not exhibiting any signs/symptoms.	Employee put under observation – self-observe for COVID-19 Symptoms.	Observe general hygiene.		If condition changes, see above.
7	Employee not of the above cases having fever or feeling unwell but without symptoms of COVID-19.		Employee to stay home until symptoms resolved. Seek medical attention if necessary.	Observe general hygiene.		

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Note:

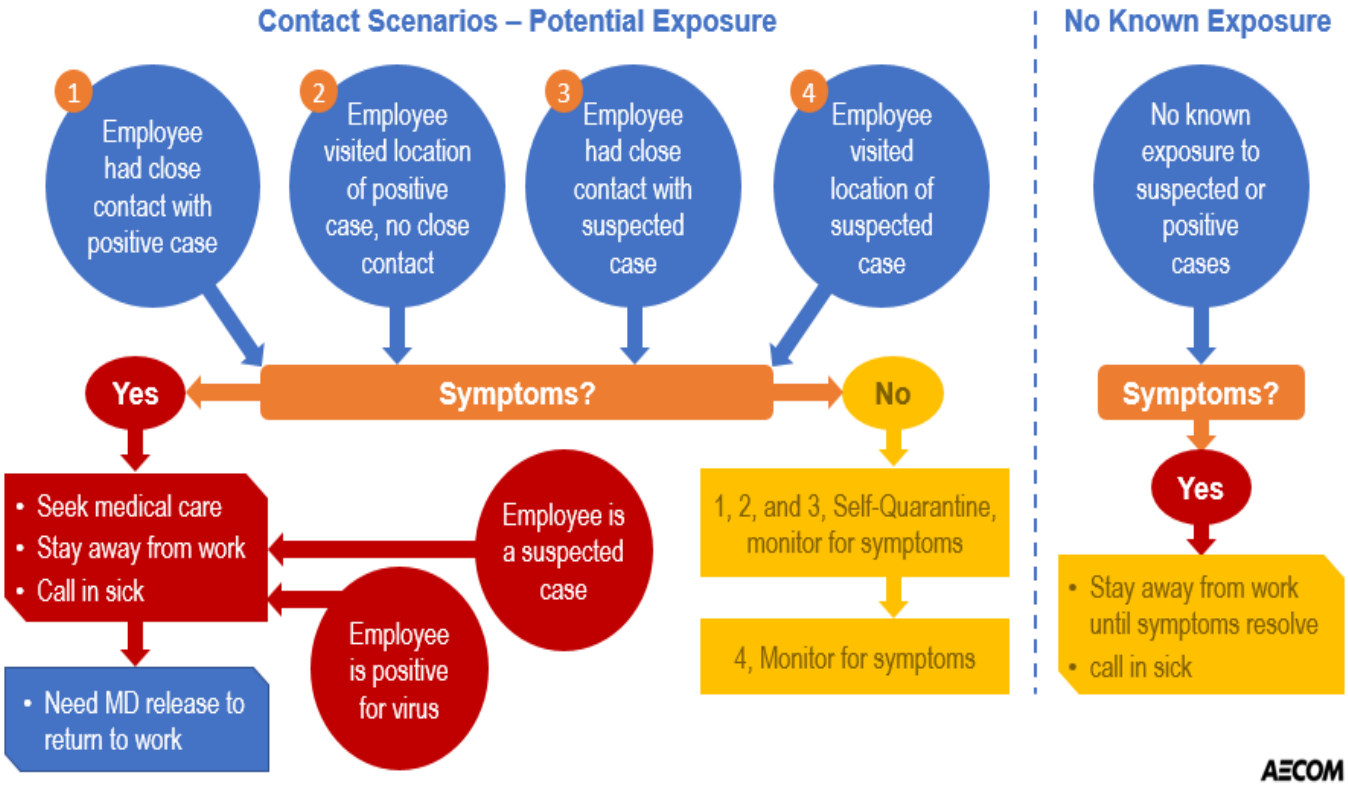
For Cases 1-6, the Employee shall report to the People Manager, HR and Business Unit Leader. The Business Unit Leader shall report to the Regional Resilience Coordinator.

For Case 7, the Employee should report to the People Manager. The People Manager should report to the Business Unit Leader.

1. Definition of Suspected Case: an individual fulfilling the following should report to a local medical facility for further investigation:
    a. Presented with fever OR acute respiratory illness OR pneumonia; AND
    b. any one of the following conditions within 14 days BEFORE ONSET OF SYMPTOMS:
        i. With travel history to Hubei Province* (irrespective of any exposure to a wet market or seafood market); OR other location where COVID-19 is active.
        ii. Visited a medical hospital in an area that has elevated numbers of the virus as identified by the World Health Organization.
        iii. Had close contact with a confirmed case of novel coronavirus infection while that patient was symptomatic.
2. Close contact refers to contact within 1meters (3 ft) for a period ≥ 30 min; or having meeting ≥ 30 min within a confined meeting room regardless of distance.
3. Location refers to, places other than the AECOM Office, the same meeting room or the same confined common area where our Employee and the concerned person (of confirmed or suspected case) have visited during the concerned time and stayed for > 30 min.
4. For all notices and announcements, Business Unit Leader shall give the facts (details of the Case and Sub-case, date, place) to Comms Partner. Resilience Administrator, to inform Comms Partner what action is being taken, or has been planned, on the same date the case is known. Comms Partner will prepare the draft for the Regional Resilience Coordinator. Formal notice and updates to Organizational Resilience Executive via Disruptive Event Briefing Agenda Template - AECOM Global will be issued by the Regional Resilience Coordinator. Business Leaders may forward the announcement to stakeholders (e.g. Client and authorities) as a response to their queries on an as needed basis.
5. Staff feeling unwell or experiencing symptoms who stay home shall apply for leave/PTO. Staff being required to observe quarantine in the above cases will be considered as working from home. Business Leaders to report the status of quarantine and work from home cases to HR and to assess the impact on work progress and efficiency.
6. This guideline provides the minimum requirements to be observed. Business Leaders may exercise discretion to adopt more cautious measures if they consider the case is of a higher risk (e.g. for other staff affected by the concerned employees where close contact is regular/frequent).
7. To ensure privacy, any notifications/announcements regarding specific cases must be approved by AECOM Legal.

This document constitutes internal guidelines compiled based upon general external advice and publications to assist management and staff in dealing with and making management decisions in relation to the Coronavirus (COVID-19). The document should not be construed as providing medical or legal advice and should not be shared outside of AECOM. To the extent that you require any further clarification or have any queries in relation to the content set out therein, please seek further guidance from Legal or the Resilience Team.

AECOM Pandemic Flow Chart



Appendix 2 - Virus Prevention Posters & Flyers

World Health Organization | Patient Safety — A World Alliance for Safer Health Care | SAVE LIVES — Clean Your Hands

How to Handwash?

WASH HANDS WHEN VISIBLY SOILED! OTHERWISE, USE HANDRUB

Duration of the entire procedure: 40-60 seconds

0



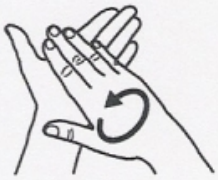
Wet hands with water;

1



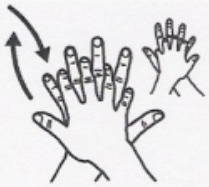
Apply enough soap to cover all hand surfaces;

2



Rub hands palm to palm;

3



Right palm over left dorsum with interlaced fingers and vice versa;

4



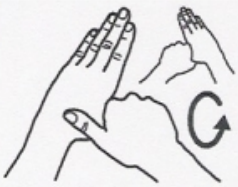
Palm to palm with fingers interlaced;

5



Backs of fingers to opposing palms with fingers interlocked;

6



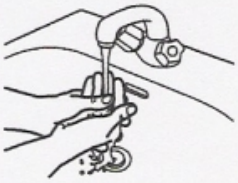
Rotational rubbing of left thumb clasped in right palm and vice versa;

7



Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa;

8



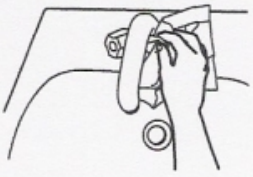
Rinse hands with water;

9



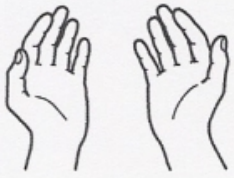
Dry hands thoroughly with a single use towel;

10



Use towel to turn off faucet;

11



Your hands are now safe.

Wash your hands

Wash your hands with soap and running water when hands are visibly dirty



If your hands are not visibly dirty, frequently clean them by using alcohol-based hand rub or soap and water



World Health Organization

Protect yourself and others from getting sick

Wash your hands



- after coughing or sneezing
- when caring for the sick
- before, during and after you prepare food
- before eating
- after toilet use
- when hands are visibly dirty
- after handling animals or animal waste

World Health Organization

STAY HEALTHY WHILE TRAVELLING

If you become sick while travelling, inform crew and seek medical care early





If you seek medical attention, share travel history with your health care provider

World Health Organization

© AECOM Restricted


STAY HEALTHY
WHILE TRAVELLING
Avoid travel if you have a fever and cough
If you have a fever, cough and difficulty breathing seek medical care early and share previous travel history with your health care provider
World Health Organization

Americas

Safe Work Standards & Rules

S3AM-001-PR1

1.0 Purpose and Scope

1.1 Demonstrates AECOM's commitment to the establishment and maintenance of workplaces free from recognized hazards.

1.2 This procedure applies to all AECOM Americas based employees and operations and any other entity and its personnel contractually required to comply with this document's content..

2.0 Terms and Definitions

2.1 **Safety Violation –** Not following verbal or written safety policies, rules and procedures (e.g., horse play, failure to wear selected PPE, abuse of selected PPE, etc.).

2.2 **Safe Work Practices** – Safe work practices are generally written methods outlining the requirements associated with how to perform a task with minimum risk to people, equipment, materials, environment, and processes.

2.3 **Safe Job Procedures** – Written step-by-step set of instructions about completing a specific task safely including control measures and responding to emergency situations.

2.4 **SH&E Plan -** A written, reviewed, and approved plan for how the required work will be completed in a safe manner (may also be known as a Safety Plan, Safe Work Plan, Health and Safety Plan, Accident Prevention Plan, etc.).

3.0 References

3.1 AECOM Employee Handbook

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Managers and Supervisors**

- Confirm compliance with all procedures and governmental requirements, and will be held responsible to prevent or bring any violations to the attention of the appropriate level of Management for corrective actions as per AECOM HR policies.
- Confirm implementation of, and compliance with, this procedure.

4.1.2 **SH&E Managers**

- Provide guidance as to safe work standards, rules, requirements and guidelines.

4.1.3 **Human Resource Managers**

- Provide guidance and direction to managers and supervisors implementing the disciplinary process for safety violations (as defined in the Employee Handbook).

4.1.4 **Employees**

- Responsible for adhering to all AECOM safe work standards, rules, requirements and instructions and to provide input as appropriate.

4.2 Safety, Health & Environment (SH&E) Procedures

4.2.1 Safe work practices and safe job procedures are embodied in AECOM's SH&E Procedures and are available on the AECOM SH&E website.

4.2.2 Specific safe work practices and safe job procedures have been developed in conjunction with employees and with particular input from those who have significant experience.

4.2.3 AECOM SH&E Procedures have been developed to provide clear instruction regarding the safety and reporting requirements of staff and operations.

4.3 Inspections and Audits

4.3.1 The Manager directing activities of the facility, site, or project location shall conduct project audits and office inspections to identify safe work practices and potential safety violations.

4.4 Any employee who willfully disregards AECOM or client safety standards, rules or requirements is subject to disciplinary action.

4.4.1 Disciplinary action will be documented in accordance with AECOM Human Resources policy.

5.0 Records

None

6.0 Attachments

6.1 S3AM-001-ATT1 Safety Rules

Americas

Stop Work Authority

S3AM-002-PR1

1.0 Purpose and Scope

1.1 This procedure establishes the requirements for AECOM personnel to stop any task or company operation if they believe there is an imminent safety, health, or environmental risk as described within this document.

1.2 The AECOM Safety Red Card is a key component in the Stop Work Authority for Unsafe Work procedure. The Safety Red Card is derived from its use in football (soccer), where circumstances are such that a referee has to stop the play, similar to an imminently dangerous situation on a project site. The Safety Red Card is a physical tool that reinforces the Stop Work Authority Procedure.

1.3 This procedure applies to all Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content..

2.0 Terms and Definitions

2.1 **Contractor** – For the purposes of this procedure, a person or business whose contract to provide work or services is not with AECOM. AECOM may have the responsibility of safety oversight for Contractor-controlled work on a particular project or construction site if specified in the associated contract.

2.2 **Direct Subcontractor** – For the purposes of this procedure, a person or business which has a contract directly with AECOM to provide work or services.

2.3 **Imminent Danger –** For the purposes of this procedure, an immediately dangerous situation that, if left uncorrected, is likely to result in serious injury, loss of life, or environmental impairment.

2.4 **Project Management / Construction Management (PM-CM)** – AECOM has contractually agreed with the client to the specified roles and responsibilities of oversight of Contractor-controlled work for the given project.

2.5 **Safety Red Card** - A tangible reminder of stop work authority for all AECOM employees that can be presented when stopping work. The intent is for every employee to have or have access to their own Safety Red Card.

2.6 **Stop Work Order – AECOM and Direct Subcontractors -** A directive to cease AECOM-directed work, issued for failure to follow procedures, Imminent Danger situations/conditions, accumulation of safety violations, etc. The Stop Work Order will also be completed when there is disagreement between those affected or involved regarding the validity of the stop work issue or adequacy of the resolution actions. The Stop Work Order will apply to AECOM employees and AECOM Direct Subcontractors placed at risk by the identified situations or conditions. Refer to *S3AM-002-FM1 Stop Work Order – AECOM Employees and Direct Subcontractors*.

2.7 **Stop Work Order – Project Management / Construction Management** – Applies to Contractor-controlled work for which AECOM Project Management / Construction Management (PM-CM) has contractually agreed to the responsibility of safety oversight of Contractors for the given project. A directive served to the Contractor to cease Contractor-controlled work, issued for failure to follow procedures, Imminent Danger situations / conditions, accumulation of safety violations, etc. Refer to *S3AM-002-FM2 Stop Work Order-Project Management / Construction Management.* Note: If PM-CM has not contractually agreed specifically to oversight of safety, this form does not apply.

3.0 References

3.1.1 S3AM-004-PR1 Incident Reporting, Notifications & Investigation

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Employees**

- Any time an employee identifies a condition or act that is likely to cause an Imminent Danger situation:
- Responsible for stopping associated AECOM-directed work and that of Direct Subcontractors, and for bringing it to the attention of the appropriate supervisor, manager, SH&E Representative, and/or Contractor representative.
- Where Employees are working alongside Contractors for which AECOM has contractual Project Management / Construction Management (PM-CM) safety oversight of the Contractor, employees shall be responsible for stopping associated Contractor-controlled work and for bringing it to the attention of the appropriate supervisor, manager, SH&E representative, and/or Contractor representative.
- Where employees are working alongside Contractors for which AECOM PM-CM has not contractually agreed to the responsibility of safety oversight of Contractors for the given project, employees can, as applicable, report unsafe conditions/acts to the Contractor's site representative (supervisor, foreman, etc.) for resolution. Employees shall promptly report the situation to AECOM management.
- Where no contract exists between AECOM and the party presenting the situation, employees can, as applicable, and report unsafe conditions/acts to the parties' site representative (supervisor, foreman, etc.) for resolution. Employees shall promptly report the situation to AECOM management.
- Where Employees are working under the direction of client / customer supervisors and/or working on a task with a client / customer employee, Employees shall be trained, as is applicable, to communicate directly with the worker involved, report the unsafe conditions/acts to their client / customer supervisor and/or point-of-contact for resolution and subsequently report it to AECOM management.
- Decline to participate in client / customer-directed work under unsafe conditions or acts and immediately report the situation to AECOM management.
- Employees shall retain their individual Safety Red Card. An Employee may or may not physically present a Safety Red Card when stopping work.

4.1.2 **SH&E Manager**

- Review all Stop Work Orders applicable to their scope.
- Provide technical guidance for the development and implementation of corrective actions.
- Training of AECOM Employees should include how to exercise stop work authority and the measures AECOM management will take as a result of the work stoppage.
- Honor any worker refusals of unsafe work. Assist in resolving issues before operations resume, and that all stop work actions are properly resolved with required follow-up completed.

4.1.3 **Manager**

- Establish a safety culture where the stop work authority is embraced by the workforce as a tool so that all AECOM employees share the responsibility for safe working conditions.
- Training of AECOM Employees should include how to exercise stop work authority and the measures AECOM management will take as a result of the work stoppage.
- AECOM Employees have or have access to their own Safety Red Card and understand its meaning.

- Contractors for which AECOM PM-CM has contractual safety oversight, and Direct Subcontractors are informed of the stop work authority of AECOM and its Employees as a regulatory and Company requirement, as well as the intent of the program, which is to empower employees to work safe and prevent injuries.
- Clients / customers understand stop work authority of Employees is a regulatory and Company requirement, as well as the intent of the program, which is to empower Employees to work safe and prevent injuries.
- Honor any worker refusals of unsafe work, Resolve issues before operations resume, and that all stop work actions are properly resolved with required follow-up completed.
- Confirm reporting is completed any time an Employee exercises stop work authority
- Review so that Reporting is appropriate to the stop work situation, using inspection and observations programs (e.g. LifeGuard, Office Inspections, etc.) and IndustrySafe. Refer to *S3AM-004-PR1 Incident Reporting, Notifications & Investigation* for additional direction.
- Maintain and track reports associated with the stop work situation until resolved/closed.
- Stop work interventions that include a near miss or incident shall be reported as such.
- Review for Stop Work Orders completed when AECOM Employees or Direct Subcontractors completing AECOM-directed work fail to provide resolution to the stop work situation, or if at any time the actions or failure to act of those involved in the Stop Work Order cause Imminent Danger to the health and safety of Employees, any other person at the place of employment, or the environment. Refer to *S3AM-002-FM1 Stop Work Order – AECOM Employees and Direct Subcontractors*.
- Review Stop Work Orders – Project Management / Construction Management are completed when Contractors performing Contractor-controlled work, subject to AECOM contractual safety oversight, fail to provide resolution to the stop work situation, or if at any time the actions or failure to act of those involved in the Stop Work Order cause Imminent Danger to the health and safety of Employees, any other person at the place of employment, or the environment. Refer to *S3AM-002-FM2 Stop Work Order – Project Management / Construction Management*.
- When an unsafe condition or act has been reported by an AECOM Employee of a Contractor for which AECOM does not have specific contractual safety oversight, communicate promptly with client representative(s).
- Review corrective actions have appropriately addressed the conditions leading to the stoppage of work or the Stop Work Order.
- If AECOM has control over the circumstance that led to the condition, initiate additional corrective actions necessary to correct the conditions leading to the Stop Work Order. Otherwise, remain in communication with the persons or entities that are taking the corrective measures.
- Communicate such corrective actions and the effects of such corrective actions on the project / location / office to the client and/or next level of AECOM Management.
- Work activities of AECOM-directed work should not resume until the stop work situation has been resolved to the satisfaction of all involved and/or the appropriate approvals received to resume work.
- Monitor that work activities of Contractors subject to AECOM contractual safety oversight do not resume work until the unsafe situation has been resolved.
- Documentation related to the Stop Work Order and corrective actions is placed in the project / location / office file.

4.2 Requirements

4.2.1 Employees shall be trained in how to exercise stop work authority, the use of the Safety Red Card and in the measures AECOM management will take as a result of the work stoppage.

4.2.2 Employees will each be provided a Safety Red Card for their own use.

4.2.3 It is AECOM's policy and firm commitment that Employees are expected to stop their work to prevent unacceptable exposure to workplace hazards, including unsafe conditions or worker behaviors, without fear of reprimand or reprisal.

- "Stopping work" for AECOM-directed work may include stabilizing an Imminent Danger situation, as is safely possible, to the extent that it can be left unattended for a prolonged period of time until the issue is resolved.
- Stop work interventions to correct some unsafe situations that do not present an Imminent Danger (e.g., to remind workers to put on their hard hats, safety glasses, etc.) may not require formal stop work notification but should be appropriately reported (e.g. LifeGuard, Inspection Report).

4.2.4 There will be no retribution or any form of intimidation directed against an employee for good faith reporting of SH&E issues or the good faith stopping of work due to unsafe conditions.

4.2.5 Where Employees identify an unsafe act or condition related to a Contractor or worker for which AECOM does not have specific contractual safety oversight , as applicable, Employees should report the situation to the Contractor or worker's site representative (supervisor, foreman). Employees shall immediately report the situation to AECOM management who, in turn, shall promptly communicate with the client representative(s).

- While Employees may not be authorized to stop client / customer-directed work, Employees shall decline to participate in work under the Imminently Dangerous situation and immediately report the situation to the client / customer representative and AECOM management.

4.2.6 AECOM's stop work authority applies to all work AECOM-directed work and to Contractor-controlled work for which AECOM PM-CM has contractually agreed to the responsibility of safety oversight of Contractors for the given project.

- When an Employee identifies an Imminent Danger situation, the Employee shall immediately stop work and notify the affected co-worker(s) and supervisor, manager, SH&E representative and/or Contractor representative.
- If the supervisor / manager / representative is not readily available and/or the affected person(s) are in an Imminent Danger situation, the stop work intervention should be initiated directly with the Employee(s) at risk. The supervisor / manager / representative shall be informed as soon as possible.
- The supervisor / manager / representative shall communicate the stop work situation with any other affected personnel and the applicable client / customer representative(s).
- Managers, and/or SH&E Managers may issue a formal Stop Work Order for AECOM-directed work in the following situations:
    - Imminent Danger exists involving an employee's safety and health, that of any other person at the place of employment or damage to the environment, facilities, or property.
    - A project, or any segment of the project, is executed improperly or is out of compliance with applicable regulations or standards.

4.2.7 Stop Work Order – Project Management / Construction Management

Applies to Contractor-controlled work for which AECOM Project Management / Construction Management (PM-CM) has contractually agreed to the responsibility of safety oversight of Contractors for the given project. Refer to *S3AM-002-FM2 Stop Work Order- Project Management / Construction Management.*

- With a stop work situation related to Contractor- controlled work for which AECOM has contractually specified safety oversight, the Contractor is expected to immediately resolve the stop work situation. A Stop Work Order – Project Management / Construction Management form must be completed if:

- Imminent Danger exists involving the Employees' safety & health, the environment, facilities, or property.
- There is a discrepancy, deficiency, or potentially dangerous condition or act that is likely to cause an unsafe or unhealthy situation or an Imminent Danger situation.

- When a Stop Work Order – Project Management / Construction Management is issued by AECOM, the Contractor is expected to establish and document corrective actions and provide items (e.g. pictures, documents, etc.) related to the stop work situation and related corrective actions. AECOM will monitor the Contractor's corrective actions.

4.2.8 Stop Work Order – AECOM Employees and Direct Subcontractors

With a stop work situation related to AECOM-directed work, the appropriate parties (e.g. affected personnel, supervision, SH&E representative, management, client / customer representative, etc.) shall discuss and gain agreement on the stop work issue.

- If determined and agreed by all involved that the task or operation is cleared to safely proceed, the affected persons shall immediately resume work.
- If determined and agreed that the stop work issue is valid, then every attempt must be made to resolve the issue for the safety of Employees, Contractors, any other person at the place of employment, and the environment.
- If the stop work issue cannot be resolved immediately, work shall be suspended until proper resolution can be achieved to the satisfaction of all involved.
- If all affected by the stop work issue cannot agree that work can be resumed safely (opinions differ regarding the validity of the stop work issue or adequacy of the resolution actions), a Stop Work Order must be completed. Refer to *S3AM-002-FM1 Stop Work Order – AECOM Employees and Direct Subcontractors*.
    - In order for work to resume, the completed Stop Work Order must be reviewed by the Manager, the applicable SH&E Manager and any other parties necessary (this may include the Employee who initiated the stoppage of work) to determine whether work can be resumed safely.
- If it is determined work can be resumed safely but the disagreement remains, work will only commence with the written approval to return to work by the Vice President of the applicable business group and, as applicable, the client representative. Refer to *S3AM-002-FM1 Stop Work Order – AECOM Employees and Direct Subcontractors.*
- If the responsible organization fails to provide resolution, or if at any time the responsible organization's acts or failure to act cause Imminent Danger to the health and safety of **Employees**, that of any other person at the place of employment, or the environment, AECOM may issue a Stop Work Order. Refer to *S3AM-002-FM1 Stop Work Order – AECOM Employees and Direct Subcontractors*.

4.2.9 In most cases, a Stop Work Order affects only those areas immediately involved in the hazardous situation. The Stop Work Order will apply to AECOM – directed work, its **Employees** and its Direct Subcontractors placed at risk by the situations or conditions. The Stop Work Order – Project Management / Construction Management will apply to Contractor-controlled work and its employees for which AECOM PM-CM has contractually agreed to the responsibility of safety monitoring of Contractors for the given project.

4.2.10 AECOM may issue a Stop Work Order for a portion of the work area(s) or for an entire work area when unacceptable risks exist.

4.2.11 The Stop Work Order will remain in effect until the responsible organization resolves the problem(s) and brings the work area(s) to satisfactory conformance with established AECOM SH&E requirements. Corrective actions taken and preventative measures put in place must be communicated to all affected by the Stop Work Order.

4.2.12 Work will not resume until appropriate corrective actions have been completed. The “Return to Work” portion of the Stop Work Order must be completed.

4.2.13 An AECOM Employee’s failure to comply with any Stop Work Order in whole or in part may result in disciplinary action, and/or termination of employment. An AECOM Direct Subcontractor Employee’s failure to comply with any Stop Work Order may result in immediate removal from the project, location and/or office.

5.0 Records

5.1 The completed Stop Work Order and any corrective action reports generated will be maintained at the project site for the duration of the project and placed in the closed project file.

6.0 Attachments

6.1 S3AM-002-FM1 Stop Work Order – AECOM Employees and Direct Subcontractors

6.2 S3AM-002-FM2 Stop Work Order – Project Management / Construction Management

6.3 S3AM-002 ATT1 Stop Work Order – Authority Table

Americas

SH&E Training

S3AM-003-PR1

1.0 Purpose and Scope

1.1 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content. These are the minimum safety, health and environment (SH&E)-related training requirements and tracking procedures. Additional training requirements may exist related to a specific task. Specific geographic entities, business units, and projects may have additional training requirements.

1.2 This procedure was developed to assist employees and managers in the identification of training requirements and to define the AECOM procedures for tracking and documenting SH&E training. The goals of this procedure are to ensure regulatory compliance and to provide employees with the information and training they need to accomplish their work assignments safely; prevent injuries to themselves, coworkers, surrounding communities, and customers; and protect company and/or customer property and the environment.

1.3 Major objectives of this procedure include:

- Identify accountability, responsibility, and authority pertaining to SH&E training program requirements.
- Establish minimum training course and/or instructor criteria to support compliance with applicable regulatory requirements as well as AECOM policy.
- Provide a framework to assess participant competency and understanding.
- Define recordkeeping requirements for the training program.
- Maintain consistency in SH&E training content throughout the Americas.

2.0 Terms and Definitions

2.1 **Compliance Training –** Training meant to provide a safe and healthy workplace for AECOM employees and others through adherence to legislative and regulatory mandates (e.g., Federal, State, Provincial, Territorial, local/municipal governments and agencies thereof).

2.2 **Conformance Training –** Training developed by AECOM intended to further develop the AECOM SH&E culture, as specified in AECOM SH&E policy and procedure, or client requirements.

2.3 **Learning Management System (LMS) –** An electronic training delivery and data management system utilized for implementation of the SH&E training program.

3.0 References

3.1 S3AM-015-PR1 Newly Hired or Transferred Employees

3.2 S3AM-202-PR1 Competent Person Designation

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Executives**

- Establish adequate resources (budget, staffing, etc.) to implement this procedure.
- Assignment/support of Learning Management System administration duties.

4.1.2 **Supervisors/Managers**

- Confirm new employees complete the AECOM Safety Orientation.

- Assist employees in identifying training requirements.
- Confirm supplemental employee training courses are identified based on local/client requirements.
- Confirm additional employee SH&E training requirements are identified based upon prudent risk management considerations and local performance issues.
- Confirm employee's training requirements are re-evaluated whenever an employee's assigned duties change significantly.
- Provide time and resources to allow employee to complete required training.
- Verify corrective actions are implemented when employees fail to meet training requirements.
- Confirm that the appropriate level of training is being assigned to the employee with regard to their specific job and task assignments and client needs.
- Confirm employees have current and applicable training to the employee's assigned tasks associated with the program or project.
- Confirm their own supervisory or management training is complete and current as applicable to the scope of work and type or oversight (e.g., AECOM employees, subcontractors, etc.).

4.1.3 **Vice President SH&E**

- Establish and maintain this procedure.
- Provide the necessary tools, support, and staff for on-going development and support of the training program.
- Report/communicate training status to senior management.

4.1.4 **SH&E Managers**

- Confirm management understands the function of the LMS and provide training, access and resources.
- Work with management to develop schedules, develop skills of employees assigned with training and recordkeeping duties, and provide training classes as requested.
- Confirm qualifications of safety training providers are reviewed and approved.
- Confirm training lesson plans and course agendas for training courses are reviewed and approved to verify the course content meets compliance/conformance requirements.
- Offer training participants the opportunity to evaluate training events.
- Report compliance with training program requirements to line management.
- Develop a training calendar.

4.1.5 **Employees**

- Complete the AECOM Safety Orientation.
- Coordinate with their supervisor to complete required training within any specified timeframes.
- Monitor their training expiration dates and coordinate refresher training to prevent expiration of any required training certification.
- Maintain a personal record of all training certifications.
- Supply copies of training completion certificates for inclusion in the LMS, as requested.
- Provide feedback on training through the evaluation process.

4.2 Identifying Required Training

4.2.1 All new employees shall complete the AECOM Safety Orientation.

- The AECOM Safety Orientation communicates the responsibility of each employee for a safe working environment and establishes AECOM's commitment to safety.
- The orientation communicates AECOM's Safety, Health and Environment (SH&E) Policy and the fundamental principles of the SH&E Management System; Safety for Life and the Life

Preserving Principles. Employees are informed of various aspects of the program, including but not limited to:

- Monitoring and evaluation of the program by leadership on an ongoing basis.
- Availability of AECOM policies and procedures and reference to the AECOM intranet site.
- The importance and requirement of pre-planning, including hazard assessment basics.
- Responsibility to report unsafe actions and conditions and the authority to stop unsafe work.
- The availability and importance of task specific training, refresher training, and related initiatives.
- Basic requirements and importance of incident reporting, notifications and investigation.
- Substance abuse prevention program, fit for duty requirements and the availability of medical support.

- Employees shall also complete any applicable site specific field or office orientations.
  - Employees shall be oriented to the layout of the site and instructed on the recognition of unsafe conditions.
  - Employees shall be informed of the site specific field or office hazards, any applicable control measures and any site specific field or office requirements and restrictions (e.g. rules, required PPE, etc.) through the review of the applicable field or office SH&E Plan.
  - Site specific orientations shall include the location specific Emergency Response Plan, including any required actions and responsibilities.
  - As applicable, the site specific orientation may address any Short Service Employee requirements. Refer to *S3AM-015-PR1 Newly Hired or Transferred Employees*.
  - As applicable, any regulatory or client specific requirements and restrictions.

4.2.2 Employee training requirements are dictated by the work each employee performs (or is expected to perform) and the geographic area(s) where the employee performs these activities. Employees include all AECOM personnel (e.g. office/field personnel, supervisors, managers, etc.).

- The attached *SH&E Training Matrix (S3AM-003-FM1)* is a matrix of the most common courses that may be required, the frequency, and expected participants. The Attachment contains four tables. Table 1 is applicable to all Business Groups of AECOM. Table 2-4 are Business Group-specific requirements. Table 1 and the applicable Business Group-specific table should be used to evaluate an employee's training requirements.
- Additional tools such as a Training Assessment may be developed at the business group level if desired to further define training requirements.

4.2.3 Training requirements shall be evaluated upon hire. Employees shall not undertake a task for which they have not been adequately trained. SH&E training needs shall also be re-evaluated periodically and may also be identified through individual risk assessments, incident investigations, observed non-compliance, when procedures change, or through the annual staff appraisals process, and whenever an employee's assigned duties change significantly.

4.3 Training Competency Levels

4.3.1 Information Dissemination

- Information is provided to employees through verbal or written communication.
- This type of training may be used in scenarios where the goal is to provide information to employees with no expectation of implementation or executing a regulatory requirement or SH&E procedure.
- The communication is mostly one way and there is no confirmation or knowledge assessment (e.g., test, interactive discussion, etc.) that the employee shall pass to demonstrate understanding and meet a training goal. Examples of this type of communication would be newsletters, safety alerts, webinar presentations, video only presentations, etc.

4.3.2 Awareness Level

- Awareness-level training is applicable to training where the primary goal is to transfer knowledge from the organization to participants.
- Training will typically take the form of instructor-led discussions, presentation of related video content, and/or self-directed e-learning modules.
- In most cases comprehension assessment will be performed through discussion of the training topic with the participants and/or a simple quiz. When quizzes are provided employees will successfully complete at least 80% of the questions.

4.3.3 Performance Level

- Performance-level training will build upon the Awareness level. The goal of Performance Training is to have an employee successfully demonstrate that they can apply the knowledge discussed during training and perform the desired skills necessary to perform their job.
- Training materials are provided and discussed, and will incorporate a demonstration of the skills to be completed.
- The instructor will gauge the level of understanding through interactive discussion with participants and a pass/fail designation of demonstrated skills by the employee. A test or quiz of moderate difficulty will be provided, with participants scoring 80% or better, followed by the successful demonstration of the desired skill to receive certification.

4.3.4 Competent Person Level

- Competent Person-level certifications may be applicable to, and dictated by, specific regulatory standards. Refer to *S3AM-202-PR1 Competent Person Designation* for additional guidance.
- When Competent Person-level certifications are offered, comprehension assessments will build upon Performance-level certification.
- Competent Person certifications will incorporate classroom training along with on-the-job mentoring provided by employees previously certified to the Competent Person-level in the area of competency being sought. Candidates for Competent Person certification will be required to score 80% or better on administered written exams.
- Additionally, candidates shall be capable of repeatedly demonstrating the desired skills and regulatory knowledge, both in a classroom setting as well as in an actual work setting to the Instructor, Manager for the program or project the employee is seeking to gain and apply the certification to, and/or the mentoring Competent Person.
- Competent Person(s) will be designated on a program/project-by-program/project basis, in accordance with *S3AM-202-PR1 Competent Person Designation.* Forms to document certification and designation of a Competent Person are provided with the procedure and a record of the designation will be maintained within the project files and LMS.

4.4 Training Delivery

4.4.1 Internal Training

- Internal training is performed by AECOM's internal resources and may include intranet and classroom-based training.
- To ensure consistency in content and duration and in meeting regulatory and company requirements, AECOM training materials should be used as the basis for training whenever they are available. Trainers may always elect to supplement the base training materials for these courses with specifics for the program, project, customer, office, or geographic unit.
- AECOM instructors shall have the experience, education and competency and any required current licensing, registrations and/or certifications relevant to the course taught. Training format and material shall be appropriate to the topic and audience. Refer to *S3AM-003-FM4 SH&E Training Syllabus Template.*

- Course content of training provided on an annual basis will be updated as appropriate, or multiple versions of training may be developed for rotating use, to provide participants with new learning materials and avoid stagnation.
- Course content shall be periodically reviewed, with no greater than five years between reviews.

4.4.2 External Training

- External vendors conduct training that is not available through internal training sources. This training may be classroom or on-line training. External vendors should be pre-approved by the SH&E Department prior to any employee attending a training class.

4.5 Training Evaluation

4.5.1 At the conclusion of a training event, participants will be provided with the opportunity to anonymously evaluate the training session with through the use of *S3AM-003-FM3 Course & Instructor Evaluation* or an online survey.

4.5.2 Training instructors will review evaluations at the conclusion of training and request assistance addressing consistently noted issues if appropriate.

4.6 Training Expiration

4.6.1 Training will expire in accordance with requirements specified in applicable regulations or on syllabus. Expiration of training will be tracked electronically using the AECOM LMS. Employees tracking training outside of the AECOM LMS are responsible for tracking their individual training expiration dates. If training expires for an employee, they will be disqualified from performing tasks associated with the training when training is required by AECOM defined requirements or legislation/regulation to perform the tasks. Once training has been renewed, the employee will again be qualified to perform associated tasks.

5.0 Records

5.1 Courses denoted in *S3AM-003-FM1 SH&E Training Matrix* or commonly required training shall be tracked in the AECOM LMS when completed. Employee training tracked in the AECOM LMS shall be retained for the duration of the employee's employment.

5.2 Classroom training shall be documented using an attendance record and course agenda. Attachment *S3AM-003-FM2 SH&E Training Sign-In Sheet* may be used to document attendance. Attachment *S3AM-003-FM5 SH&E Training Certificate Template* may be used to document course completion. Course completion may also be documented by LMS-generated certificates when allowed by regulation.

5.3 For training provided by customers/vendors, training documentation shall be entered into a training database or LMS and documentation shall be maintained by the employee. Copies of certificates or other evidence of required project training may be included in program or project training files.

5.4 In some cases, objective evidence of comprehension is required (passing a test) and this information may be tracked in addition to the course information.

5.5 Attendance sheets, agendas, course evaluations, completed tests, and copies of certificates will be maintained. These should be filed in program or project training files by course then by date for easy access/auditing.

5.6 Locations/projects/programs will maintain records on any project, program, or location- or site-specific training requirements.

6.0 Attachments

6.1 S3AM-003-FM1 SH&E Training Matrix

6.2 S3AM-003-FM2 SH&E Training Sign-In Sheet

6.3 S3AM-003-FM3 Course and Instructor Evaluation

6.4 S3AM-003-FM4 SH&E Training Syllabus Template

6.5 S3AM-003-FM5 SH&E Training Certificate Template

6.6 S3AM-003-FM6 New Employee SH&E Orientation

Americas

SH&E Training Matrix

S3AM-003-FM1

Employee Name: **Employee Number:**

Location: **Date:**

Table 1 – All Employees

Course Title	Regulatory	Frequency	Should You Attend?	Check if Required ☒	Comments
10 Hour Outreach Course (OSHA – General Industry or Construction)	N	Once	As required by client or local regulations.	☐	
30 Hour Outreach Course (OSHA – General Industry or Construction)	N	Once	As required by client. Required if you serve as a site safety and health officer on US Army Corps of Engineers (USACE) projects, or other DoD projects which follow the provisions of EM 385-1-1 (USACE Safety and Health Requirements Manual).		
Asbestos Inspector	Y	Annual	You perform asbestos sampling tasks.	☐	
Asbestos Planner	Y	Annual	You serve as the project asbestos planner.	☐	
Automated External Defibrillator (AED)	Y	As established by the training provider	You are designated to be an AED user at an office or project site.	☐	
Bloodborne Pathogens	Y	Annual	Required for employees designated as a first aid responder or others who have a potential bloodborne pathogen exposure.	☐	May be included in first aid or CPR class.
Cardiac Pulmonary Resuscitation (CPR)	Y	As established by the training provider – typically biennial	Required for 1) employees who are designated as first aid responders, 2) employees who are performing high hazard activities (e.g., potential for falls, suffocation, electrocution, amputation) and medical attention is more than 4 minutes away, or 3) required by client contract.	☐	Acquire training from recognized source (e.g., Red Cross, American Heart).
Confined Space Entry	Y	Once	You perform confined space entry/authorizer/attendant duties (including anyone performing non-entry rescue activities).	☐	

Course Title	Regulatory	Frequency	Should You Attend?	Check if Required ☒	Comments
Confined Space Refresher	N	As needed	Recommended if you perform entry activities.	☐	
Confined Space Rescuer	Y	Once	You may have to enter a confined space to perform a rescue.	☐	
Emergency Preparedness Plan/ Emergency Action Plan	Y	Once	Required for all employees.	☐	For office personnel, this information is covered in employee orientation. For field/site personnel, this is covered in project/site safety training.
Excavations/Trenching	Y	Once and as required by client or training provider	You are or may be involved in excavation or trenching operations	☐	Frequency may be established by an applicable standard (e.g., Gold Shovel Standard - annual)
Experienced Miner Training	Y	Once, followed by annual refreshers	You meet the US Mine Safety and Health Administration (MSHA) definition of an "Experienced Miner."	☐	See Surface Miner and Underground Miner training for information on annual refreshers.
Fall Prevention/Protection	Y	Once	You supervise tasks or perform tasks at heights (on roofs, scaffolding, ladders, unfinished flooring).	☐	May be included in OSHA 10 or other classes
Fire Extinguisher	Y	Annual	You may be expected to use fire extinguishers (fixed facilities and project sites).	☐	
First Aid	Y	As established by the training provider - typically biennial	Required for 1) employees who are designated as first aid responders, 2) employees who are performing high hazard activities (e.g., potential for falls, suffocation, electrocution, amputation) and medical attention is more than 4 minutes away, or 3) required by client contract.	☐	Acquire training from recognized source (e.g., Red Cross, American Heart).
Hazard Communication	Y	Initially and if hazards change	Required for anyone who is potentially exposed to/works with hazardous chemicals.	☐	Training must occur before any work with hazardous chemicals. Included (as needed) in safety orientation. After the initial training, required updates will typically be handled as part of project-specific safety training.
Hazardous Materials Shipping	Y	Biennial	Required for anyone who packages, labels, transports, completes paperwork for, or offers for shipment, hazardous materials/dangerous goods.	☐	

Course Title	Regulatory	Frequency	Should You Attend?	Check if Required ☒	Comments
Hazardous Waste Operations (40-hours)	Y	Once	Anyone performing work or expected to perform at hazardous waste sites or treatment, storage, and disposal facilities.	☐	Training must have a 'hands-on' component (i.e., donning/doffing PPE). Any exceptions must be approved by a Regional SH&E Manager.
Hazardous Waste Operations – Refresher (8 hours)	Y	Annual	(See Hazardous Waste Operations.)	☐	When offered as a combination of online modules and classroom instruction, online modules must be completed prior to the classroom portion for participants to receive credit. Both portions (online and classroom) need to be completed within the same calendar year.
Hazardous Waste Operations – Supervisor (8 hours)	Y	Once	Required for anyone serving as the site supervisor or overseeing subcontractor activities at a hazardous waste site.	☐	When offered as a combination of online modules and classroom instruction, online modules must be completed prior to the classroom portion for participants to receive credit. Both portions (online and classroom) need to be completed within the same calendar year.
Hearing Conservation	Y	Annual	Employees exposed to noise ≥ 85 decibels averaged over an 8-hour day, or who otherwise utilize hearing protectors.	☐	May be included in OSHA 10 or other classes
Injury/Illness Prevention	Y	Once	You are assigned to California offices or job sites.	☐	Covered in California office/project Safety Orientation.
Laboratory Safety	Y	Once	You work in a fixed or mobile wet chemistry lab.	☐	Completed as part of site or project orientation.
Lead Project Designer	Y	Every 3 years	You are a lead project designer.	☐	
Lead Risk Assessor	Y	Every 3 years	You are a project lead risk assessor inspector.	☐	
Lockout/Tagout Awareness – Affected Person	Y	Once; follow-up as required by regulations	You work with and around equipment that may need to be locked out/tagged out. (You are not responsible for applying tags/locks).	☐	May be included in OSHA 10 or other classes
Lockout/Tagout – Authorized Person	Y	Once; follow-up as required by regulations	You lock out or tag out machines or equipment in order to perform servicing or maintenance on that machine or equipment.	☐	Specific to individual machines.

Course Title	Regulatory	Frequency	Should You Attend?	Check if Required ☒	Comments
Marine Trash and Debris Awareness and Limitation	Y	Annual	You work on contract operations for lessees and/or operators of oil and gas operations in the Gulf of Mexico.	☐	Provided by lessee or operator.
Nuclear Density Gauge Operator	Y	Once; follow-up as required by regulations	You operate nuclear density gauges / densometers.	☐	Troxler or equivalent training.
Nuclear Density Gauge Transporter	Y	Every 3 years	You transport nuclear density gauges / densometers.	☐	Hazardous Materials shipping.
Orientation Video	N	Within one week of starting at AECOM	Required for all employees.	☐	Training will set the expectations of the AECOM Safety for Life program
Powered Industrial Trucks (Forklifts)	Y	Once	Your job assignments include operating a powered industrial truck (forklift).	☐	Required more frequently if assessments indicate the need.
Radiation Worker	Y	Once; follow-up as required by regulations	You may require non-routine or short-term unescorted access to radiological controlled areas (excluding Radiation Areas and Airborne Radiation Areas), or you work in areas where radioactive materials are stored.	☐	Public dose limits apply. Additional training required when public dose limits may be exceeded.
Radiation Safety Officer	Y	Once	You are designated as a Radiation Safety Officer.	☐	
Respiratory Protection	Y	Annual	Required for any employee who may be required to wear a respirator.	☐	May be included in HAZWOPER refresher training
Safety Trained Supervisor (STS) or Safety Qualified Supervisor (SQS)	N	Once	Any manager directly overseeing revenue generating projects with any aspect of work conducted outside of an AECOM office	☐	Schedule for the associated Business Group established by the applicable VP SH&E or designee..
Self-Contained Breathing Apparatus (SCBA)/Cascade Systems	Y	Once	Required for any employee required to wear SCBAs or to operate a supplied air system.	☐	Part of Project Safety training as needed.
Shipping Specialist	Y	Once	You are designated as a Shipping Specialist.	☐	Updates are required as regulations change.
Substance Specific	Y	Once	Any U.S. employee potentially exposed to a substance covered by the 29 CFR substance specific regulations.	☐	Includes lead, asbestos, benzene, etc. Offered as part of project-specific training.
Surface Miner Training – New (24 hours)	Y	Once	You perform work at surface mine sites regulated by MSHA.	☐	Training is conducted by MSHA-approved instructors under MSHA-approved training plan.

Course Title	Regulatory	Frequency	Should You Attend?	Check if Required ☒	Comments
Surface Miner Training – Annual Refresher (8 hours)	Y	Annual	You perform work at surface mine sites regulated by MSHA.	☐	Training is conducted by MSHA-approved instructors under MSHA-approved training plan.
Supervisor Training in Accountability and Recognition Techniques (START)	N	Once	Required for all supervisors	☐	
Underground Miner Training – New (40 hours)	Y	Once	You perform work in underground mine sites regulated by MSHA.	☐	Training is conducted by MSHA-approved instructors under MSHA-approved training plan.
Underground Miner Training – Annual Refresher (8 hours)	Y	Annual	You perform work in underground mine sites regulated by MSHA.	☐	Training is conducted by MSHA-approved instructors under MSHA-approved training plan.
Waste Specialist	Y	Once with Annual Refresher	You are responsible for waste management at a small or large quantity generator facility.	☐	
Welding/Brazing/Cutting	Y	Once	You job duties include these activities.	☐	May be included in OSHA 10 or other classes
Workplace Hazardous Materials Information System (WHMIS)	Y	Annual	You are assigned to a Canadian facility and work with or around hazardous materials.	☐	Canadian Hazard Communications

Table 2 – Applicable to Energy, Infrastructure and Industrial Construction (EIC) Group

In addition to the courses in Table 1, the following courses may be applicable.

Course Title	Regulatory	Frequency	Should You Attend?	Check if Required ☒	Comments
Defensive Driving	N	Once, followed by refresher as required	Required for all employees who are Authorized Drivers. Recommended for other staff that drive on behalf of AECOM.	☐	
Reasonable Suspicion for Substance Abuse	N	Once upon assignment as responsible supervisor	For project and office supervisors with responsibility for administering the Substance Abuse Program (SAP).	☐	On line training provided by the SAP Program Administrator.
New Employee Safety Orientation Training	N	Once and at each new project assignment	Required for new employees and employees assigned to project sites per site requirements	☐	New employees receive orientation per HR program; project employees per site requirements.
First Aid/CPR/AED/BBP	N	Once plus annual refreshers, or as required by regulations	Recommended for office and project safety floor wardens.	☐	Provided by authorized trainers both internal and external as available

Table 3 – Applicable to Management Services Group

In addition to the courses in Table 1, the following courses may be applicable.

Course Title	Regulatory	Frequency	Should You Attend?	Check if Required ☒	Comments
New Employee Safety Orientation Training (Approx. 1 hour)	N	Once	Required for new employees.	☐	Access through Vision
Standards of Safety Performance (Approx. 1 Hour)	N	Annual	Required for all employees.	☐	Specific content will depend on the site and the employees' expected work.
Site Safety Training (up to 4 hours)	N	Biennial	Site specific training based on site specific work and safety processes (e.g., warehouses, laboratories, vehicle maintenance, and aircraft maintenance).	☐	Specific content will depend on the site and the employees' expected work.
Site Supervisor Safety Training	N	Once	Expected for all Supervisors in the pursuit of STS certification.	☐	

Table 4 – Applicable to Design & Consulting Services (DCS) Group

In addition to the courses in Table 1, the following courses may be applicable.

Course Title	Regulatory	Frequency	Should You Attend?	Check if Required ☒	Comments
10 Hour Outreach Course (OSHA – General Industry or Construction)	Y (as per jurisdiction)	Once	You perform work that exposes you to construction or industrial hazards	☐	
30 Hour Outreach Course (OSHA – General Industry or Construction)	Y (as per jurisdiction)	Once	You manage work with some safety responsibility that exposes you and/or other workers to construction or industrial hazards	☐	
New Employee Orientation	Y	Once	All new employees.	☐	Accomplished via a combination of AECOM University modules and location-specific training.
Vehicle / Driver Safety	N	Once	Required for all employees who drive on behalf of AECOM.	☐	Generally completed upon hire by employees who may become authorized drivers. Available online through the AECOM University.
Ergonomics	N	Once	Required for all employees with significant ergonomic risk.	☐	Generally completed upon hire or change in assignment. Available online through the AECOM University.
Confined Space Entry Awareness	N	As needed	Employees who work around confined spaces but are not responsible for performing entry/authorizer/attendant duties.	☐	Available online through AECOM Univerisity.
Defensive Driving	N	Once, followed by refresher every three years	Required for all DCS employees who drive on behalf of AECOM.	☐	National Safety Council, Alert Driving, Smith System or equivalent.
Excavations/Trenching Awareness	N	As needed	Employees who work at sites where excavation/trenching tasks are performed.	☐	Available online through AECOM University.
Field Safety Training (2 hours)	N	Annual	Required for all employees performing field work who are not in the hazardous waste or mine safety training programs. This training is also required for any DCS Project Manager that manages projects where field work is performed. The 10-Hour OSHA course is an acceptable alternative to Field Safety Training.	☐	Specific content and delivery method will depend on the office and the employees' expected work. The Field Safety requirement (every year) continues to apply after the completion of the 10-hr course.

Americas

Incident Reporting, Notifications & Investigation

S3AM-004-PR1

1.0 Purpose and Scope

1.1 To provide direction for timely reporting, notification and investigation of SH&E incidents.

1.2 This procedure applies to all AECOM Americas based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 **Fatality –** Loss of life of any AECOM employee, AECOM subcontractor personnel, client personnel or member of the general public.

2.2 **High Potential Incident (HiPo)** – An incident with potential or actual consequence assessed at a risk rating of 10 (high) or above using the AECOM Risk Matrix.

2.3 **Lost Time Injury/Illness –** A work-related injury or illness that has caused a worker to be absent from work following the day that the injury or illness occurred.

2.4 **Recordable Injury/Illness –** A work-related injury or illness that results in the following. (See *S3AM-017-PR1 Injury & Illness Recordkeeping* for additional information.)

- Fatality;
- Medical treatment beyond first aid;
- Days away from work;
- Restricted work or transfer to another job;
- Loss of consciousness; and/or
- A significant injury or illness as diagnosed by a physician or licensed health care professional; and/or
- Injuries or illnesses determined under criteria established in *S3AM-017-PR1 Injury & Illness Recordkeeping*.

2.5 **Restricted Work** (also called "**Modified Work**") – Occurs when an employee, after the initial day of injury, because of an AECOM work-related injury or illness:

- Is assigned to another job on a temporary basis;
- Works at their permanent job less than full time;
- Works at their permanent job but cannot perform all duties normally performed at least once per week; or
- Performs light duty work at the direction of a Supervisor.

2.6 **SH&E Incidents** – The following events or situations as applied to AECOM employees and/or AECOM-controlled operations are considered SH&E Incidents:

- Any injury or illness to an AECOM employee or subcontractor, even if it does not require medical attention. This would include work-related injuries/illnesses that have become significantly aggravated by the work environment.
- An injury to a member of the public, or clients, occurring on an AECOM-controlled work site.
- Re-occurring conditions such as back pain or cumulative trauma disorders (e.g., carpal tunnel syndrome).
- Fire, explosion, or flash that is not an intended result of a planned event (e.g., remediation process, laboratory procedure).

- Any incident involving company-owned, rented, or leased vehicles (including personal vehicles used for company business).
- Any failure to comply with the requirements of a regulatory permit issued to AECOM.
- Any notice of violation or notice of non-compliance received from a regulatory authority.
- Property damage resulting from any AECOM or subcontractor activity.
- Unexpected release or imminent release of a hazardous material.
- Confirmed or suspected chemical or biological exposure.
- A safety-related complaint from the public regarding AECOM activities.
- SH&E-related incidents that could result in adverse public media interest concerning AECOM or an AECOM project.
- Any inspection by a safety, health, & environmental enforcement agency.

2.7 **Significant SH&E Incident –** Any SH&E incident that meets/involves the following criteria:

- Fatality;
- Amputation;
- Hospitalization for treatment for more than 24 hours (admission);
- Any single event resulting in more than one employee requiring medical treatment or more than one employee being away from work more than three days;
- Any SH&E-related Consent Agreement/Order/Lawsuit or enforcement action seeking more than $10,000 or alleging criminal activity;
- Any spill or release of a hazardous material that is reportable to a regulatory agency;
- Any Notices of Violation resulting from not operating within a regulatory agency permit/license or consent;
- Any incident resulting in property damage expected to exceed $10,000 US dollars;
- Any security-related incident that could have caused significant harm to an AECOM employee; and/or
- Any Near Miss that may have resulted in any of the above but because of “luck” did not happen.

2.8 **Near Miss –** This is defined as an unplanned event involving interaction or contact with a hazard but resulting in no negative outcome - that is it had the potential to cause injury, compromise health, environmental impairment, business interruption, or property damage– but did not. Near Misses should be addressed by reporting and, as applicable, investigation, and implementation of corrective action to minimize recurrence.

2.9 **Security Incident –** Any security related incident that could cause harm to or is associated with an AECOM employee in the course of duty. Refer to Global Resilience Group resources for additional information.

2.10 **SH&E Incident Report (IR) Form** (*S3AM-004-FM1 SH&E Incident Report Form)* **–** Form used to document incidents which shall be completed when there is no internet access to the on-line incident management system (e.g., IndustrySafe). IR’s shall be completed within 4 hours for a Significant Incident and 24 hours for all other SH&E incidents. IR’s should be submitted to the Supervisor and SH&E Manager.

3.0 References

3.1 S3AM-017-PR1 Injury & Illness Recordkeeping

3.2 S3AM-018-PR1 Injury & Claims Management

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 Employee

- In an emergency/life-threatening situation, use the appropriate local emergency phone numbers and seek immediate medical care.
- For work-related non-emergency medical support contact the following immediately, regardless of time of day/day of week.
    - **Construction Services (CS) & Management Services (MS)** – Notify supervisor and SH&E personnel. Upon approval from the supervisor and SH&E personnel, contact the Occupational Health Team using the AECOM-dedicated line at 877-878-9525.
    - **Management Services (MS)** – All Reportable Incidents occurring outside the US should be reported to the MS Occupational Health Director.
    - **Design & Consulting Services (DCS)** – Contact the DCS Incident Reporting Line at 800-348-5046 where information regarding the incident will be collected and if an injury/illness has occurred. If medical support is needed, the employee will be transferred to the Occupational Health Team.
- Immediately notify his/her Supervisor that an incident (including a Near Miss) has occurred, the circumstances involved, the nature and extent of the injuries/illness, and whether medical treatment may be required. Except for emergency situations, affected employees are required to discuss their injury/illness status with their Supervisor and SH&E Manager, and/or project SH&E professional prior to obtaining medical treatment.
- Do not discuss the incident with members of the news media or legal representatives (except AECOM legal counsel or your personal legal advisor) unless directed to do so by AECOM management.
- Do not make statements pertaining to guilt, fault, or liability.
- Incident Reporting - Complete a report within four hours of a Significant Incident and 24 hours for all other SH&E incidents. If injury/illness prevents completing the report, the Supervisor will be responsible for completing the report.
    - **Construction Services (CS) & Management Services (MS)** – Complete *S3AM-004-FM1 SH&E Incident Report Form* and provide to SH&E personnel for entry into AECOM's on-line incident reporting system (e.g., IndustrySafe).
    - **Design & Consulting Services (DCS)** – Complete an electronic incident report in AECOM's on-line incident reporting system (e.g., IndustrySafe). If an employee does not have internet access, a hardcopy *S3AM-004-FM1 SH&E Incident Report Form* shall be completed and submitted to the SH&E Manager.
- Near Miss Reporting - Complete on-line reporting (e.g., IndustrySafe,) within 24 hours of the event occurring.

4.1.2 Supervisor

- In an emergency/life-threatening situation, use the appropriate local emergency phone numbers and seek immediate medical care for the employee.
- Address any immediate corrective actions required to make the scene safe. Consult with the SH&E Manager and management if guidance is required.
- For Significant Incidents immediately contact management up to the Operations Executive and SH&E Manager by phone once the situation has stabilized.
- If an incident occurs on a client-controlled site, management will ensure that appropriate client notifications are made within the required time frames. These notification requirements will be documented in project-specific planning documents.

- Drug and alcohol testing shall be performed in accordance with *S3AM-019-PR1 Substance Abuse Prevention* and the business group drug and alcohol (substance abuse) testing program requirements.
    - More stringent site-specific procedures may apply.
    - Under no circumstances will an employee be premitted to drive to the testing facility, home from the testing facility, or from the workplace once returned from the facility after testing.
- Complete an initial incident notification using on-line incident management system if employee is not capable/incapacitated and any other applicable documentation and attach to the on-line report such as:
    - Police Report
    - Photographs of incident scene
    - Witness statements
    - Federal/State/Province specific forms
    - Timeline
    - Root cause analysis
- Review the incident report or the near-miss report for completeness and accuracy. Ensure the reports are distributed properly.
- Assist with incident evaluation and investigation as directed by management. The preliminary investigation shall be completed within 7 working days of an incident.
- With management, identify cause(s) of the incident and identify corrective actions needed to avoid recurrence.
- Implement corrective actions as directed by management.
- Where there is potential for criminal, civil or regulatory action against AECOM or any of its employees or subcontractors, a representative of AECOM's legal team (typically regional legal counsel) shall be contacted prior to any external communication, correspondence, or meeting concerning any incident, governmental investigation, or environment impact. AECOM's Counsel, or designee, may supplement this policy or require additional measures to protect the best interests of AECOM and its employees.

4.1.3 SH&E Manager

- If required, notify regulatory agencies of the incident (e.g., reporting to OSHA of severe injuries and/or fatalities using the toll free number, or the reporting application located on OSHA's public web site).
- Complete external reporting requirements, if required.
- As appropriate, assist in an incident investigation and review.
- Report all fatalities and/or Significant Incidents to the VP SH&E and Operations Executive immediately by phone if not already notified by the Supervisor.
- Ensure electronic entry of incident information in the on-line incident management system and coach Supervisors and Employees on completing investigations. Be responsible to manage open incidents until closure.
- Enter corrective actions as a result of incident investigation into the on-line incident management system and monitor to completion.

4.2 Incident Investigation

4.2.1 Perform root cause investigations on the following types of incidents:

- A recordable injury or illness of an AECOM or subcontractor employee.

- All high potential incidents ([HiPos] assessed at a risk rating of 10 or above using the AECOM Risk Matrix) including but not limited to:
  - A vehicle incident involving an AECOM employee (while working) where either the employee or a member of the public is hospitalized.
  - Incidents that result in significant adverse public media interest in AECOM or an AECOM project.
  -
  - Damage to Company- or Government-owned equipment that exceeds $25,000, unless otherwise required by a client.
  - A release to the environment of a substance in excess of a mandated reportable quantity, and requiring the response of external response organizations.
  - Any near miss that a SH&E Manager determines—if taken to its logical conclusion—would have resulted in a fatality, multi-day lost-workday case, and/or inpatient hospitalization.
- Any near miss or incident occurring on projects undertaken for specific clients, where AECOM has contractually agreed to participate in safety systems that dictate that all near misses and incidents undergo a root-cause analysis.
- Any incident that the Vice President of SH&E or SH&E Manager deems appropriate for an investigation.

4.2.2 The following actions will be taken to investigate an incident:

- The Manager will notify the responsible SH&E Manager that a recordable incident has occurred.
- The investigation may require that an investigation team be assembled. The team will consist of personnel from operations and SH&E.
- The responsible SH&E Manager may include other appropriate members of management in an investigation team, and may solicit input from AECOM Legal regarding the investigation. The person leading the investigation will be trained in investigation techniques and root-cause analysis.
- If deemed appropriate by the Vice President of SH&E, the responsible SH&E Manager will complete the investigation under the direction of AECOM Legal Counsel and the Vice President of SH&E (or designee).
- Following an incident, immediately determine the sources of evidence. Evidence may include a listing of people, equipment, and materials involved; a recording of environmental factors such as weather, illumination, temperature, noise, ventilation; and physical factors such as fatigue and medical conditions.
- The investigation process will include interviews with those involved or those directly witnessing the event.
- The investigation team lead should ensure that investigation tools are available (e.g., cameras, protective equipment, tape measures, marking devices, etc.).
- Store evidence (e.g., witness statements, photographs, documentation, etc.) that is collected during the investigation in a secured and locked location.
- Investigation teams should avoid reference to specific sites, locations, or involved employees that could compromise personal privacy or business confidentiality, unless doing so is necessary to accurately investigate the incident and develop appropriate corrective and preventative actions.
- If photos are taken, a photo log should be created as the photos are taken during the investigation.
- Prepare an Incident *Investigation Summary (S3AM-004-FM2)* for any investigation within 7 working days of the incident. The Incident Investigation Summary should be uploaded into on-line incident management system.

- Investigation reports will identify the critical factors involved in the incident. Develop direct and contributing causes to identify the root cause(s) of an incident. Investigators will evaluate causes associated with human activities, physical causes, and systems causes. The report will identify corrective actions, and assign a responsible party and due dates.
- *Incident Investigation Report (S3AM-004-FM3)* may be used as a template to prepare a detailed incident investigation report.
- The responsible Manager (or designee) should complete a *Lessons Learned (S3AM-004-FM4)* within 7 working days of the incident.
  - This Lessons Learned shall be forwarded to the SH&E Manager or Vice President of SH&E and after review and approval be distributed to operations. This will then be used for communication to AECOM staff in order to facilitate the communication of lessons learned.
  - The Lessons Learned will contain only basic facts; will be without reference to a site, location, or employee; and will be developed solely for the purpose of conveying lessons learned to prevent a similar incident, illness, or injury.
  - Lessons Learned information should be posted on the Company intranet for other employees to access.

4.2.3 Release of the investigation report outside of AECOM may only be authorized by the business group Vice President of SH&E (or designee). Appropriate information shall be redacted to ensure personal privacy and business confidentiality are maintained.

4.2.4 Following the completion of the incident investigation and development of corrective actions, it is critical that the requirements for preventing a recurrence of the event be implemented prior to re-starting the activity.

4.3 Injury & Claims Management

Refer to *S3AM-018-PR1 Injury & Claims Management* for guidelines to ensure that employees receive appropriate, immediate, and high-quality health care services that will minimize disability and promote rapid recovery.

4.4 Fatalities & Significant Incidents

4.4.1 Immediately notify AECOM management by telephone (or other direct means) in the order listed below for incidents involving an AECOM employee or subcontractor: death, inpatient hospitalization, amputation, burns to a major portion of the body, loss of sight in an eye, or equipment damage valued at more than $100,000 (USD). (Refer to the Business Group reporting procedures for required contacts and notification times.)

- Appropriate senior management for the affected program.
- Business Group Vice President of SH&E.
- Notifications in accordance with the applicable Emergency Response Plan.
- Notifications in accordance with applicable Business Group notification procedures.

4.4.2 The Vice President of SH&E will notify the AECOM Management, Chief Safety Officer and the Vice Presidents of SH&E for the other business groups.

4.4.3 If required, the designated SH&E Manager or site/project (or designee) will notify federal and state/provincial/territorial authorities as appropriate within the required timeframe (usually 8 hours – work-related fatality, 24 hours – severe injury. Please consult jurisdictional requirements).

4.4.4 The Vice President of SH&E in the business group in which the serious incident occurred will direct the investigation. Subject matter experts from other AECOM business groups may be asked to assist in the investigation.

4.4.5 Prepare documentation related to the incident at the direction of AECOM Legal Counsel. Documentation must contain “Privileged and Confidential” and “This document was prepared at the direction of counsel for use in anticipated litigation.”

4.4.6 Route copies of incident reports, medical reports, certificate of death, and other correspondences to the Vice President of SH&E (or designee) and AECOM Legal to maintain privilege.

4.5 Executive Incident Reviews

4.5.1 Executive Incident Reviews shall be conducted in accordance with *S2-001-ATT3 Minimum Global Safety, Health & Environment Requirements*.

5.0 Records

5.1 Incident reports and supporting documentation are maintained in the on-line incident management system.

5.2 If a hardcopy Incident Report is generated it should ultimately be scanned and kept in the on-line incident management system. All incident information must be retained by AECOM. Records relating to occupational injury and incidents must be kept for up to 30 years (or permanently in the Northwest Territories), depending on the classification of incident.

6.0 Attachments

6.1 S3AM-004-FM1 SH&E Incident Report

6.2 S3AM-004-FM2 Incident Investigation Summary

6.3 S3AM-004-FM3 Incident Investigation Report

6.4 S3AM-004-FM4 Safety Alert / Lessons Learned

Americas

SH&E Training Sign-In Sheet

S3AM-003-FM2

Course Name:					
Region:		**District/Area:**			
Business Line:		**Dept #:**			
Office:		**Address:**			
Date:		**Start Time:**		**Stop Time:**	

Certification Level (Check One): **Awareness** ☐ **Performance** ☐ **Competent Person** ☐

Lead Instructor:	**Instructor 1:**	**Instructor 2:**

	Employee Name: (PRINT LEGIBLY)	**Employee Signature**	**Region/Office Company (if not AECOM)**	**Employee ID #:**	**Instructor Initials verifying completion**
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					
16.					
17.					

By my signature I certify that the individual(s) beside whom I have initialled on this roster have

Lead Instructor Signature **Date**

attended and successfully passed the course (assessment).

Americas

Driving

S3AM-005-PR1

1.0 Purpose and Scope

1.1 The purpose of this document is to establish policies and procedures for operation of AECOM-owned, rented, or leased vehicles, client or customer-owned vehicles, and personal vehicles used by AECOM employees.

1.2 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content. Policies and procedures related to the operation of commercial motor vehicles are in addition to this procedure; refer to *S3AM-320-PR1 Commercial Motor Vehicles.*

2.0 Terms and Definitions

2.1 **AECOM Business** – Any activity that is performed in the name of AECOM. This includes, but is not limited to, vehicle travel between work locations, client sites, meeting locations as well as driving performed as a part of work-related travel (e.g., driving to and from airports, hotels, train stations). AECOM business does not include driving that is a part of a daily routine commute from home to an AECOM location.

2.2 **Authorized Driver** – AECOM employees who receive manager approval following evaluation of driver criteria to drive and maintain an AECOM-owned, leased or rented vehicle, a client or customer-owned vehicle, or a personal vehicle operated in the course of conducting AECOM business. Authorized Drivers shall maintain a current driver's license with full privileges applicable to the vehicle to be operated. There are three categories of Authorized Drivers;

- Professional (AECOM employee who operates a commercial motor vehicle. Please refer to *S3AM-320-PR1 Commercial Motor Vehicles*).
- Hired (Employee's specific AECOM role is to drive employees in a normal street vehicle, which may or may not require commercial licensing by the applicable authorities. This category does not include busses or vans with a capacity of more than 12 people.).
- General (Driving is required as a part of the employee's job duties. This includes driving AECOM-owned, leased, or rented vehicles, client or customer-owned vehicles, or personal vehicles on AECOM business).

2.3 **Collision** – Any incident in which a motor vehicle that (whether in motion, temporarily stopped, or parked) makes contact with another vehicle or pedestrian, or results in property damage and/or bodily injury, regardless of who was injured, what property was damaged, or who was responsible.

2.4 **Commercial Motor Vehicle (CMV)** – Any self-propelled or towed motor vehicle used for AECOM business (e.g., to transport passengers or property) when the vehicle is one of the following:

- Has a gross vehicle weight rating (GVWR) or gross combination weight rating equal to or greater than the weight specified by the applicable jurisdiction (e.g.,U.S. $\geq$ 10,001 pounds [4,536 kilograms]); or
- Is designed or used to transport more than the number of passengers specified by the applicable jurisdiction, including the driver, for compensation; or
- Is designed or used to transport more than the number of passengers specified by the applicable jurisdiction, including the driver, and is not used to transport passengers for compensation; or
- Is used in transporting hazardous material in quantities ≥ 1,001 pounds (454 kilograms) combined total weight at any time.
- Refer to *S3AM-320-PR1 Commercial Motor Vehicles* for additional information.

2.5 **Distracted Driving** – An activity that takes the driver's attention away from the primary task of driving.

2.6 **Driving Under the Influence (DUI)/Driving While Intoxicated (DWI)** – The operation of a vehicle while under the influence of alcohol, drugs, medications, or other substances capable of inducing an altered mental state and/or impairing physical and mental judgments, such that the influence of the substances produces impairment in violation of the applicable governmental laws.

2.7 **Fatigue** – A general term used to describe the experience of being "sleepy", "tired" or "exhausted". The effect of fatigue is both physiological and psychological and can severely impair a driver's judgement. Fatigue can cause lapses in concentration which could prove fatal. Fatigue is not just a problem for drivers on long trips, as drivers can also suffer from fatigue on short trips.

2.8 **Incident** – For the purposes of this procedure, a vehicle collision or other event where personal injury or property damage occurs, or where a citation is issued while the employee is on AECOM business. This may also include acts of theft, vandalism, and criminal mischief.

2.9 **Journey Management** – A process for planning and executing necessary journeys safely.

2.10 **Local Laws** – Signs, postings, laws, regulations, ordinances and codes applicable for the jurisdiction in which the motor vehicle is being operated.

2.11 **Motor Vehicle Report (MVR) / Driver's Abstract** – A listing of the tickets (violations), incidents collision for an individual driver over a period of time (e.g., 3 years, 5 years) provided by a state or provincial authority such as the Department of Motor Vehicles.

2.12 **Personal Vehicle** – A motorized vehicle owned or leased by an employee.

2.13 **Portable Electronic Device** – A mobile electronic device that is used to receive or communicate voice, email, internet, and/or public media. The device requires user interaction (typing, dialing, reading, keying, etc.) that distracts the motor vehicle operator. Example devices include, but are not limited to:

- Mobile Communication Devices (MCD)
  - Mobile/Cellular phones
  - Two-way Radios
- Personal Data Assistant (PDA)
- iPads, iPods, or other tablet models
- Computers
- Global Positioning System (GPS) receivers

2.14 **Spotters –** Extra personnel that may provide guidance when maneuvering in close and/or complex situations in order to avoid the occurrence of an incident.

2.15 **Task Hazard Analysis (THA)** – A tool for evaluating work activities for the purpose of:

- Identifying the SH&E hazards and risks associated with the activity being performed;
- Identifying and implementing control measures to eliminate or reduce hazards and risks; and,
- Evaluating the effectiveness of control measures and making modifications as needed.

3.0 References

3.1 AECOM Global Travel Policy

3.2 RS2-001-PR Firearms Standard

3.3 S3AM-003-PR1 SH&E Training

3.4 S3AM-004-PR1 Incident Reporting, Notifications & Investigation

3.5 S3AM-009-PR1 Fatigue Management

3.6 S3AM-010-PR1 Emergency Response Planning

3.7 S3AM-209-PR1 Risk Assessment & Management

3.8 S3AM-314-PR1 Working Alone

3.9 S3AM-319-PR1 All-Terrain Vehicles

3.10 S3AM-320-PR1 Commercial Motor Vehicles

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager / Supervisor**

- Confirming employees are informed of the provisions of this procedure and related vehicle procedures.
- Providing a copy of this procedure to an employee who will be driving an AECOM-owned, leased or personal vehicle for AECOM business.
- Allowing employees to designate time to complete required driving safety training, vehicle inspections and related activities.
- Assigning driving tasks to authorized employees only.
- Selecting and providing vehicles for use by authorized employees that are appropriate for the planned working conditions and environment.
- Supporting employees in the reporting of vehicle incidents per *S3AM-004-PR1 Incident Reporting, Notifications & Investigations,* including the entry of the incident into the on-line incident management system (e.g., IndustrySafe).
- Confirm notification of AECOM Human Resources and Counsel upon receipt by an employee of a legal summons associated with a moving violation related to the use of a company vehicle.

4.1.2 **Employee**

- Follow this procedure and applicable laws while operating a vehicle.
- Complete assigned driver safety training based on the training matrix and any additional training assessments developed at the business group. Refer to *S3AM-003-PR1 SH&E Training, including S3AM-003-FM1 SH&E Training Matrix.*
- Report to the Manager / Supervisor if the vehicle selected is not appropriate for the working conditions and environment.
- Report to the Manager / Supervisor if the employee is inexperienced in operating the type of vehicle assigned.
- Report to the Manager / Supervisor if the employee is inexperienced in driving in the type of working conditions and environment assigned.
- Review the completed Task Hazard Assessment and complete journey management. If required, document the Journey Management Plan using *S3AM-005-FM1 Journey Management Plan* or equivalent.
- Immediately report vehicle incidents per *S3AM-004-PR1 Incident Reporting, Notifications & Investigations*, including the entry of the incident into the on-line incident management system (e.g., IndustrySafe).
- Notify the appropriate Manager / Supervisor and SH&E Manager upon receipt of a legal summons associated with a moving violation related to the use of a company vehicle.
- Immediately report a change or limitation(s) to his/her Driver's License to the appropriate AECOM Human Resources representative or his/her Manager / Supervisor.

- Conducting a pre-operational inspection of the vehicle for damage or deficiencies and reporting discovered deficiencies affecting the safe operation of the motor vehicle to the appropriate authority (e.g., supervisor, rental car agency, etc.).

4.1.3 **SH&E Manager**

- Maintaining and updating training resources for vehicle and driver safety.
- Providing guidance.
- Assisting operational leaders with determining the risk incurred by the use of motor vehicles.
- Assist in the incident investigation and review process.

4.2 General Procedures and Practices

4.2.1 Only Authorized Drivers are to operate a motor vehicle (rental, personal, client or customer-owned, or AECOM-owned/leased) while on AECOM business.

4.2.2 Drivers must comply with *AECOM's Global Travel Policy* and applicable laws, and employ safe driving practices. (NOTE: *Individual state, provincial, and local laws vary*.) Refer to *S3AM-005-ATT1 Authorized Driver Safety Practices*.

4.2.3 Authorized Drivers shall confirm their operating license is on their person, and valid registration and insurance is maintained with the respective vehicle prior to operation.

4.2.4 All local laws including, signs, postings, regulations, ordinances, and codes applicable for the jurisdiction in which the motor vehicle is being operated shall be adhered to.

4.2.5 At-risk driving behavior by AECOM employees shall be identified and managed accordingly.

4.2.6 Authorized Drivers must be at least 18 years of age (noncommercial license) or 21 years of age (commercial license) and have a current driver's license for the appropriate class of vehicle (unless more stringent requirements are established by the leasing/renting agency). Employees with conditional licenses are prohibited from operating vehicles on AECOM business.

4.2.7 If an Authorized Driver receives a citation resulting in their license being suspended, has his/her driver's license revoked, or is otherwise unauthorized to drive, he/she shall notify the appropriate AECOM Human Resources representative or his/her Manager prior to start of the following work day. Failure to do this may result in disciplinary action up to and including termination.

4.2.8 The office to which the vehicles are registered is liable for any damages to the vehicle being operated by an Authorized Driver.

4.2.9 Seat belts are to be worn by the occupants. The number of passengers shall not exceed the manufacturer's specifications for the vehicle.

4.2.10 The vehicle may not move until all passengers have fastened their restraints in the proper manner (e.g., lap belt secured and shoulder harness placed over the shoulder). Vehicles are not to be operated or used by AECOM employees if seatbelts are not included as part of the vehicle's safety equipment.

4.2.11 The vehicle's engine is to be turned off during refueling. Smoking or cellular phone use is not allowed while refueling.

4.2.12 Motorcycles may not be operated on AECOM business unless the following requirements are met:

- Specific approval is provided by the Supervisor with concurrence from the SH&E Manager.
- A hazard analysis is completed.
- Required training and license is in place.
- Headlights or daytime running lights will be used when the vehicle is in operation.
- A Class 2 or 3 safety vest and appropriate helmet shall be worn while operating a motorcycle.

4.2.13 When practical, drivers should travel during daylight hours and avoid driving during adverse weather conditions. Drivers should also inform colleagues of their travel itinerary including destination and anticipated departure and arrival times.

4.2.14 Fire arms and weapons are not permitted in AECOM-owned, leased or rented vehicles insured by AECOM. Firearms and weapons in personal vehicles are subject to the laws and regulations of the respective local, provincial, state, territory, federal and region and/or country. Refer to the *RS2-001-PR1 Firearms Standard*.

- Exceptions to this standard may exist where there is a credible and demonstrated risk to AECOM employees or assets, or when knives or weapons are required as part of the work activity. Under such circumstances, the exception must be approved by the Chief Resilience Officer, and must strictly adhere to the procedures set forth by the Global Resilience Group.

4.2.15 Vehicles are to be selected based on the nature of planned use. In some working conditions, specialized vehicles, such as four-wheel drive and higher clearance vehicle, may be required to confirm safe travel. These specialized vehicle requirements/specifications shall be identified in the project specific SH&E Plan and/or THA.

4.2.16 Vehicles are to be maintained according to manufacturer's specifications and the applicable environmental and operating factors (e.g. winterized with appropriate fluids, winter tires installed, appropriate coolant for hot climates, etc.).

4.2.17 Vehicles are to be outfitted with the appropriate support equipment based on the THA or client vehicle specifications. Support equipment may include, but is not limited to, cones, rotating warning lights, warning flags, vehicle identification (magnetic door signs or similar), wheel chocks, cargo nets, and rollover protection.

4.2.18 Drivers are to operate vehicles in a manner that avoids situations where backing is necessary. Whenever possible and as permitted, reverse parking of all vehicles while on business is required. A spotter shall be used when backing of trucks and heavy equipment presents a risk of collision.

4.2.19 Non-AECOM drivers (those other than AECOM employees [e.g., subcontractors, joint venture partners, clients, etc.]) are prohibited from operating an AECOM company owned, leased or rented vehicle unless the activity is specifically agreed to in the applicable contract and only if the use of the vehicle is consistent with the terms of the contract.

4.2.20 Authorized drivers required to operate vehicles with special hazards (e.g., trucks carrying fuel cells, vehicles used to tow trailers, vehicles with limited visibility, etc.) will be thoroughly briefed on the hazards and control measures necessary for safe operation of the vehicle. The local AECOM operation will maintain documentation of the briefing.

4.2.21 Define specific vehicle travel routes and parking areas at field sites through the use of fencing, cones, or other markings.

4.2.22 When a vehicle will be left unattended without an authorized driver in the driver's seat, the vehicle must be turned off, placed into park (or gear for manual transmissions), and the emergency brake set. When parked on a grade, the wheels or tracks of mobile equipment shall be either chocked or turned into a bank.

4.3 Distracted Driving

4.3.1 Distractions while driving are a major cause of incidents. Distractions include the use of cellular phones (including texting), eating, drinking, smoking, and engaging in intense conversations. AECOM Authorized Drivers must exercise proper control of the vehicle at all times, including the management of possibly distracting actions and behaviors.

4.3.2 The use of portable electronic devices that may distract the driver while driving is prohibited. This includes cell phones, two-way radios and other items whether hand-held or hands-free. Electronic devices include, but are not limited to, all mobile phones pagers, iPods, MP3s, GPS units, DVD players, tablets laptops and other portable electronic devices that can cause driver distraction.

- Employees shall not use a personal or company mobile communication devices (MCD) while driving any vehicle on AECOM business.
- Employees shall not use a company MCD while driving a personal vehicle.
- Driving includes the time spent in traffic or while stopped at red lights or stop signs.

4.3.3 GPS units and devices (e.g., smart phones, tablets) used for navigation may only be used if factory installed or secured to the vehicle with a bracket that allows the driver to view the image without having to take their eyes off the road. Note: windshield mounting brackets are not permitted in many jurisdictions, with dashboard mounts being acceptable. Consult jurisdictional requirements.

4.3.4 Electronic devices shall be setup for operation prior to commencing driving activities and shall not be changed by the driver while driving.

4.4 Impairment

4.4.1 Impairment can take many forms ranging from fatigue, to the use of prescription medication or alcohol (even small amounts), to the abuse use of illegal and legal drugs and alcohol. AECOM employees shall not drive in an impaired condition.

4.4.2 AECOM employees are prohibited from being under the influence of alcohol or drugs or improperly using medication in a way that could diminish, or raise questions concerning, an employee's ability to perform at his or her best while performing services for or on behalf of AECOM. Operation of vehicles while under the influence may void insurance coverage.

4.4.3 Drivers/operators will not drive or operate vehicles while under the influence of medications when told by a physician, another healthcare provider, or the manufacturer (e.g., instructions on the label) the medication could render the activity unsafe.

4.4.4 AECOM employees are prohibited from operating a vehicle if they are experiencing signs and symptoms of fatigue. Employees should stop work and rest before driving. No employee should operate a vehicle if they have worked 14 consecutive hours within a 24 hour period. Refer to *S3AM-009-PR1 Fatigue Management*.

4.5 Journey Management

4.5.1 When practical, alternatives to road travel should be evaluated including teleconferencing/video conferencing, the use of public transportation or carpooling.

4.5.2 Journey management is a process for planning and executing necessary journeys safely and may or may not be documented. Review the completed THA and complete the journey management process. If required, document a Journey Management Plan (JMP) using *S3AM-005-FM1 Journey Management Plan* or equivalent. The journey management process includes the following steps:

- Determining if the trip is necessary.
- Evaluating alternative safer modes of transport.
- Evaluating the potential to combine journeys with others.
- Planning the trip.
- Select the safest and most efficient route. Confirm compliance with any site specific specified routes, route rules, or restrictions.
- Confirm route planning factors in fatigue management. Refer to *S3AM-009-PR1 Fatigue Management*.
- Review road conditions and potential hazards associated with the route.
- Review weather conditions and forecast.
- If applicable, review *S3AM-314-PR1 Working Alone*.
- Confirm Emergency Response Plan includes procedures to be taken in the event of a collision or vehicle incident.
- Allow for adequate travel time.
- Inform others of destination, estimated time of arrival and routing.

4.5.3 Drivers who are to undertake trips in excess of 250 miles (400 km) each way, drive in remote or hazardous areas, or when otherwise deemed necessary, shall develop and document a JMP. This plan typically includes the route, location of route hazards, timing, rest periods and locations, communications, emergency response and security arrangements.

4.5.4 Drivers are responsible for developing the JMP and coordinating with the applicable parties identified in the plan.

4.6 Driver Safety Training

Authorized drivers shall have a current driver's license for the appropriate class of vehicle (unless more stringent requirements are established by the leasing/renting agency).

Driver safety training is to be assigned based on the risks posed with the work environment, driver type and vehicle type, using the training matrix and any additional training assessments developed at the business group level. Refer to *S3AM-003-PR1 SH&E Training, including S3AM-003-FM1 SH&E Training Matrix*. A determination of training type is at the discretion of the Manager / Supervisor, with the following guidance applied.

4.6.1 All Authorized Drivers (Professional, Hired, and General Drivers) shall be trained in this procedure; *S3AM-005-PR1 Driving*.

4.6.2 All Authorized Professional Drivers shall be trained in *S3AM-320-PR1 Commercial Motor Vehicles.*

4.6.3 Vehicle / Driver Safety Training

- Recommended for all employees who drive on behalf of AECOM (Professional, Hired and General Drivers).
- This may be completed online (e.g., AECOM University – Driver Safety).
- Recommended to be completed within 1 month of the Authorized Driver's hire date.

4.6.4 Defensive Driver (online) Training

- Recommended for all Authorized Drivers (Professional, Hired, and General Drivers) who are assigned an AECOM company owned, leased or rented vehicle for a significant period of time with the expectation that the employee utilizes the vehicle on a regular basis for AECOM business.
- It is recommended that authorized drivers who have completed web-based defensive driver training or equivalent also complete a refresher every three years.
- Defensive Driver training is available online through AECOM University (e.g., Alert Driving Basic, Alert Driving Skills) or one of the following AECOM-approved training resources:
  - The National Safety Council
  - Alert Driving

4.6.5 Defensive Driver (hands-on) Training

- Recommended for all Authorized Professional Drivers and Authorized Hired Drivers.
- Recommended for Authorized General Drivers who drive in remote locations, hazardous environments (such as refineries, ports, terminals etc.), at-risk drivers, and when required by clients.
- Defensive Driver hands-on training is provided through an AECOM-approved training resource, such as Smith Systems.
- Hands on defensive driver training may be required as a result of an incident or negative Motor Vehicle Report.

4.6.6 Driver Retraining

- Drivers involved in repeated motor vehicle incidents, incidents of sufficient severity or concern, or drivers identified as at-risk through review of their Motor Vehicle Report/Driver Abstract may

be retrained or, as applicable, subject to disciplinary action and refused the right to drive on behalf of AECOM.

- Retraining programs will be implemented at the discretion of the Supervisor and SH&E Manager.
- Employees eligible to continue driving shall be subject to a driver retraining program that may include any of the above programs or other training programs appropriate for the type of driving the employees performs.

4.6.7 Special Vehicles and Driving Conditions

- Vehicles such as All-Terrain Vehicles (ATVs), four wheel drive vehicles, motorized carts, snowmobiles, box vans and trailers (towing) require specialized training and supervision. For ATVs, Refer to *S3AM-319-PR1 All-Terrain Vehicles* for additional information.
- Use of these types of vehicles is limited to AECOM projects, therefore training and qualification programs for drivers will be project specific. The Manager / Supervisor shall work with the SH&E Manager to tailor training to the specific needs of the project.

4.7 Personal Vehicles (additional requirements)

4.7.1 The requirements of this procedure apply to the use of a personal vehicle for AECOM business. Additional requirements are set forth in the *AECOM Global Travel Policy*.

4.7.2 Personal vehicles driven by Authorized Drivers for business use must satisfy the jurisdiction's registration and inspection requirements and may not be modified beyond manufacturer's specifications.

4.8 Rental Vehicles (additional requirements)

4.8.1 The requirements of this procedure apply to the use of a rental vehicle for AECOM business. Additional requirements are set forth in the *AECOM Global Travel Policy*.

4.9 Requirements for Authorized Drivers

4.9.1 Review the *S3AM-005-ATT1 Authorized Driver Safety Practices* for specifics.

4.9.2 Drivers are not to permit unauthorized persons to operate an AECOM-owned/leased/rented vehicle.

4.9.3 All Authorized Drivers shall perform a walk-around inspection of the vehicle prior to operation.

4.9.4 Pre-operation vehicle inspections shall be performed and documented by all Authorized Professional Drivers and all Authorized Hired Drivers. A sample vehicle inspection checklist is provided in *S3AM-005-FM2 Vehicle Inspection Checklist*.

4.9.5 Vehicles with deficiencies that affect or could potentially affect the safe operation of the vehicle shall be removed from service and promptly repaired as necessary to permit safe vehicle operation.

4.9.6 As applicable, arrange for and/or coordinate with appropriate AECOM personnel to facilitate preventive maintenance services for the vehicle. Maintain it in sound mechanical condition, as per the manufacturer's recommendations provided in the owner's manual.

4.9.7 Do not operate the vehicle if unsafe maintenance conditions exist that would likely result in vehicle damage or personal injury. This applies to vehicles owned or leased by AECOM and to personally-owned vehicles used for AECOM business. Escalate other maintenance issues for correction to appropriate authority (e.g., manager, rental car agency, supervisor, etc.).

4.9.8 Transport only persons on AECOM related business or those persons receiving transportation as a prescribed service. Only drive vehicles in conditions for which the driver has the appropriate training and experience.

4.9.9 AECOM-owned, rented, or leased vehicles are for official business use only and are not to be used for personal activities. Exceptions to this requirement can be made only with the specific written approval of the Manager of the office or location the vehicle is registered to.

4.9.10 Smoking (including the use of e-cigarettes) and chewing tobacco is not permitted in AECOM-owned, leased or rented vehicles.

4.9.11 Drivers are responsible for damage caused by abuse of the vehicle.

4.9.12 Secure the vehicle when left unattended.

4.9.13 Securing loads in the inside and outside compartments of the vehicle.

- Do not rely on weight/shape of load alone. Always use a cargo net, straps, containers or other mechanical device when necessary to confirm load is secure.
- Mark loads that extend the beyond the end of truck, trailer or similar edge with a red warning flag of at least 16 square inches.
- Red lights will be utilized at night to mark loads that extend the beyond the end of truck, trailer or similar edge.

4.9.14 Do not modify existing equipment (warning sounds, backing alarms etc.) or install aftermarket equipment including toolboxes, truck caps, specialty lights, or towing equipment) without approval from the Manager of the office or location the vehicle is registered to and AECOM Procurement Department.

4.10 Emergency Preparedness

4.10.1 AECOM-owned or leased vehicles are to have a “Safety Kit” that contains a first-aid kit, portable fire extinguisher, safety triangle, and two reflective safety vests. If not available, contact the Manager / Supervisor or SH&E Manager to determine how to obtain a kit.

4.10.2 The following suggested items should be kept in vehicles used for AECOM business in remote project locations:

- First aid kit, appropriate to the work and crew size, or per regulations.
- Fire extinguisher, safety triangle, and safety vest.
- Emergency equipment (e.g., flares, flashlight, blanket, drinking water, etc.) based on conditions.
- Means of communication (cell phone, radio or satellite phone), extra batteries or a charger.

4.10.3 To the extent possible, employees should refrain from changing tires or making repairs to vehicles in the field.

- A road side assistance service should be identified for vehicles used for AECOM business in advance travel.
- If changing tires or making repairs to vehicles is necessary in the field, assessment of hazards shall be completed and all applicable safe procedures and manufacturer’s specifications shall be followed.

4.10.4 Specific emergency procedures are to be identified in the applicable Emergency Response Plan, JMP or the THA. Refer to *S3AM-010-PR1 Emergency Response Planning*.

4.11 Vehicle Incidents

4.11.1 Vehicle incidents are to be reported and managed in accordance with *S3AM-004-PR1 Incident Reporting, Notifications and Investigation* regardless of how minor the incident might be.

4.11.2 The Employee(s) involved in a collision shall follow the below guidelines:

- Assess the situation to confirm everyone is safe, and remove any vehicle occupants from harm’s way. Call, or have someone else call 911 immediately, if necessary.
- As appropriate, remain at the scene of a collision to contact the police. Ask another motorist to call the police if necessary; never leave the scene of a collision.

- As applicable, provide (if requested) to police and the other driver(s) the liability insurance information. Obtain the officer's jurisdiction, name, and badge number and a copy of the police report.
- As applicable, consider moving the vehicle out of the traffic flow if it is safe to do so, the vehicle is operational, and/or no further damage to the vehicle can occur.
- Do not operate a damaged vehicle if its safety is questionable, its operating condition is illegal by applicable laws or its condition is such that further damage would likely result from its operation.
- Turn on the vehicle's flashers to warn other motorists.
- Obtain:
  - Names, phone numbers, and addresses of owner(s), driver(s), and occupants of the other car(s) involved.
  - Other party's insurance company's name, address, phone number, policy number, and insurance agent.
  - Names, phone numbers, and addresses of all witnesses.
  - Photographs of the accident scene when safe to do so.
- Cooperate with AECOM Counsel if the incident results in unresolved risks or third party claims, or if the employee receives a summons, complaint or other legal documents relating to a traffic incident.
- DO NOT ADMIT LIABILITY, AGREE TO PAY FOR DAMAGE OR SIGN A DOCUMENT RELATED TO AN INCIDENT EXCEPT AS REQUIRED BY LAW.
  - Statements made in haste or anger may be legally damaging.
  - If contacted by a third party, do not answer any questions. Immediately report this contact to the Manager / Supervisor and/or Legal Counsel
- Employees shall report the incident to AECOM's Global Travel Department. If the incident involved a third party, the driver is responsible for obtaining a copy of the police report and providing to global travel

4.11.3 Employees must cooperate with the incident investigation team during any investigation of an incident meeting the investigation protocol.

4.11.4 Vehicle repairs shall be conducted at the authorization of the Manager / Supervisor.

4.12 Drug and Alcohol Testing

4.12.1 Testing for Alcohol and/or Drugs procedures shall be administered in accordance with the applicable policy and procedures. Refer to *S3AM-019-PR1 Substance Abuse Prevention.*

4.12.2 In the event that a police/regulatory officer responding to a vehicle incident administers field and/or laboratory impairment testing AECOM reserves the right, as permitted, to obtain copies of such testing results for inclusion in the incident report and consideration in a subsequent incident investigation.

4.13 Driving Privileges, Citations and Violations

4.13.1 A violation of this vehicle safety standard is subject review by the appropriate AECOM Human Resources representative and may be subject to disciplinary action, up to and including termination. The applicable Manager / Supervisor will review all incidents involving AECOM-owned, rented, or leased vehicles.

4.13.2 Citations and violations which occur while driving for AECOM business are to be reported as a vehicle incident in accordance with *S3AM-004-PR1 Incident Reporting, Notification & Investigation* within 24-hours. Incidents will be investigated as appropriate.

4.13.3 The AECOM Manager responsible for the employee, in consultation with the appropriate AECOM Human Resources representative, may suspend the privilege to operate vehicles on AECOM business due to noncompliance with the AECOM Vehicle and Driver Safety Program, involvement

in a motor vehicle incident, or resulting citations or other legal actions associated with motor vehicle violations.

4.13.4 The employee's driving privileges will be suspended for any of the following:

- Accidents or legal action involving alcohol or drug use (e.g., driving under the influence).
- Driving without a license.
- Hit-and-run driving or leaving the scene of an accident.
- Unauthorized use of AECOM vehicles (e.g., using an AECOM vehicle for moving personal items, carrying passengers who are not associated with work activities, etc.).

4.13.5 The employee's driving privileges may be suspended for any of the following:

- Two or more at-fault accidents involving the same Authorized Driver within a 12-month period.
- Multiple complaints from other employees or members of the public about driving performance.
- Any accident caused by an AECOM Authorized Driver where damages exceed $2,500.
- Failure to comply with the distracted driving requirements.
- Gross misconduct or violation of policy.

4.13.6 An Authorized Driver's driving privileges may be reinstated as follows:

- For any suspension resulting from law enforcement agency legal action involving drugs and alcohol on the part of the former Authorized Driver, driving privileges may be reinstated only by concurrent agreement of the Vice President of SH&E for the applicable Business Group and Human Resources Manager.
- For those Authorized Driver's privilege suspensions that are not related to driving under the influence of drugs or alcohol, privileges may be reinstated with concurrent agreement by the AECOM Manager, the SH&E Manager, and Human Resources Manager upon completion of required remedial training.

4.13.7 Disciplinary action may include the following:

- Loss of AECOM driving privileges.
- Disciplinary warning.
- Termination.

4.13.8 The employee is personally responsible for payment of fines for moving violations and parking citations incurred while driving a vehicle on AECOM business and for reporting such incidents to his/her Manager / Supervisor. The Manager is responsible for notifying Counsel.

4.13.9 If an Authorized Driver receives a citation resulting in the license being suspended from driving or has his/her driver's license revoked, he/she is required to notify his/her Manager / Supervisor prior to start of the following work day. Failure to do so may result in disciplinary action up to and including termination.

5.0 Records

5.1 Documentation of employee training completed shall be retained in accordance with *S3AM-003-PR1 SH&E Training*.

5.2 As applicable, completed *S3AM-005-FM2 Vehicle Inspection Checklists* and/or *S3AM-005-FM1 Journey Management Plans* shall be retained in project files.

6.0 Attachments

6.1 S3AM-005-ATT1 Authorized Driver Safety

6.2 S3AM-005-FM1 Journey Management Plan

6.3 S3AM-005-FM2 Vehicle Inspection Checklist

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Journey Management Plan

S3AM-005-FM1

Project:	Journey Management Plan Identifier # (optional):
Project Specific Requirements:	
Journey Management Plan – Minimum – required for trips > 250 miles / 400 kilometers (one way) and as identified in the project specific requirements.	
1. Driver and Passenger Information	
Driver Name:	Driver Training Completed:
Passengers:	
2. Vehicle Information	
Company Owned ☐ / Rental / Leased ☐ / Personal ☐	
Vehicle Type/Description/Registration No.:	
3. Trip Information	
What is the purpose of the trip?	Estimated distance:
Single Trip: ☐ Reoccurring Trip: ☐ / / to / /	
This Journey Management Plan is to be assessed and reviewed prior to each trip.	
Have alternate modes of travel (telepresence, public transportation, air, train) been evaluated? ☐ Yes ☐ No	
Has a Safe Work Plan or Task Hazard Assessment been completed and attached? ☐ Yes ☐ No ☐ NA	

Destination 1:			
Departure Date:	Time:	Arrival Date:	Time (ETA):
Destination 2:			
Departure Date:	Time:	Arrival Date:	Time (ETA):
Destination 3:			
Departure Date:	Time:	Arrival Date:	Time (ETA):
Destination 4:			
Departure Date:	Time:	Arrival Date:	Time (ETA):

4. Special Conditions / Hazards (Check all that may apply)	
☐ Night Driving ☐ Weather ☐ Road Conditions (e.g., construction, ice, snow) ☐ Rush Hour/Heavy Traffic ☐ Long Driving / Fatigue (Over 2 hours) ☐ Potential for distraction	☐ Rugged Terrain (4 x 4 ☐ Large Vehicles ☐ Animals ☐ Towing (e.g., trailer) Other
Additional Conditions / Hazards Details:	
Weather forecast:	

5. Contact Information	
Traveler No. 1 (Driver) - Name:	Phone No:
Traveler No. 1 (Driver) - Personal Contact Name:	Phone No:
Traveler No. 2 - Name:	Phone No:
Traveler No. 2 - Personal Contact Name:	Phone No:

Traveler No. 3 - Name:		Phone No:
Traveler No. 3 - Personal Contact Name:		Phone No:
Manager - Name:		Phone No:
Check-In Contact - Name:		Phone No:
Alternate Check-In Contact - Name:		Phone No:
Destination Contact (if applicable) - Name:		Phone No:
Other (description)	Name:	Phone No:
Other (description)	Name:	Phone No:

6. Route of Travel

Route of travel (insert map or give detailed route directions):

Is the return route of travel the same? ☐ Yes ☐ No

7. Check-In Procedure

- Check-In Interval -
- Advise Manager and any other applicable personnel of travel plans and supply with a copy of this form (including attachments)
- Confirm availability of Manager or Check-In Contact. Confirm check-in interval with Manager or Check-In Contact.
- Discuss with contacts the possibility of travel within a cell phone “dead zone”.
- Advise Manager or Check-In Contact of departure.
- Call Manager or Check-In Contact upon arrival at destination (e.g. worksite, office, home).
- If multiple destinations, the process is repeated.

7.A Missed Check-In Procedure for Manager

- Attempt to call traveler(s) using contact number(s) listed above.
- Contact traveler’s personal contact listed above.
- If unsuccessful, discuss options with Manager, Check-In Contact (is anyone nearby who can be sent out along the route to destination, how much daylight remains, etc.?).
- Call 911 or local police.

8. Emergency Planning

AECOM Supervisor	Name:	Phone Number:
AECOM Manager	Name:	Phone Number:
Roadside Service:		
Emergency: 911 or equivalent	Incident Reporting:	

9. Approvals: All Journey Management Plans shall be reviewed and acknowledged by the driver and the driver’s manager / supervisor. Copies of the form shall remain with the driver and the manager / supervisor for the duration of the journey. (Electronic copies are acceptable).

Driver’s Signature:

Manager or Supervisor	Name:	Signature:

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Vehicle Inspection Checklist

S3AM-005-FM2

Vehicle Tag No:	Mileage:	Date:	Time:	Driver Name:	Location:

Inspection Checklist: This Pre-Trip Vehicle Inspection Checklist is intended to be completed by the vehicle driver prior to departing on a trip. Checking boxes means that item is present and functioning. Deficiencies that affect or could potentially affect the safe operation of the vehicle shall be repaired or corrected prior to departure. This checklist should only be used in addition to an on-going vehicle maintenance program.

Item	Yes	No	N/A
1. General			
1-1 Proof of insurance and registration available and current?	☐	☐	☐
1-2 Is the date of the last regular maintenance known, or is the mileage/date of next scheduled maintenance known?	☐	☐	☐
1-3 Is the overall condition of the vehicle good (no body damage, unusual sounds, leaks, odors, etc.)?	☐	☐	☐
2. Tires			
2-1 Do all tires have sufficient tread for driving conditions? Legal limit: 2/32" (for rain/snow: > 4/32")	☐	☐	☐
2-2 Are tires sufficiently inflated for driving conditions?	☐	☐	☐
2-3 Are the lug nuts and stem caps present and tight for each tire?	☐	☐	☐
2-4 Is the spare tire and jack present and in good condition?	☐	☐	☐
3. Vehicle Interior			
3-1 Are the brake and accelerator pedal pads in good condition?	☐	☐	☐
3-2 Are the floor mats in good condition and not interfering with the brake or accelerator pedals?	☐	☐	☐
3-3 Is the seat properly adjusted (including the headrest)?	☐	☐	☐
3-4 Is the seatbelt in good condition?	☐	☐	☐
3-5 Are the mirrors in good condition (not broken, dirty)?	☐	☐	☐
3-6 Are the dashboard/instrument lights working?	☐	☐	☐
3-7 Is the dashboard free of warning lights and do the gauges appear to work when the car is started?	☐	☐	☐
3-8 Does the horn work?	☐	☐	☐
3-9 Are distractions such as cell phones and GPS units secured so they do not encourage use?	☐	☐	☐
4. Lights and Signals			
4-1 Do the headlights and high beams work?	☐	☐	☐
4-2 Do the tail lights function properly?	☐	☐	☐
4-3 Do the turn signals work (front and rear)?	☐	☐	☐
4-4 Do the brake lights work (including high light in the rear window if applicable)?	☐	☐	☐
4-5 Do the hazard lights (emergency flashers) work?	☐	☐	☐
4-6 Do back up / reverse lights work?	☐	☐	☐
4-7 If equipped with a back-up alarm can it be heard clearly?	☐	☐	☐
5. Mechanical			
5-1 Do the brakes work and feel solid (not soft)?	☐	☐	☐
5-2 Does the parking/emergency brake work?	☐	☐	☐
5-3 Is the steering in good working condition (not loose)?	☐	☐	☐
5-4 Is the engine oil level full or in the operating zone?	☐	☐	☐
5-5 Excessive vehicle bounce going over bumps reported (possible sign of worn shock absorbers)?	☐	☐	☐
5-4 Is the fuel level full or at an adequate level for the proposed usage?	☐	☐	☐

Item	Yes	No	N/A
6. Windows and Windshield			
6-1 Is the windshield clean and unbroken?	☐	☐	☐
6-2 Are the wiper blades in good condition (front and rear)?	☐	☐	☐
6-3 Are all the windows clean and unbroken and windshield fluid available and operational?	☐	☐	☐
7. Emergency Equipment (as needed per conditions/project requirements)			
7-1 Is there a “Safety Kit” (fire extinguisher, first aid, safety triangle and 2 reflective vests)?	☐	☐	☐
7-2 Is there a first aid kit, has it been inspected recently?	☐	☐	☐
7-3 Is survival gear and equipment available (blanket, water, heat source, flashlight, etc.)?	☐	☐	☐
7-4 Is a means for emergency communication available?	☐	☐	☐
8. Other Equipment (as needed per conditions/project requirements)			
8-1 Is there a means to secured loads (cargo next, container)?	☐	☐	☐
8-2 Are cones or other warning devices available?	☐	☐	☐
8-3 Is weather specific equipment (snow chains, tired etc.)?	☐	☐	☐
8-4 Does the vehicle have a snow brush/ice scraper?	☐	☐	☐
8-5 Does the vehicle have a fire extinguisher?	☐	☐	☐
9. Comments			

Inspector Name:	Signature:	Date:

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Authorized Driver Safety

S3AM-005-ATT1

1.0 Before Vehicle Operation

1.1 Learning and practicing good driving habits will help reduce the chance of a traffic collision. Learning to properly scan surroundings will improve hazard awareness and avoidance. With correct driving habits, errors can be significantly reduced and incident response time can be decreased.

1.2 All Authorized Drivers shall perform a walk-around inspection of the vehicle prior to operation.

1.2.1 Authorized Drivers should use the “Get Out And Look” (GOAL) method before placing a vehicle in motion. Drivers are to make a 360-degree (360°) walk around of the vehicle immediately before placing vehicle into motion in order to determine whether there are hazards or possible obstructions in the proposed path of travel. Drivers are to clear the area of people and objects before placing the vehicle in motion. A check will also be performed to confirm overhead and side clearances are adequate. The following are recommended best practices:

- Placement of cones on the right side of the front and rear of vehicle upon parking and retrieved during the 360° GOAL walk-around.
- In lieu of cones, place GOAL magnets on the right side of the hood and truck/tailgate of the vehicle upon parking. The GOAL magnets should then be retrieved during the 360° GOAL walk around just prior to moving the vehicle again.
- Place a GOAL sticker on the driver side door window as a reminder to get out and look.

1.2.2 Pre-operation vehicle inspections shall be performed and documented by all Authorized Professional Drivers and all Authorized Hired Drivers. A sample vehicle inspection checklist is provided in *S3AM-005-FM2 Vehicle Inspection Checklist*.

1.3 Drivers shall be familiar with applicable client rules and regulations when on the client’s sites. The employee may, for example, be required to leave their keys in the ignition with the vehicle turned off or to display a vehicle pass. When parking, it is recommended that employees back the vehicle into the parking space.

1.4 Drivers must be trained, competent and in possession of a current driver’s license that is valid to the jurisdiction and the vehicle driven. Any additional certification required given the particular vehicle and equipment transported must also be current (e.g. air brake certificate).

1.5 Execute proper travel planning to avoid being in a rush, traveling during peak traffic hours, and traveling through high traffic volume areas. Utilize the *S3AM-005-FM1 Journey Management Plan* as appropriate.

1.6 All drivers must be involved in a task hazard assessment applicable to the task(s) undertaken (may exclusively be the driving task or may include the driving task).

1.7 Confirm current insurance and registration is maintained with the vehicle and any equipment being towed. License plates must be clean.

1.8 As applicable, check all safety equipment (e.g. First Aid Kit, Fire Extinguisher, Flares, Triangles, Reflective Vest, etc.).

1.9 As applicable, check for survival gear and equipment. Emergency kits should include blankets, food, water, flashlight, extra batteries, a method of communication and a heat source such as a candle.

1.10 When accessing any pickup truck box, staff will: step up into the box to avoid excess reaching and strain and; use three point contact getting in and out of the truck box (i.e., avoid jumping off the tailgate).

1.11 Confirm no items are hanging from the rear view mirror that could obstruct vision.

1.12 Adjust mirrors to confirm optimal visibility.

2.0 Vehicle Operation – General

2.1 Be vigilant of differences between trucks and small cars related to blind spots, turning radius, and required overhead and undercarriage clearances.

2.2 It is a personal responsibility of the driver to operate a vehicle safely and in compliance with regulations (e.g. Cargo Securement, Traffic, Dangerous Goods, etc.).

2.3 Confirm compliance with applicable traffic legislation, driver regulations, and rules (e.g. commercial driver hours of service, state / provincial highway acts, municipal bylaws, private road/property owner rules, site specific rules, etc.).

2.4 All vehicle occupants shall wear seatbelts at all times.

2.5 Keep reflectors, lights and windows (inside and out) clean.

2.6 Window cleaner should be on hand for cleaning the interior of the windows as well as headlights that have become obscured due to road spray or slush.

2.7 A shovel and a supply of sand or gravel can help to extract a stuck vehicle that does not have traction.

2.8 Maintain good housekeeping practices and confirm items and loaded materials are secured from movement on both the interior (e.g. cab, glove box, etc.) and exterior (e.g. box, flat deck, etc.) of the vehicle.

2.9 Conduct en-route inspections as required to check cargo securement.

2.10 Pulling Over

2.10.1 Pull the vehicle off the road to a safe location as required by the applicable jurisdiction (e.g. rest stops, a side road, an unused approach):

- If, in the ongoing assessment of road and weather conditions, it has been concluded that travel is no longer safe (i.e. heavy rain, sleet), and wait until conditions allow for safe travel.
- To review or adjust navigation equipment and check cargo securement.
- To check telephone messages, text messages or to take notes.
- For interval breaks, to stretch and if fatigued (try to take a break every two hours).
- To manage and eliminate driver distractions.

2.10.2 If it is necessary to park a vehicle on the shoulder of an active roadway, park as far off the road as possible, and turn on the four-way indicators (hazard lights) prior to leaving the vehicle. Use cones or other warning devices, and wear a high visibility traffic vest.

2.10.3 Observe extra caution in and around emergency and construction zones.

2.10.4 Avoid unattended rest areas, when possible, and especially at night.

2.10.5 If the vehicle breaks down, attempt to get to a secured location. Call police or roadside assistance as appropriate.

2.10.6 Contact the police to help those with car trouble instead of stopping to assist.

2.10.7 When possible, employees should have a car mechanic or roadside assistance change or repair a flat tire. If the Driver or passenger must change a tire, the Driver and passenger must adhere to the manufacturer's specifications and observe the proper lifting technique and safety procedures. Proper lifting is addressed in *S3AM-104-PR1 Manual Material Handling*.

2.10.8 When parking or leaving a vehicle, the following procedures must be followed:

- Engage the transmission in park (automatic transmission) or first gear (standard transmission).
- Shut off the engine.

- Set the parking brake.
- Remove the ignition keys, and lock the vehicle.

2.10.9 If work (e.g., surveying) is required alongside an active road, park the vehicle behind the area of work to provide a barrier against out-of-control vehicles.

2.11 Backing Up

2.11.1 Keep reverse motion to a minimum as the most common incidents involve backing up.

2.11.2 Whenever possible, vehicles should be parked in a manner that prevents the driver from backing (reversing) upon departure. For example, the vehicle should be backed into a parking spot or drivers should select a parking spot that allows them to “pull” through” so that the vehicle is facing the direction of departure.

2.11.3 Confirm the area behind the vehicle is clear prior to and while reversing a vehicle.

2.11.4 All vehicles with limited visibility operated around workers or on a construction site:

- Should have an audible back-up alarm installed that functions automatically when the vehicle is put into rear motion; or
- Shall be backed up only when a signaler communicates that it is safe to do so.
- If a vehicle is not equipped with an audible back-up alarm, the operator shall sound the vehicle horn twice to indicate intention to back vehicle up.

2.11.5 Confirm compliance with applicable traffic legislation regarding backing up (i.e. Texas – An operator may not back the vehicle on a shoulder or roadway of a limited-access or controlled-access highway; Ontario – No driver of a vehicle shall back the vehicle upon the roadway or shoulder of any highway divided by a median strip on which the speed limit is in excess of 80 km/h; etc.).

2.11.6 Take the time to become acquainted with the area the vehicle is to be backed into.

2.11.7 Inspect the area to be backed into (i.e. walk around it by foot, identify obstructions and possible hazards).

2.11.8 Line up as straight as possible with intended final position prior to backing equipment or vehicle up.

2.11.9 If the area is congested with people or equipment a signaler SHALL be used.

2.11.10 Before putting the vehicle into motion, decide:

- The method of communication (hand signals, two-way radios or other means).
- If hand signals are going to be used, confirm both the driver and signaler agree on signals to be used.
- If two-way radios are being used confirm there is continuous voice contact between the signaler and driver. If there is nothing being transmitted on the two-way radio the driver shall STOP the vehicle.

2.11.11 While backing up:

- Confirm there is constant visual contact with the signaler when the vehicle is in motion if using hand signals.
- If driver loses eye contact with the signaler at ANY time, the driver shall STOP the vehicle until eye contact is regained. The exception is where the communication between the signaler and driver is conducted by two-way radio.
- When possible, the signaler shall stand on the driver’s side of the vehicle during motion.

- The signaler must always keep a safe distance from the vehicle or equipment and never stand directly in the path of motion. Refer to Safe Work Practice – Red Zone.
- While backing up using a signaler, the driver must confirm that the vehicle radio (not to be confused with two-way radio) is off and the windows are down (if possible) to avoid distraction and to be able to hear outside of the vehicle.
- If the driver notices anything out of the ordinary (despite what the signaler is directing) the driver will STOP the vehicle or equipment and assess the situation.
- If at any time the safety of any person or property is at risk, including that of the signaler, the signaler shall signal the driver to STOP the vehicle IMMEDIATELY.
- Any person (other than the signaler) can direct the driver to STOP the vehicle or equipment and the driver must take that as a valid direction to STOP.

3.0 If Vehicle is to be Left Unattended

3.1 Turn the ignition off, remove the key and set the emergency brake (if parked on an incline).

3.2 Lock and secure the vehicle.

3.3 Secure equipment and property in a locked trunk or tool chest.

3.4 Do not leave keys in an unattended vehicle.

4.0 Defensive Driving

4.1 Demonstrate an effective and positive driving attitude.

4.2 Use road courtesy, expect the unexpected and be patient. Do not rush or drive aggressively.

4.3 Follow and obey regulations.

4.4 Do not make sudden lane changes and always use signal lights.

4.5 Be Visible – Be seen by all other drivers, pedestrians, cyclists and others using or crossing the road:

4.5.1 Avoid driving in blind spots of other vehicles.

4.5.2 Confirm vehicle lights are on, working and clean before and during travel.

4.5.3 Confirm the vehicle's horn works and use it as necessary to warn others.

4.5.4 Tapping the vehicle brakes may provide a visible alert for following vehicles.

4.5.5 Confirm adequate distance to enable passing of other motorists safely.

4.6 If it is necessary to turn a vehicle around, confirm that the operation is conducted safely and according the applicable traffic legislation and rules.

4.7 Always operate a vehicle within operator driving limitations. Do not be enticed by others to exceed driving capability for any reason. When behind the wheel, drivers must be in control of all driving related situations.

4.8 Maintain awareness of all objects in the immediate circle of influence. Whenever possible, stay well clear of other vehicles, machinery, equipment and pedestrians.

4.9 Scan Ahead – Check the path of travel for obstacles and other vehicles:

4.9.1 Utilize three driving monitoring zones (should not be confused with safe following distances):

- Action Zone (approximately 4 to 6 seconds in front of the vehicle) – activity in this zone generally requires immediate reaction by the driver.

- Planning Zone (at least 15 seconds in front of the vehicle) – look ahead to visually identify if there is slowing traffic or another type of road hazard ahead or to the side. Do not drive behind vehicles that block visibility.
- These zones may require enlarging based on speed and driving environment (e.g. traffic congestion, weather, etc.).

4.9.2 Get the big picture and look for hazards (other motorists, pedestrians, cyclists, road debris, etc.).

4.9.3 Moving eyes every 2 seconds can help to avoid fixating on any one object. Check rear view mirror every 5 to 8 seconds and any time braking.

4.9.4 Read and obey traffic signage and controls.

4.9.5 Use high beam head lights when possible.

- Use low bean headlights when following closely behind other vehicles or when approaching and meeting oncoming traffic.
- Use low beam headlights in fog or heavy snow.

4.9.6 Wear appropriately tinted sunglasses to improve visibility in sunny conditions. Do not wear sunglasses at night and, if wearing at dusk or dawn, confirm the tint is of the type that improves and does not hinder visibility.

4.10 Keep a Space Cushion:

4.10.1 Maintain a space cushion around the vehicle to improve the potential of avoiding a collision. Create an out by monitoring the space in front, behind and to each side of the vehicle, leaving enough area as a cushion to enable evasive action if needed.

4.10.2 Maintain a minimum of 2 seconds plus 1 second for every 10 feet (3m) of vehicle length between the vehicle driven and the vehicle ahead:

- Pick a marker on the road ahead, such as a road sign or pole.
- Count "one thousand one, one thousand two”.
- When the front of the driven vehicle reaches the marker, stop counting.
- If the marker is reached before "one thousand two," increase the space cushion.
- Add more time (space) in poor driving conditions.
- Add more time (space) if the vehicle operated is heavily loaded.
- Add more time (space) if the vehicle ahead is smaller and lighter and may stop more quickly than the vehicle operated.

4.10.3 When stopped behind another vehicle leave 1 vehicle length between the vehicle driven and the vehicle ahead.

4.10.4 Do not travel in a traffic cluster. Manage the space to the front, left and right of the vehicle driven.

4.10.5 Fog, heavy rain, snow, slush or wind require speed and distance between vehicles to be adjusted accordingly.

4.11 Recognize and Anticipate Hazards:

4.11.1 Exercise increased caution at night, dawn and dusk.

4.11.2 When driving at night look to the right of the on-coming headlights and not directly head-on.

4.11.3 Identify changing road hazards or conditions.

4.11.4 Identify changing weather or driving conditions:

4.11.5 Light rain and heat can draw oil to the surface of asphalt creating slippery driving conditions.

4.11.6 Heavily rain soaked roads can result in a vehicle hydroplaning / aquaplaning.

4.11.7 Fluctuating cold temperatures may produce ice.

- Open hilltops may become icy due to blowing snow accumulating and freezing on the road.
- Shaded areas, such as overpasses and bridges, will freeze first and dry out last. These locations are prone to black ice.
- Be aware that black ice may be very difficult to spot. Darker, glossy spots may indicate black ice.

4.11.8 At dawn or dusk, the low sun can create a significant visibility hazard.

4.11.9 Be aware of changing conditions (i.e. traffic patterns, accidents, traffic lights, other vehicles).

4.11.10 Watch for large loads or slow moving agricultural equipment:

- Exercise extreme caution, provide extra room and pass only if it is safe to do so.
- Be aware that large loads or heavy equipment cannot stop as quickly as smaller vehicles and require a longer stopping distance.
- Never pull directly in front of these vehicles after passing or merging, but leave adequate space to confirm safe operation.
- Signal well in advance of any intended maneuver to give large vehicles additional time to react.

4.11.11 Avoid travelling in the blind spots of other vehicles or mobile equipment.

4.11.12 Scan road and shoulders for wildlife and pedestrians:

- Animals may travel in groups. Maintain heightened awareness when spotting one.
- Leave plenty of room when driving around an animal on or near the road – a frightened animal may run in any direction.
- Honk in a series of short bursts to make animals move out of the way.
- Avoid *swerving* for wildlife as this could result in veering into oncoming traffic.

4.12 Reduce Speed:

4.12.1 Adjust speed to accommodate traffic flow and patterns.

4.12.2 Adjust speed to all weather pattern changes (Rain/Hydroplaning, Ice & Frost/Traction Loss, and Restricted Visibility).

4.12.3 Adjust speed in response to inconsistent road surfaces.

4.12.4 Reduce speed when required by law, in construction zones and school and playgrounds.

4.12.5 Safely and appropriately reduce speed upon observing any hazard to increase reaction time.

4.12.6 Always be prepared to brake at an intersection.

4.12.7 Always come to a full stop at uncontrolled railway intersections and verify it is safe to proceed.

4.12.8 Make eye contact with other motorists at intersections (particularly uncontrolled intersections) before proceeding.

4.12.9 Never assume other motorists are following and obeying road rules.

4.12.10 Keep to the right of the road or in the right-hand lane on multi-lane roads unless turning left or passing another vehicle.

4.12.11 Confirm driving practice and vehicle position allow for a defensive or avoidance maneuver.

4.13 Eliminate Distractions

4.13.1 Confirm appropriate time is taken to become acquainted with an unfamiliar vehicle prior to driving.

4.13.2 Do not operate a vehicle if preoccupied, agitated or have existing health issues that could potentially pose a safety issue.

4.13.3 Do not operate a vehicle if under any form of impairment (i.e. fatigue, alcohol, drugs, etc.).

4.13.4 Remain engaged. Do not succumb to boredom, complacency, or allow the focus to drift from the driving task.

4.13.5 Remain focused on driving defensively and follow any given direction when passing an accident scene.

4.13.6 Avoid any activity that requires moving a hand from the steering wheel (e.g. changing radio stations, handing articles to passengers, etc.).

4.13.7 Do not engage in activities that may distract from the driving task (e.g. operating navigation systems, ridding the cab of an insect, etc.).

4.13.8 Do not engage in eating or drinking that may distract from the driving task.

4.13.9 The use of electronic devices that may distract the driver while driving is prohibited. This includes cell phones, two-way radios and other items whether hand-held or hands-free (a simple text message sent while travelling at highway speed results in an operator's eyes being off the road for the length of a football field).

5.0 Road Rage

5.1 Road rage is a dangerous driving situation that can occur and should be avoided whenever possible, but NEVER instigated. Do not get drawn into a confrontation. Avoid any confrontational eye contact or gestures.

5.2 The driver should be aware of the vehicles around them, paying frequent attention to the vehicle's mirrors.

5.3 Get out of the way if safely possible, even if the other motorist is speeding. The other driver may be dealing with an emergency situation.

5.4 Unless it is necessary to use the horn as an alert, do so sparingly.

5.5 If followed after an on-the-road encounter, drive to a public place or to the nearest police station and seek assistance.

5.6 Attempt to note the offender's license plate number and write it down as soon as it is safe to do so and the vehicle is not in motion.

5.7 Report any aggressive driving to the police immediately. This action may aid in preventing further occurrences by the same driver.

6.0 Winter Driving

6.1 Clear snow from exterior vehicle surfaces.

6.2 Do not cruise control on icy roads.

6.3 Accelerate and brake gently to reduce skids or spinouts.

6.4 Wear winter clothing that does not restrict movement, vision or hearing.

6.5 Where required, have snow chains for the vehicle and be familiar with their installation.

6.6 Use extra caution while driving during hazardous winter conditions.

6.7 Avoid sudden changes of speed or direction to reduce possibility of skidding.

6.8 Drivers should leave extra distance between their vehicle and the vehicle ahead of them. Stopping on ice takes approximately eight times the distance that it takes on dry pavement.

6.9 Carry suitable warm clothing and emergency equipment during the winter months. Temperatures can plunge rapidly.

6.10 Be aware of icy patches on the road bridges and intersections that are especially prone to icing.

6.11 Be familiar with the skid control procedures for the type of vehicle being driven (e.g., front, rear or four-wheel drive).

7.0 Gravel Roads and Remote Locations

7.1 Prior to driving on a road with an assigned radio frequency, the passenger will test the two-way radio to confirm that the proper radio frequency is set, and that the transmission is being received clearly by other traffic. The passenger will operate the two-way radio.

7.2 Drivers will maintain appropriate speed for the road conditions.

7.3 Headlights will be used when operating the vehicle.

7.4 Drivers will respect the understood road protocol, drive defensively and respect intersections.

7.5 4WD options will be utilized at the discretion and comfort level of the driver. If road conditions are questionable even for 4WD use, the road will not be traveled and either another route found or the job postponed until road conditions improve.

8.0 Off-road

8.1 If inexperienced, seek supervisory advice and training.

8.2 Vehicles should only be driven off roads after other available options (e.g., use of ATV's, etc.) have been considered.

8.3 Prior to driving off-road, check to see that the vehicle is in good operating condition and tires are properly inflated.

8.4 Realize the limitations of the vehicle and do not become over confident.

8.5 Seat belts should be kept fastened and loose objects in the vehicle securely fastened to prevent them from becoming projectiles in the event of a sudden stop.

8.6 Drive according to the ground conditions.

8.7 Speed and power are normally not required in rough off-road driving.

8.8 Learn to read the surrounding terrain. Monitor the ground conditions ahead of the vehicle -- it is essential to know what to expect in light of the road conditions.

8.9 When slowly traversing difficult areas of soft ground, try to keep the vehicle in motion.

8.9.1 Once stopped it is far more difficult to get the vehicle going again.

8.9.2 If the vehicle becomes stuck, do not spin the wheels, as they will only dig in further or deeper until the vehicle chassis rests on the ground.

8.9.3 Try to slowly back the vehicle in its own tracks, as these have been previously compressed by the vehicle. In most cases this will be successful. If not, place appropriate material (e.g., wooden planks, mats, branches, etc.) under the wheel to improve traction.

8.10 Before driving over rough terrain, the terrain should be inspected on foot first.

8.11 When climbing hills in the vehicle travel straight up or down.

8.11.1 Be aware of what is on the other side of the hill prior to climbing.

8.11.2 At the base of the hill the driver should apply more power. Ease up on the power while approaching the top and before going over the crest.

8.11.3 If the vehicle stalls on the ascent, back straight down the hill in reverse.

8.11.4 For downhill travel in a vehicle with manual transmission, always use the lowest appropriate gear, and do not disengage the clutch to allow the vehicle to coast. If the vehicle is equipped with an automatic transmission, use low range and the lowest drive setting.

8.11.5 DO NOT drive a hill at an angle this increases the risk for a roll-over incident.

8.11.6 DO NOT attempt to climb a very steep hill if there is doubt the vehicle can successfully climb the hill.

8.12 When driving through water, consider the maximum wading depth of the vehicle.

8.12.1 The air intake must always be kept clear of water.

8.12.2 Driving through water should always be done slowly to keep the bow wave low.

8.12.3 In addition, slow speed prevents a hot engine from suffering tension cracks by sudden contact with cold water.

8.12.4 Check the brakes after leaving the water.

8.13 Prior to returning to the road, do a vehicle inspection to confirm the vehicle is road worthy.

9.0 Towing

9.1 Conduct a pre-start inspection of the equipment to be towed.

9.2 Only hook-up equipment, using a signaler to do so, that has been verified as safe for transport.

9.3 Confirm the hitching equipment of the vehicle and that of the equipment to be towed are compatible.

9.4 Always inspect the hitch for defects and to confirm it is securely closed (e.g. safety pin in place, safety chains hooked up using the “crossed” or “cradle” method, locking devices on hooks).

9.5 Confirm light cord is plugged in and any emergency braking devices are hooked up. Verify all lights are in working order.

9.6 Conduct a brake test prior to travelling.

9.7 Confirm speed of travel does not exceed the manufacturer’s specification for the equipment towed.

9.8 Maintain awareness of total dimensions of the vehicle plus the equipment towed. Adjust driving accordingly (i.e. widen turning radius, increase distance between vehicles).

Americas

Behavior-Based Safety

S3AM-007-PR1

1.0 Purpose and Scope

1.1 The purpose of this procedure is to describe the AECOM approach to implementing our behavior-based safety program.

1.2 Behavior-based safety is a process that provides a higher level of safety excellence by promoting proactive involvement, building ownership, and fostering communication that relates to employee safety. A primary concept is that most accidents are due to at-risk behavior, and behavioral changes may be made that significantly reduce accident potential.

1.3 This procedure applies to all AECOM Americas based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 **At-Risk Behavior**: Individual actions that increase the chance of injury, despite knowledge of the hazard. An example is excessive speed while driving.

2.2 **Activators**: Items that are intended to produce desired behaviors. Activators for safety include, but are not limited to, policy statements, safety procedures, training, safety slogans, posters and signs, health and safety plans, safe work plans, safety meetings, and rules and regulations.

2.3 **Behaviors**: Visible actions on the part of individuals and can be characterized as safe (following health and safety plans, using work practices that minimize risk, coaching others on safe behavior, having safety as a priority over speed and convenience, etc.), or at-risk.

2.4 **Consequences:** Result of safe and at-risk behaviors, and can therefore be positive or negative. Examples of consequences include self-approval, reprimand, peer approval, penalty, feedback, inconvenience, and comfort. The most effective consequences are positive, immediate, and certain.

3.0 References

3.1 **None**

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager or Supervisor**

- Implementation of this procedure is the responsibility of the manager directing activities of the facility, site, or project location.
- Provide clearly defined safety expectations and encourage/reinforce the implementation of safety observations.
- As appropriate, provide consequences for at-risk observed behaviors throughout the course of the work shift.
- As appropriate, provide acknowledgement for observed safe behaviors throughout the course of the work shift.

4.1.2 **Employee and Co-Worker**

- Intervene when observing at-risk behavior.
- Provide positive feedback for safe behavior.
- Volunteer to be observed.

4.2 Values of Behavior-Based Safety

4.2.1 Employees hold safety as a core value.

4.2.2 Each employee feels responsible for the safety of their co-workers as well as themselves, and takes action accordingly.

4.2.3 Each employee is willing and able to “go beyond the call of duty” on behalf of the safety of others.

4.3 Identification of At-Risk Behaviors

4.3.1 Observations will be used by AECOM Safety Officers to help identify at-risk behavior.

4.3.2 Employee observations

- Employees may perform a safety observation of another AECOM employee, subcontractor or member of the public.
- Observation checklists may be used as a tool to help identify safe and at-risk behaviors and why the behavior(s) occurred. *S3AM-007-FM1 Behavior Based Safety Checklist* may be used.
- Employees will be instructed on using the checklists.
- The checklists will include the expected safe behaviors.
- Peers will complete the checklist for applicable work tasks.
- Checklists may vary depending on a client/project to include additional behaviors.

4.4 Feedback to Employees

4.4.1 Observers will immediately provide one-on-one feedback to the observed, noting both safe and at-risk behaviors.

4.4.2 Observer and observee will discuss the identified barriers to safe behavior, and potential solutions.

4.4.3 Management and Safety staff will verify compliance with this procedure.

4.5 Feedback Follow-up

4.5.1 Observation checklists may be collected and discussed at periodic safety meetings.

4.5.2 The manager will review the trends for at-risk and safe behaviors and report the trends to the employees. The manager will implement corrective actions to address at-risk behaviors.

4.6 Training

4.6.1 Employees will be trained on the value of behavior based safety and observations, how to perform an observations and how to provide feedback.

5.0 Records

5.1 None

6.0 Attachments

6.1 S3AM-007-FM1 Behavior Based Safety Checklist

Americas

Behavior Based Safety Checklist

S3AM-007-FM1

Use comment column when unsafe behavior / conditions were observed. Describe what was observed and why this occurred.

Job Location: _____ Date: _____

Task/Work Observed: _____ Observer: _____

	Safe	Unsafe	Comments
Personal Protective Equipment			
Head	☐	☐	
Hand	☐	☐	
Feet	☐	☐	
Eyes/Face	☐	☐	
Skin	☐	☐	
Hearing	☐	☐	
Fall Protection	☐	☐	
Equipment / Tools			
Proper tool for the job	☐	☐	
Condition	☐	☐	
Proper Use	☐	☐	
Body Use / Position			
Lifting	☐	☐	
Pinch Point	☐	☐	
Ladder / stairs	☐	☐	
Hand placement	☐	☐	
Travel path / speed	☐	☐	
Body position	☐	☐	
Work Practices			
Follow Safety Plan / Procedures	☐	☐	
Housekeeping	☐	☐	
Other			
_____	☐	☐	
_____	☐	☐	
_____	☐	☐	
_____	☐	☐	
_____	☐	☐	

Americas

Fitness for Duty

S3AM-008-PR1

1.0 Purpose and Scope

1.1 AECOM is committed to providing a safe workplace for its employees, clients and others. In order to provide a safe work environment, employees must be fit for work, be able to perform their job duties in a safe, secure, productive, and effective manner, and remain able to do so throughout the entire time they are working.

1.2 This procedure applies to to all AECOM Americas-based employees and any other entity and its personnel contractually required to comply with this document's content.

1.3 Fit for duty means an individual is in a state (physical, mental, and emotional) that enables them to perform assignments competently and in a manner that does not threaten the health and safety of themselves or others.

1.4 Fitness for duty expectations can vary with specific job tasks, location and regulatory requirements. Fitness for duty may be affected by significant fatigue, stress, emotional issues, illness, injury, or the effects of drugs and alcohol. Employees who are not fit for duty may present a safety hazard to themselves, to other employees, to the Company, or to the public.

1.5 The decision to request a fitness for duty examination (and repeat examinations as necessary) can be made by Operations, Safety, Health and Environment (SH&E) and Human Resources (HR). The decision will be based on the need to protect the employee and co-workers when there is concern about an employee's ability to perform his or her job safely, based on the observations of a supervisor, manager, or medical personnel.

1.6 Should AECOM require a fitness for duty examination, it shall be performed at no expense to the employee and will be performed by an occupational specialist, physician or other medical specialist designated by the Company or Employee Assistance Program (EAP). Employees awaiting a fitness for duty examination may be temporarily relieved of any work duties or may have their work duties modified.

1.7 The purpose of this policy is to establish consistent procedures by which AECOM will evaluate an employee's fitness for duty when an employee is:

1.7.1 Having observable difficulty performing work duties in a manner that is safe for the employee, for the employee's co-workers, for the Company, or for the public, as determined by the supervisor;

1.7.2 Posing an imminent and serious safety threat to self or others; or

1.7.3 Involved in the event of a workplace incident or accident.

2.0 Terms and Definitions

2.1 None

3.0 References

3.1 None

4.0 Procedure

4.1 It is the responsibility of all employees to:

4.1.1 Maintain a safe workplace;

4.1.2 Manage their health in a manner that allows them to safely perform their job responsibilities;

4.1.3 Arrive to work fit for duty and capable to perform their job responsibilities in a safe, secure, productive, and effective manner during the entire time they are working and refraining from behavior which could impair safety in the workplace;

4.1.4 Notify their supervisor or HR when they are not fit for duty and to declare any medication side effects and/or situations/concerns which may have an impact on their ability to perform work; and

4.1.5 Notify a supervisor when they observe a co-worker acting in a manner that indicates the co-worker may be unfit for duty. If the supervisor's behavior is the focus of concern, an employee may inform a senior manager and a HR representative.

4.2 The Company will not tolerate retaliation against any employee for filing a complaint or concern or for participating in any way in an investigation. It is the responsibility of AECOM management and supervisors to:

4.2.1 Communicate to all employees the content of this procedure and other applicable safety policies and procedures

4.2.2 Observe (and record when necessary) the attendance, performance, and behavior of the employees they supervise;

4.2.3 Fairly and consistently follow this procedure when presented with circumstances or knowledge that indicate that an employee may be unfit for duty by contacting SH&E and HR as appropriate;

4.2.4 Consider an employee's personal assessment of their own fitness for duty; and

4.2.5 Keep any information of medical conditions or records strictly confidential at all times.

4.3 HR and SH&E will assist in the administration of this program, ensuring that the requirements of the procedure are implemented by all responsible departments.

4.4 The supervisor who believes they have received reliable information that an employee may be unfit for duty, or through personal observation believes an employee may be unfit for duty, will validate and document the information or observations as soon as is practical and contact SH&E and HR immediately. While there is a great variety and range of acceptable behavior among employees, dramatic or sudden changes in any particular employee's customary behavior may be a cause for concern. Atypical behavior that may trigger the need to evaluate an employee's fitness for duty include, but is not limited to, problems with dexterity, coordination, concentration, memory, alertness, vision, speech, inappropriate interactions with co-workers or supervisors, inappropriate reactions to criticism, or suicidal or threatening statements. Though the mere presence of any one factor or sign of behavior may not be sufficient to require an evaluation, it should not be ignored and may lead to the ordering of an evaluation.

4.5 The supervisor will present the information or observations to the employee at the earliest possible time in order to validate them and will allow the employee to explain his or her actions, or to correct any mistakes of fact contained in the description of those actions. An employee is not required to disclose a disability to a supervisor; however, a supervisor may inquire regarding the conduct, behavior or circumstances that give rise to his or her concerns. The supervisor will then determine whether the employee should leave the workplace immediately for safety reasons. Where possible, discussion and meetings with any employee should occur with SH&E and/or HR staff present.

4.6 Depending on the severity of the situation or event and the type of behavior, possible actions may include the following:

- Documenting and noting the event or behaviour.
- Encouraging the employee to use the EAP (if applicable) or to seek medical treatment.
- Placing the employee on a paid leave of absence (Paid Time Off (PTO)) or paid administrative leave, depending on the situation).
- Arranging for the employee's safe transportation home.
- Making a management referral to the EAP or other local assistance agencies.

- Taking disciplinary action, if appropriate.
- Calling 911 or local emergency authorities.

4.7 If there is a basis for thinking that a crime may have been committed and/or the employee is making threats to harm himself or herself or others, or is acting in a manner that is immediately dangerous to himself or herself or others, contact 911 or local emergency authorities directly. HR and the EAP should be consulted regarding the fitness for duty procedure after the immediate safety issue has been addressed.

4.8 In all other circumstances, the supervisor shall take appropriate action, including contacting HR. If it is not immediately practicable to contact HR, managers have the authority and ability to contact the EAP when they receive reports and validate or personally observe an employee's unfit behavior. Depending on circumstances, such as when an employee's conduct immediately or directly threatens safety, a supervisor may immediately relieve the employee of duty pending further evaluation.

4.9 The Company will rely on the EAP or occupational specialist, physician or other medical specialist (which may include a registered psychologist or psychiatrist) to assist with the evaluation process. Each case will be evaluated on a case-by-case basis. In all instances, it is imperative that the EAP or medical professional be provided complete and accurate information on the employee's job duties, responsibilities and expectations in order to make a fully informed decision. Please refer to *S3AM-008-FM1 Description of Job Duties*.

4.10 The employee must comply and cooperate with all aspects of the fitness for duty and evaluation procedures, including furnishing necessary consent and release forms to the health service provider. Noncompliance (including delayed compliance) may be grounds for disciplinary action up to and including termination. Information will be requested from the health service provider regarding work restrictions and/or accommodations that may be required upon the employee's return to work.

4.11 If it is determined that a fitness for duty evaluation is necessary, the employee will be asked to leave the workplace until the evaluation is completed. A recommendation is provided by the occupational specialist, physician or other medical specialist to HR. When it is determined that the employee can return to work safely, a HR manager will contact that employee with the date and conditions of their return to work. If there are conditions that the employee will need to comply with in order to ensure continued safe working habits, they will be required to sign an acknowledgement that they will comply with those conditions.

4.12 This procedure is not intended as a substitute for other Company policies or procedures related to performance nor is intended as a substitute for discipline. Situations involving violations of Company policies or practices may result in disciplinary action being taken.

5.0 Records

5.1 None

6.0 Attachments

6.1 S3AM-008-FM1 Description of Job Duties

Americas

Fatigue Management

S3AM-009-PR1

1.0 Purpose and Scope

1.1 The purpose of this procedure is to reduce the potential for employee fatigue by providing criteria for recognition, treatment, and management.

1.2 This procedure applies to AECOM Americas-based employees and operations, and any other entity and its personnel contractually required to comply with this document's content, where fatigue can be a factor impacting an employee's fitness for duty. Fatigue is mental or physical exhaustion that stops a person from being able to function normally.

- Fatigue is mainly caused by a lack of sleep, but may also be associated with prolonged periods of physical and/or mental exertion without sufficient time to recover.
- Fatigue can be caused by work-related stresses, non–work-related stresses, or a combination of both. Work-related stress may be due to items such as pace of work schedule, location of work, environmental conditions of the work area (e.g., noise, lighting, tasks), and degree and duration of concentration required to perform a task.
- Non–work-related fatigue is influenced by personal lifestyle, health issues, and family and relationship responsibilities.
- Long-distance travel causes fatigue primarily by disruption of natural biological rhythms through both external factors and internal factors.
- Acute Mountain Sickness (AMS) is a group of symptoms including fatigue that jeopardizes the well-being and the work capacity of people who are not acclimated when exposing themselves to altitudes above 3,000 meters. It appears in the first hours after exposure, declining after 1 or 2 days because of acclimatization. Its prevalence is directly related to high-altitude work, ascent speed, and personal susceptibility.

2.0 Terms and Definitions

2.1 None

3.0 References

3.1 None

4.0 Procedure

4.1 Implementation of this procedure is the responsibility of the manager directing activities of the facility, site, or project location.

4.2 Fatigue, and the level to which it impacts an employee, is associated with a number of factors including:

4.2.1 The quantity and quality of rest obtained before and after a working day.

4.2.2 The time of day in which work takes place.

4.2.3 The length of time spent at work and on work-related activities (including travel time to and from work).

4.2.4 The type and duration of a work task and the environment in which it is performed.

4.2.5 The physical and mental demands of work.

4.2.6 Activities outside the workplace, such as sports, family commitments, or second jobs.

4.2.7 Disruption of normal circadian rhythms (human clock, bio-rhythms).

4.2.8 Individual factors, including existing medical conditions, illnesses, or sleep disorders.

4.2.9 Extreme alcohol intake or sleep deprivation.

4.2.10 Travel requirements, including daily commute distances and long- distance air travel.

4.3 Fatigue Recognition

4.3.1 Employees are expected to carry out their work activities in a manner that does not risk the health and safety of themselves, their fellow employees, or any other personnel on the site (e.g., contractors, clients, the public, etc.). If an employee feels that they are unable to perform their work activities safely due to the effects of fatigue, they are required to stop work immediately and notify their supervisor. If this occurs while an employee is driving a vehicle, the employee is required to stop driving and find a suitable location to rest.

4.3.2 Similarly, if an employee suspects a co-worker (including contractors or clients working with the employee) of suffering from the effects of fatigue, they are required to intervene on behalf of the affected person, stopping work and notifying their supervisor.

4.3.3 Characteristics that may assist in the identification of fatigue may include, but are not limited to:

- Physical Symptoms
  - Bloodshot eyes
  - Poor coordination
  - Slower movements
  - Slower-than-normal response time (e.g., response to commands or radio signals)
- Cognitive Function Symptoms
  - Distraction from task
  - Poor concentration or lapses in concentration
  - Inability to complete tasks
  - Short-term memory loss
  - Nodding off momentarily
  - Fixed gaze
  - Reports of blurred vision
- Emotional/Behavioral Symptoms
  - Appears depressed
  - Does not care about work
  - Easily frustrated with task/irritability
  - Increased or noticeable level of unexplained or unusual absenteeism

4.4 Fatigue Treatment

4.4.1 Where fatigue has been identified, employees are suggested to take action to treat the underlying causes of the fatigue. Suggestions include:

- Getting adequate, undisturbed, regular and consistent amounts of sleep each night. A minimum of 7 hours is recommended.
- Eating well-balanced and nutritious meals at regular intervals.
- Ensuring adequate consumption of water throughout the day.

- Exercising or stretching regularly.
- Maintaining a reasonable work and personal schedule.
- Avoiding alcohol, smoking, and drugs. Note that stimulants, including caffeine, may provide temporary relief from certain types of fatigue, but can increase the problem when the effect wears off.
- Changing stressful circumstances through vacation or personal leave.

4.5 Fatigue Management – Managers and Supervisors

4.5.1 Identify factors in the work place that may contribute to fatigue. Inform employees of potential fatigue-producing activities and how to manage them. Re-evaluate work tasks periodically to control fatigue.

4.5.2 Monitor employees for the signs and symptoms of fatigue.

4.5.3 Provide employees with sufficient breaks for food, water, and rest throughout the work day. Calling for unscheduled breaks/meals where fatigue factors are evident may be necessary.

4.5.4 Consult with employees regarding fatigue factors when extended work periods or shift work is anticipated.

- When possible and apart from shift work, minimize early morning starts before 6:00 AM local time, because early start times give employees less time to get adequate sleep.
- When possible and apart from shift work, minimize late-evening work after 9:00 PM local time (except where shift work is required), because employee alertness tends to decline after this time.
- Limit extended work days to a maximum of 14 hours, and extended work weeks to 60 hours. Where this is not feasible, develop project-specific fatigue management guidelines for inclusion in site-specific SH&E plans.
- For emergency work, a single shift should be limited to 16 hours, and an employee should be off work for at least 12 hours before the next shift start.
- Project-specific extended work schedules shall be reviewed and approved prior to implementation.
- Shift lengths longer than 12 hours should have two or more long breaks (at least 20 minutes) to allow time for meals.
- If shift work is required, employees should be given sufficient time to get a continuous 7- to 8-hour period of sleep in each 24 hours, and at least 50 hours every 7 days.
- At the end of extended night shifts, there should be a minimum of 36 hours or two sleep periods prior to transition to day shift.

4.5.5 Project industrial hygienists must consider extended work shifts in personal monitoring, and permissible exposure limits for acute chemical hazard exposures.

4.5.6 Review safety observations, near misses, injuries, and incidents that have occurred which may have resulted due to fatigue. Use the findings of these documents to revise project-specific fatigue management procedures, as necessary.

4.5.7 Supply adequate supervision for jobs that are physically or mentally demanding, repetitive, or require a high level of vigilance.

4.5.8 Develop job rotation and cross-training strategies for repetitive or monotonous work.

4.5.9 Consider providing ergonomic equipment such as anti- fatigue mats in areas of prolonged standing and lift assist devices for repetitive lifting tasks.

4.5.10 Remove obviously fatigued workers from activities where there is a risk to safety and health. These employees may be rotated to a task that creates a much lower immediate risk, or advised to go home. Where driving presents a further fatigue risk, provide transportation to ensure the employee reaches their destination safely.

4.5.11 Encourage employees to take adequate time away from work through vacations and personal leave. There should be at least one personal weekend in every 4 weeks of work.

4.5.12 Train employees on how to recognize fatigue, control fatigue through appropriate work and personal habits, and reporting of fatigue to a supervisor.

4.5.13 Where fatigue issues recur with an employee, consider referring the employee to the Employee Assistance Program (EAP) for help in the self-management of fatigue or other issues that may have a bearing on fatigue at work. Review working arrangements to assist employees in managing non–work-related fatigue causes.

4.5.14 Provide training to all employees as required by project- specific conditions or client-specific requirements (e.g., project startup training, onset of schedule changes, annual refresher training, etc.).

4.6 Fatigue Management – Employees

4.6.1 Employees are responsible for managing personal fatigue in the work place. This may include the following:

4.6.2 Report to work well-rested and mentally alert. Manage non– work-related choices that enable fitness for duty, including getting sufficient rest and sleep to recover from prior work duties, and managing personal, commuting, medical, and health issues.

4.6.3 Seek medical advice for any personal conditions affecting sleep, such as apnea or insomnia.

4.6.4 Advise your physician of any changes in your regular work schedule if you are taking daily prescriptions. Many medications exhibit important differences in the time course and effects depending on when the medication is administered.

4.6.5 Notify your manager or supervisor when you are feeling fatigued.

4.6.6 Take adequate rest and meal breaks for the working conditions.

4.6.7 Do not operate machinery or perform high-risk activities for at least 24 hours if you travel over 6 or more time zones or if you are required to work at elevations above 3,000 meters without adequate acclimatization.

4.6.8 Inform managers or supervisors when you suspect a co- worker of being fatigued or if you feel fatigued to a point of increased risk of an incident or error.

4.6.9 Consider seeking assistance from the Employee Assistance Program (EAP) for help in the self-management of fatigue or other issues that may have a bearing on fatigue at work.

5.0 Records

5.1 The following documentation will be maintained in the project file:

5.1.1 Safety observations, near misses, injuries, and incidents that have occurred as a possible result of fatigue.

5.1.2 Records of site-specific training in fatigue identification and management issues.

6.0 Attachments

6.1 None

Americas

Emergency Response Planning

S3AM-010-PR1

1.0 Purpose and Scope

1.1 Providing the requirements for preparation and planning for potential emergencies that may occur while AECOM staff are working.

1.2 Applies to all AECOM Americas-based staff working inside and outside an AECOM office, including location and project environments, and to any other entity and its personnel contractually required to comply with this document's content.

1.3 The intent of this plan is to:

- Enable prompt, informed emergency responses.
- Promote the safety of workers, visitors, and those responding to an emergency.
- Reduce the potential for destruction of goods and other property.
- Reduce the magnitude of environmental and other impacts.
- Help those responding to an emergency quickly determine and initiate proper remedial actions.
- Reduce recovery times and costs.
- Provide confidence to workers, visitors, and those responding to an emergency that emergencies will be properly managed.

1.4 This procedure represents AECOM's minimum requirements and should be augmented by more stringent local regulatory requirements and/or client requirements.

1.5 Location Specific Emergency Response Plans are to be included in the respective Office Safety, Health and Environment Plan (refer to *Global Office Safety, Health & Environment Plan*) or the location specific SH&E Plan (refer to *S3AM-209-PR1 Risk Assessment & Management).*

1.6 Emergency Response is an initial response which may require additional actions as detailed in *RS2-003-PR1 Disruptive Event Response Standard*.

2.0 Terms and Definitions

2.1 **Emergency –** An unplanned situation or event (including natural disasters) resulting in involvement of the public emergency services, police, fire, paramedic, or the environmental regulatory authorities.

2.2 **Emergency Response Coordinator –** An individual in a worksite or project environment designated to lead and direct the immediate emergency response.

2.3 **Emergency Communication Tree (ECT) –** a layered hierarchical communication model used to notify specific individuals of an event - typically unplanned in nature - and coordinate recovery, if necessary. It is also known as a phone tree, call list, phone chain or text chain. Each listed employee may have several contacts, including office and cellphone numbers, and an email address.

2.4 **Local Resilience Coordinator (LRC)** – A manager designated as the Office or Worksite lead for local level organizational resilience who may or may not be the emergency response coordinator. The LRC is the point of contact with the Region Resilience Team in determining further action, including notifications, following an initial emergency response. Refer to *RS2-003-PR1 Disruptive Event Response Standard*.

2.5 **First Aid Provider** – Is a First Aid, CPR, and AED trained, volunteer, AECOM employee who provides emergency first aid or treatment (including performing CPR and applying an AED) to someone who is injured or suddenly ill, before emergency medical services (EMS) arrives. This is a voluntary action and not an occupational duty assigned by AECOM. They may use a limited amount of equipment to perform initial

assessment and provide immediate life support and care while awaiting arrival of emergency medical services. Refer to *S3AM-012-PR1 First Aid*.

2.6 **Floor Marshall** – An individual in the office environment designated to lead and direct the immediate emergency response.

2.7 **Floor Warden** – An individual in the office environment, as required by building design and employee numbers, designated to assist the Floor Marshall in directing the immediate emergency response.

3.0 References

3.1 GRG-001-RP4 Operational Security Plan

3.2 RS2-003-PR1 Disruptive Event Response Standard

3.3 S3AM-209-FM1 Office Safety, Health & Environment Plan Template

3.4 S3AM-004-PR1 Incident Reporting, Notifications & Investigation

3.5 S3AM-011-PR1 Fire Protection

3.6 S3AM-012-PR1 First Aid

3.7 S3AM-111-PR1 Bloodborne Pathogens

3.8 S3AM-209-PR1 Risk Assessment & Management

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Managers**

- Develop and implement Location Specific Emergency Response Plans and security standards for the applicable office, location and/or project personnel.
- Confirm Location Specific Emergency Response Plans and security standards are included in the respective Office Safety, Health & Environment Plan or location specific SH&E Plan.
- Confirm appropriate training of employees as determined by the potential emergency situations, regulatory requirements and, if applicable, client requirements.
- Confirm the emergency response plan is communicated to all affected personnel.
- Confirm that necessary training and resources appropriate to the potential emergencies is provided to AECOM employees.
- Confirm that necessary and appropriate emergency response equipment is readily available.
- Confirm that emergency drills are completed annually or more frequently as appropriate to the risk of the potential emergency or as required by legislation. Confirm the effectiveness of the procedure and, as needed, take corrective action. The *S3AM-010-FM1 Emergency Response Drill Report* or equivalent shall be used to confirm the completion and effectiveness of the drill.

4.1.2 **Safety, Health &Environment (SH&E) Manager**

- Assist in the development and implementation of emergency response plans and security standards for the applicable office, location and/or project personnel.
- Review and, as necessary, implement emergency response plans and security standards.

4.1.3 **Supervisors**

- Review and, as necessary, implement emergency response plans and security standards.

- Confirm employees have completed any required training associated with the identified potential emergencies.
- As applicable, confirm that employees have access to communication devices that are in good working order. Maintain current rosters of employees under their supervision.

4.1.4 **Employees**

- Participate in any required training and drill exercises.
- Report any potential or actual threatening situations to the Manager, Supervisor and/or Emergency Response Lead.
- As applicable, oriented to the potential risk of violence and instructed how to identify and respond to violent situations.
- Report an injury or adverse symptom as a result of an incident of violence and when appropriate consult a physician for treatment or referral
- Review and, as necessary, implement emergency response plans and security standards.

4.2 Emergency Response Plan (ERP)

4.2.1 An assessment shall be completed by the Manager of each location to determine the potential emergency situations and the adequate number of First Aid Providers, first aid supplies, emergency response requirements, and medical requirements, including determining the response time and availability of Emergency Medical Services (EMS) and necessary third party providers (e.g., rescue services, fire brigade, etc.). Refer to *S3AM-012-PR1 First Aid* and *S3AM-011-PR1 Fire Protection.*

4.2.2 Managers will establish and implement the location specific ERP using *S3AM-010-FM2 Location Specific Emergency Response Plan Template* or *S3AM-010-FM2-A Short Visit Emergency Response Plan Template*. The ERP shall be communicated to all affected employees.

4.2.3 The location specific ERP will include:

- The location of the muster point, first aid, fire extinguishers, and as applicable, fire exits, AED, and other emergency equipment.
- As applicable, maps of the worksite / office and surrounding area as necessary to direct any third party emergency response (e.g., police, ambulance, fire crew, air medivac, etc.) to and within the location.
- Defined roles and responsibilities in the event of an emergency.
- A contact list that includes, as applicable, fire, police, ambulance, poison control, First Aid Providers on location, fire wardens on location, Site Safety Officer, security, SH&E committee, SH&E Reporting number for reporting all AECOM incidents, and other required emergency contacts.
- Emergency Communication Trees, if applicable (e.g., established to ensure appropriate notifications of all interested parties of emergency status, such as office closure).
- Procedures appropriate to the potential emergency situations (e.g., fire, evacuation, first aid, hurricane, etc.) and as necessary, to third party provider interaction and potential emergency transportation (e.g., method to engage high angle rescue team, designated route for fire truck or ambulance, method to delineate air medivac landing location, patient transportation by boat, etc.).
- As applicable, maps to appropriate services, such as hospital or medical clinic.
- *S3AM-010-FM2 Location Specific Emergency Response Plan Template* or *S3AM-010-FM2-A Short Visit Emergency Response Plan Template* shall be completed according to the office or worksite's needs.

4.2.4 The location specific Emergency Response Plan (ERP) will comply with all governing regulations.

4.2.5 The location specific ERP shall be included in the location specific Office Safety, Health & Environment Plan (refer to *Global Office Safety, Health & Environment Plan*) or the location specific SH&E Plan (refer to *S3AM-209-PR1 Risk Assessment & Management*).

4.2.6 If the hazard assessment for the location indicates a need for planned evacuation, onsite fire response, or rescue, appropriate written procedures will be developed and implemented.

- Depending upon the various contributing factors to the potential emergencies, the procedures may require additional training for AECOM personnel (e.g., First Aid, fire response, etc.), coordination with a third party provider (e.g., rescue, fire, etc.), or preparations for mass evacuation away from a site.
- If applicable, procedures should be developed to assist any personnel with disabilities in the event of an evacuation. Engage Human Resources to ensure the proper measures are in place.

4.2.7 The location specific emergency plan will be readily available to personnel.

- Worksites shall post the ERP at all worksite entrances and/or develop alternate methods to confirm ERP accessibility, such as placing the ERP at muster points, on appropriate vehicle dashboards, driver door pockets, glove boxes, muster points, etc.
- In offices and shop locations the plan will be posted at all entrances and other suitable locations throughout the workplace, such as the SH&E noticeboard or first aid room.

4.2.8 Appropriate methods to account for AECOM employees and visitors shall be established.

- Visitor registers, tailgate/toolbox sign-in sheets and/or staff listings shall be available in the event of evacuation.
- Employees leaving location should alert appropriate personnel (supervisor, reception, or other responsible party) prior to departure, as applicable, provide expected time of return and alert the appropriate personnel upon return.

4.2.9 Staff will be trained for involvement in an emergency evacuation or rescue; however, all evacuations may require special preparation and arrangements with third party rescue providers in the following circumstances:

- work at high angles,
- work in confined spaces or where there is a risk of entrapment,
- work with hazardous substances,
- underground work,
- work on or over water,
- work in remote isolation, and
- workplaces where there are persons who require physical assistance to be moved.

4.2.10 The ERP will address a clear path of travel to and from a working area, as applicable:

- The access will be made obvious and most direct with adequate illumination.
- The access will remain clear and unobstructed at all times.
- No material or equipment may be stored or temporarily left in path of egress.
- A traffic barrier will be used for facilitating vehicle and pedestrian traffic.
- Parking areas shall not restrict access by emergency personnel and vehicles.
- The access route will have a clear line of vision into oncoming traffic lanes.

4.2.11 All staff will be advised of the location of first aid services, equipment, and supplies.

4.2.12 The ERP shall be tested for deficiencies through emergency response drills annually or more frequently as required by legislation. Emergency drills such as man-down, hurricane/tornado drill, security, first aid are recommended to be conducted and lessons learned documented quarterly.

4.2.13 The ERP shall be reviewed annually or more frequently as required by legislation.

4.3 First Aid

4.3.1 Refer to *S3AM-012-PR1 First Aid* and *S3AM-111-PR1Bloodborne Pathogens* for additional information.

4.4 Other Emergency Response Equipment

4.4.1 Portable fire extinguishers shall be provided of appropriate class, size, and quantity in accordance with local legislation and *S3AM-011-PR1 Fire Protection*.

4.4.2 Provide eye wash stations (where appropriate to hazards).

4.4.3 Spill kits shall be available and properly stocked and maintained if there is potential for a spill, leak or release of hazardous materials. Refer to *S3AM-010-FM6 Chemical Spill Kit Inventory & Inspection*.

4.4.4 Maintain an ERP and emergency kit appropriate to the hazards associated with the location (e.g., earthquakes, tornadoes, hurricanes, etc.).

4.5 Communications

4.5.1 During an incident, the appropriate communications, as established in the location specific ERP, shall be initiated.

- If applicable, Emergency Communication Tree(s) (ECT) shall be initiated once the emergency management team has completed its assessment and determined employees must be notified.
- One employee shall be designated to launch the ECT, with an alternate ECT identified in the event the original lead is not available.
- Notes by those designated to make establish communication shall adequately document whether employees were successfully notified – receipt of notification shall be acknowledged to be considered successful.
- Any unsuccessful notifications shall be relayed back to the emergency team for follow-up.

- Supervisors are responsible for confirming that crews have access to communication devices that are in good working order, have reception in the area in which the crews will be working, and meet the needs of the planned check-in and emergency response procedures. This may include:
  - 2-way radios,
  - Cellular phones (or combination cell phone/2-way radio),
  - Satellite phones,
  - Car phones, or
  - Personal Locator Beacons.

4.5.2 The Manager will be responsible for confirming that crews have the appropriate means of communication before leaving for the worksite. The type of communication device will depend on the location and circumstances of the job task.

4.5.3 All staff is responsible for maintaining the communication devices in good working order before leaving for the field and for ensuring that battery-operated electronic devices have been recharged or have fresh batteries.

4.5.4 All staff is responsible for keeping communication devices clean and dry to facilitate their effective operation.

4.5.5 As appropriate, follow up notifications are made to:

- Line management and SH&E personnel – refer to applicable notification flowchart / call chain / ECT.
- Regulatory agency and client – as per legal / contractual obligations.

4.6 Visitors

4.6.1 All visitors to the location shall receive a safety orientation that includes ERP information.

- Visitors to worksite shall review the location specific SH&E Plan or Task Hazard Assessment (THA) and attend/review and sign the applicable tailgate/toolbox meeting.
- Visitors to offices and shop locations shall sign a Sign In/Out register as this record will be used to check and make sure all visitors are accounted for in the event of an emergency (e.g. evacuation to muster point). Refer to *S3AM-010-FM5 Office / Shop Visitor Register*.

4.6.2 In the event of an evacuation, visitors working directly with an AECOM host will be the escorted by their host to the muster point.

4.6.3 For in-house meetings, safety orientations will be delivered before the meeting begins so all visitors are aware of the evacuation routes and procedures

4.7 Emergency Response

4.7.1 Employees responding to emergency situations should take no unnecessary risk. In the case of an emergency, the First Aid Provider will promptly provide injured workers with a level of care within the scope of the attendant's training, objectively record observed or reported signs and symptoms of injuries and exposures to contaminants, secure medical treatment for workers with injuries considered by the first aid attendant as being serious or beyond the scope of the attendant's training.

4.7.2 All incidents shall be reported in accordance with *S3AM-004-PR1 Incident Reporting, Notifications & Investigation*.

4.7.3 If emergency action is required to correct a condition that constitutes an immediate threat to workers, only those qualified and properly instructed workers necessary to correct the unsafe condition may be exposed to the hazard and every possible effort will be made to control the hazard while this is being done.

4.7.4 In the event of an evacuation, all employees and visitors will gather together at the muster point for a roll call. Upon evacuation or dismissal, no unauthorized or nonessential personnel are allowed access to the facility or project area during an emergency.

4.7.5 All accident and emergency sites will be immediately secured to prevent unauthorized access or the possibility of further risk to workers, property, or the public at large.

4.7.6 All emergencies will be managed by the AECOM emergency management personnel identified in the ERP. This may include security personnel.

- The Local Resilience Coordinator (LRC) shall be the key point of contact with the Region Resilience Team in order to obtain further direction following an initial emergency response.
- Additional response via Resilience Teams shall be in alignment with *SR1-003-WI2 Disruptive Event Response Instruction.*

4.7.7 During an emergency, AECOM Employees shall take direction from AECOM members of the emergency team, (e.g. emergency coordinator, floor wardens, etc.) and outside professional responders, as appropriate, who are in control of the situation.

4.7.8 Employees should render assistance in the safest possible manner, using appropriate personal protective equipment and precautions.

4.7.9 Other actions that may be necessary shall be included as applicable in the location’s specific ERP. These include, but are not limited to:

- Notification of local authorities.

- Contact with appropriate AECOM security personnel for assistance.
- Notification of client representatives and any security group having authority on the worksite.

4.8 Post-Emergency Follow Up

4.8.1 If Regional, Geography or Enterprise Resilience Teams were convened, follow up response will be at the Team's direction.

4.8.2 Prior to resuming operations, the work area will be inspected to confirm that conditions are under control and no longer pose a hazard to employees. In the case of a fire or bomb threat, this inspection is to be done by the ranking public emergency responder. Management approval to return shall then be obtained in order to return to work.

4.8.3 The Emergency Response Procedure Action Checklist shall be completed (Contained in *S3AM-010-FM2 Location Specific Emergency Response Plan Template* and *S3AM-010-FM2-A Short Visit Emergency Response Plan Template)*.

4.9 Security

4.9.1 Conduct an evaluation of the worksite or location, local conditions, and contract stipulations to determine a need for:

- Access Control
- Vehicle Registration
- Identification badges for employees and visitors
- Fencing
- Security Guards
- Outside Lighting
- Secure Storage Areas
- Alarm Systems

4.9.2 *S3AM-010-FM3 Site Security Checklist* may be used to evaluate a location's need for specific security and to subsequently develop appropriate measures. This form may also be used at intervals for a given location to evaluate the need for any change to the security measures in place.

4.9.3 Where physical security of a location is required, management, with the assistance of SH&E personnel, will be responsible for organizing and supervising security guards. A local bonded security force may be used for this purpose. As an alternative, an in-house security organization may be established.

4.9.4 On many projects, identification badges or numbers are provided for employees. It may be necessary to provide a qualified security officer or team to provide the following services:

- Orientation to the location for new hires and visitors.
- Substance abuse testing for new hires.
- Issuance of badges for new hires and visitors.
- Briefing and debriefing for visitors.
- Monitoring of location activities to prevent theft, espionage, and malicious damage.

4.9.5 When a security program is established, the location specific ERP, including the procedures, and fire prevention and protection programs, shall be planned and coordinated with the program's security force.

4.9.6 On many projects involving military installations, nuclear work, and defense contracts, it may be necessary to provide a qualified security officer or team to monitor activities to prevent espionage, theft, malicious damage, and any compromise of classified information.

4.9.7 Contact the Human Resources Department for assistance if personnel security clearances are required.

4.10 Violence

4.10.1 Violence in the workplace training will be conducted where there is an elevated exposure to violence or, if required by regulation. Refer to *S3AM-003-PR1 SH&E Training*.

4.10.2 A risk assessment, refer to *S3AM-010-FM3 Potential Violence Assessment Form,* will be performed in any workplace in which there exists a risk of injury to workers from violence arising out of their employment or where required by regulation.

4.10.3 The risk assessment will include the consideration of:

- Previous experience in that workplace,
- Occupational experience in similar workplaces, and
- The location and circumstances in which the work will take place.

4.10.4 If an assessment identifies a risk of injury to workers from violence, the employer will establish procedures and work environment arrangements to eliminate or minimize the risk to workers from violence.

4.10.5 Controls will be implemented and communicated to employees to address the violence hazard. Control may include, but is not limited to, working in pairs, being assisted by police or other authority, having a clear emergency response procedure, and having access to a communication device.

4.10.6 Risk Assessment/Potential Violence Inspection Forms conducted for violence will be distributed to Managers and the applicable health and safety committees**.**

4.10.7 Workplace violence may include:

- Threatening behavior such as shaking fists, destroying property, or throwing objects.
- Verbal or written threats—any expression of intent to inflict harm.
- Harassment—any behavior that demeans, embarrasses, humiliates, annoys, alarms, or verbally abuses a person and that is known to be or would be expected to be unwelcome. This includes words, gestures, intimidation, bullying, or other inappropriate activities.
- Verbal abuse—swearing, insulting, or condescending language.
- Physical attacks—hitting, shoving, pushing, or kicking.

4.10.8 The risk of violence may increase during certain times of day and location. Be sure to plan ahead and take into account time of day, what tasks will be conducted, location(s), method of travel, and who might be accompanying.

4.10.9 Be prepared. Always carry electronic communications, such as mobile phones with emergency services numbers in speed dial list. If 911 is the emergency number, confirm that both mobile signal coverage and the 911 service work from the work location(s).

4.10.10 Public Meetings or Presentations:

- Facilitate and/or provide proper instruction to project employees on this procedure and how to identify and avoid potentially violent situations in public meetings or presentations.
- Identify community and emergency contacts.
- Determine whether a community leader should accompany employees to the public meeting or presentation.
- Ask a community leader or local police if there are any homes/areas to be avoided.
- Work with community leaders to make community residents aware of the work being undertaken. If in doubt, err on the side of caution. Do not expose employees to potentially violent situations.
- Send out advance notice to area residents about the nature and purpose of the visit.

4.11 Public Visitations

4.11.1 Before entering any home or sampling site, employees shall assess the risk of violence and confirm safety of and proper protection of themselves and co-workers. If there is any doubt about individual or group safety, do not enter the premises/area.

- Where possible, work with someone from the community who is known by and knows the residents.
- Have easily visible identification available.
- Be sensitive to cultural, social, and economic differences.
- Attempt to learn about potential problems before entering the area.
- Employees may not enter premises posted with Beware of Animal signs unless the owner has confirmed employees will be safe.

4.11.2 Employees shall report all acts of violence to their Supervisor, SH&E Manager or Human Resources Manager.

4.11.3 All acts of violence will be reported by the employee to their Supervisor or Region Human Resources Manager.

- Report any physical contact or any violent threats to the local authorities immediately, and summon help.
- Any reported incidents of violence will be held in confidence and will be handled with integrity and discretion. All incidents will be handled in accordance with *S3AM-004-PR1 Incident Reporting, Notifications & Investigation* procedure. Any injuries or results of exposure to violence will be handled in accordance with AECOM policies and procedures.

5.0 Records

5.1 The Location Specific ERP will be filed in the project file.

5.2 ERPs shall be part of site SH&E audits.

5.3 Emergency Response Drill Reports, Security Checklists and Potential Violence Assessment Forms shall be maintained in the location or project safety files.

6.0 Attachments

6.1 S3AM-010-FM1 Emergency Response Drill Report

6.2 S3AM-010-FM2 Location Specific Emergency Response Plan Template

6.3 S3AM-010-FM2-A Short Visit Emergency Response Plan Template

6.4 S3AM-010-FM3 Site Security Checklist

6.5 S3AM-010-FM4 Potential Violence Assessment Form

6.6 S3AM-010-FM5 Office / Shop Visitor Register

6.7 S3AM-010-FM6 Chemical Spill Kit Inventory & Inspection

Americas

Fire Protection

S3AM-011-PR1

1.0 Purpose and Scope

1.1 This procedure establishes the AECOM requirements for the selection, placement, use, and inspection of fire extinguishing and fire detection equipment.

1.2 This procedure includes steps to reduce the likelihood of a fire at AECOM locations, and outlines actions to be taken in the event of a fire at an AECOM site.

1.3 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 **Combustible liquid** – NFPA 30 and WHMIS Canada - A liquid that has a flashpoint at or above a temperature of 100 degrees Fahrenheit (°F) or 37.8 degrees Celsius (°C).

2.2 **Emergency Response Coordinator** – An individual in a worksite or project environment designated to lead and direct the immediate emergency response. Refer to *S3AM-010-PR1 Emergency Response Planning*.

2.3 **Flammable liquid** –

- OSHA 29 CFR 1910.106 - Any liquid having a flashpoint at or below 199.4 °F (93 °C).
- NFPA30 and WHMIS Canada - A liquid that has a flashpoint below a temperature of 100°F (37.8°C), except any mixture having components with flashpoints of 100ºF (37.8ºC) or higher, the total of which make up 99 percent or more of the total volume of the mixture

2.4 **Flashpoint** – The lowest temperature at which a liquid gives off enough vapor to be ignited at the surface of the liquid.

2.5 **Floor Marshall / Warden** – An individual in the office environment designated to lead and direct the immediate emergency response. Refer to *S3AM-010-PR1 Emergency Response Planning*.

3.0 References

3.1 S3AM-004-PR1 Incident Reporting, Notifications & Investigation

3.2 S3AM-010-PR1 Emergency Response Planning

3.3 S3AM-126-PR1 Flammable & Combustible Liquids

3.4 S3AM-332-PR1 Hot Work

4.0 Procedures

4.1 Roles and Responsibilities

4.1.1 **Manager / Supervisor**

- Confirm that any fire extinguishing and detection equipment established at AECOM facilities, leased facilities, vehicles, or sites are properly installed / mounted and appropriately inspected by competent personnel.
- Determine the inspection arrangements and servicing of fire extinguishing, detection, and suppression equipment located on-site that does not fall under the AECOM span of control.
- Confirm that fire protection equipment that AECOM owns or leases is inspected and maintained in accordance with local fire codes.

- Confirm that all personnel who may use a portable fire extinguisher or other fire protection equipment are adequately trained in their use.
- Confirm that a location specific emergency response plan has been developed and is tested for efficiency and effectiveness on an annual basis as a minimum.

4.1.2 **SH&E Manager**

- Determine and approve the appropriate fire protection equipment kept at the location.
- Assist with the development of location specific emergency response plan, and with inspections, drills and investigations as required.

4.1.3 **Floor Marshall / Warden or Emergency Response Coordinator**

- Confirm that portable fire extinguishers kept at AECOM locations are inspected at required intervals (e.g. charged and checked regularly for corrosion or any other external damage).
- Confirm that all fire equipment that has been used, or that otherwise fails an inspection is immediately tagged and removed from service.
- Confirm that fire protection equipment is kept in a conspicuous location and that access to fire protection equipment is not blocked or impeded.
- Review and be familiar with the location specific emergency response plan.
- Participate in any required training, drill exercises and reviews.
- Confirm that all fire drills and emergencies are executed to plan details and location is completely evacuated accordingly.

4.1.4 **Employees**

- Employees involved in operations where a fire extinguisher could be expected to be used shall be trained in its use (e.g. fixed facilities and project sites, fire watch, etc.). Training shall allow employees to familiarize themselves with the general principles of fire extinguisher use and the hazards involved with incipient stage fire-fighting. Training shall be renewed annually if applicable to the employee's anticipated tasks.
- Shall familiarize themselves with the fire response and protection procedures that apply to their office and client sites when working for extended periods of time within the facilities of a client.
- Review and be familiar with the location specific emergency response plan.
- Participate in any required training and drill exercises.

4.2 Planning

4.2.1 Identify flammable and combustible materials. Review SDSs to determine flammable and combustible hazards.

4.2.2 Conduct evacuation drills at least annually and review results for efficiency and effectiveness. Refer to *S3AM-010-PR1 Emergency Response Planning.*

- Maintain good housekeeping to reduce fire hazards, to ensure access to fire extinguishers and other firefighting equipment is not blocked or impeded, and to provide safe routes of egress should a fire occur.

4.2.3 All AECOM offices, sites and equipment shall be equipped with a fire extinguisher and/or fire protection equipment appropriate to the number of staff, location of the work, and job task, as specified by jurisdictional requirements and, as applicable, client requirements.

4.2.4 Fire protection equipment shall be suitable to the anticipated temperatures of the environment.

4.2.5 Portable Fire Protection Equipment may include, but is not necessarily limited to:

- Fire Extinguishers of appropriate size, class, and type for the specific hazards on-site
- Round-nosed shovel
- Axe or pulaski

- Power saw
- Fire blanket

4.2.6 Fixed Fire Protection Equipment may include, but is not necessarily limited to:

- Fire hose connections
- Sprinkler / suppression systems
- Fire doors
- Smoke / fire detectors or monitors

4.2.7 All employees shall be constantly on the alert for conditions that might contribute to a fire and shall remove or report the hazard.

4.2.8 Portable fire extinguishing equipment, rated not less than 2A:20BC and suitable for the fire hazard involved, will be provided at convenient, conspicuously accessible locations according to anticipated hazards and in accordance with applicable jurisdictional requirements.

4.2.9 All employees shall know the location of firefighting equipment in their work area.

4.2.10 Access to a firefighting equipment (e.g. portable fire extinguishers, sprinkler / suppression heads, fire hydrants, detection monitor, etc.) shall not be blocked by material, equipment, or shelving.

4.3 Fire Prevention

4.3.1 If hot work must be performed, it shall be conducted only after a hot work permit has been issued and a fire watch is established. Refer to *S3AM-332-PR1 Hot Work*.

4.3.2 Areas identified as having flammable or combustible materials should be posted with appropriate signage (e.g. no smoking, no open flame, etc.).

4.3.3 If applicable to the fire hazard, flammable refuse and garbage (e.g., solvent covered rags) shall be discarded in covered containers.

4.3.4 Smoking shall be restricted to designated areas and cigarette butts disposed of appropriately.

4.3.5 Outdoor

- Combustible materials will be stored with regard to the stability of piles and proximity to ignition sources. Height of piles shall comply with jurisdictional regulatory requirements (e.g. 29 CFR 1926.151 Open Yard Storage - maximum height of 20 feet [6 meters]).
- The method of piling combustible materials will be solid and in orderly regular piles. No combustible material will be stored outdoors within 10 feet (3 meters) of a building or structure.
- Driveways between and around combustible storage piles will be at least 15 feet (4.6 meters) wide and maintained free of accumulations of rubbish, equipment, or other articles or materials. Driveways will be spaced to produce a maximum grid system unit of 50 feet (15.2 meters) by 150 feet (45.7 meters).
- The entire storage site will be kept free from accumulations of unnecessary combustible materials. Weeds and grass will be maintained, and procedures will be established for periodic clean-up of the entire area.
- During dry weather and wildfire seasons, the below additional steps to prevent wildfires from starting and spreading will be implemented.
    - Fires of any type are strictly prohibited, at all times,
    - Defensible Space – A buffer zone or defensible space shall be established, around the work area of at least 50 feet (15.2 meters). This defensible space is created by clearing flammable materials away from the work area and buildings.
        - Remove flash fuels such as dead grass or vegetation that is down on the ground. (Do not remove live native plants from the natural area open space.)
        - Consistently monitor defensible space for maximum fire prevention.

- Smoking – Smoking will be limited to a designated area established by the Supervisor or Manager. During conditions that present a high risk for fire the area will contain a water-filled cigarette butt can and fire bucket. At instruction of the Supervisor or Manager, smoking may be prohibited during dry weather and wildfire season.
- Hot Work – During conditions that present a high risk for fire, all outdoors field hot work (welding, cutting or use of spark producing tools) should be suspended.
- Equipment – During dry weather and wildfire season, spark arrestors should be considered for use on mechanical equipment such as generators, chain saws, chop saws, string trimmers and off road vehicles to prevent sparks form exiting trough the exhaust pipe. Spark arrestors should be in proper working order. Vehicles with under carriage exhaust/catalytic converters shall not be parked in grassy areas.

4.3.6 Indoor

- Storage will not obstruct, or adversely affect, means of exit.
- Fire doors and egress must be sized and designed for the occupancy type and numbers.
  - Fire doors may not be propped open.
  - Fire exit signs must be posted and paths of travel must be maintained as per jurisdictional requirements.
  - Employees shall be oriented and familiar with exits and muster point(s).
- Materials will be stored, handled, and piled with regard to their fire characteristics.
- Flammable and combustible fluids shall be appropriately handled and stored. Refer to *S3AM-126-PR1 Flammable & Combustible Liquids*.
- Non-compatible materials, which may create a fire hazard, will be segregated by a barrier having a fire resistance of at least 1 hour.
- Materials will be piled to minimize the spread of fire internally and to permit convenient access for firefighting. Stable piling will be maintained at all times. Aisle space will be maintained to safely accommodate the widest vehicle used within the building for firefighting purposes.
- A clearance of at least 36 inches (90 cm) will be maintained between the top level of the stored material and the sprinkler / suppression deflectors.
- Clearance will be maintained around lights and heating units to prevent ignition of combustible materials.
- A clearance of 24 inches (60 cm) will be maintained around the fire door's path of travel, unless a barricade is provided, in which case no clearance is needed. Material will not be stored within 36 inches (90 cm) of a fire door.

4.4 In the Event of a Fire

4.4.1 Initiate the response in accordance with the location specific Emergency Response Plan (ERP). Refer to *S3AM-010-PR1 Emergency Response Planning*.

4.4.2 Employees responding to emergency situations should take no unnecessary risk. If available, activate the nearest fire alarm or call for help before attempting to extinguish a fire. If the fire is too big to control with the equipment at hand, retreat.

4.4.3 Never face away from a fire. Always back away until at a safe distance.

4.4.4 Never use water on an electrical fire.

4.4.5 All fire extinguisher contents shall be applied from upwind and directed at the base or outer edge of the fire with a sweeping motion.

4.4.6 Never return a discharged fire extinguisher to its normal location. Take it out of service, tag the extinguisher for recharging, and replace it with a fully charged unit.

4.5 Fire Extinguishers

4.5.1 The minimum number of fire extinguishers will be maintained in accordance with building and occupancy codes. Additional extinguishers may be maintained depending on specific site requirements or needs. Extinguishers shall be kept in an obvious location that is known to all staff.

4.5.2 Vehicles and mobile equipment used for field work may be required to carry fire extinguishers, depending on client and/or industry standards. These fire extinguishers shall be secured to the vehicle, readily accessible, and never carried loose the cab. It is the responsibility of the vehicle or mobile equipment operator to confirm that these fire extinguishers are charged, secured, and available in good working condition.

4.5.3 Fire extinguishers shall be readily available wherever the potential for fire exists (e.g., during welding, grinding, or open flame operations.

4.5.4 Fire extinguishers will also be available in locations where flammable or combustible materials are stored, handled, or used.

4.5.5 Fire extinguishers will be readily accessible, properly maintained, regularly inspected, and promptly recharged and replaced immediately after use.

4.5.6 Only trained employees should use a fire extinguisher, and only if operation does not endanger the user.

4.5.7 In the event of a fire, follow the location-specific emergency procedures for contacting the appropriate firefighting personnel (e.g. local fire department, plant fire crew, etc.).

4.5.8 Location and Identification of fire extinguishers:

- Refer to the *S3AM-011-ATT1 Portable Fire Extinguishers*.
- Fire extinguishers will be located and installed as follows:
    - Mounted in accordance with applicable building or site requirements.
    - If maintained in vehicles or equipment, securely mounted using appropriate brackets in a readily accessible location.
    - If a wheeled portable fire extinguisher, mounted and secured to the appropriate manufacturer supplied mobile bracket.
    - Located where they are readily seen. If an obstruction is unavoidable, then a sign indicating the location of the extinguisher and/or color symbol (e.g., red markings) will be used.
    - Fire extinguishers will always be positioned with the label visible.
    - If extinguishers of different classes (e.g., one Class A and one Class B) are stored together, then they will be marked using stencils or signs indicating clearly for which type of fire each will be used.
    - If an extinguisher contains an electrically conductive agent (e.g., water), it will be clearly labeled with a sign that states “Not for Electrical Fires” with letters visible from at least 3 feet (90 centimeters) away.
    - Extinguishers will not be left on the floor but will be hung on a wall, column, or other appropriate support or will be of the wheeled or cart type. Extinguishers of not more than 40 pounds will be hung so that the top is not more than 5 feet (1.5 meters) above the floor. Extinguishers greater than 40 pounds (18.1 kilograms) will be hung so that the top is not more than 3½ feet (1 meter) from the floor. The bottom of the extinguisher will not be less than 4 inches (7 centimeters) from the floor.
- Installation locations of fire shall be appropriate to the operating temperature range (e.g. can or cannot tolerate freezing).

4.6 Fixed Fire Protection Equipment

4.6.1 The design of fixed fire protection equipment will be reevaluated whenever the occupancy changes (e.g., increases) or the fire hazards increase.

4.6.2 Fixed fire protection systems shall be installed in all areas inside buildings in which flammable liquids are mixed, dispensed, applied, or used for washing or quenching, in accordance with jurisdictional requirements and standards.

4.6.3 Sprinkler / suppression heads shall not be painted or coated.

4.6.4 Sprinkler / suppressions should be installed or removed only using a sprinkler / suppression wrench designed specifically for that purpose.

4.6.5 Pipe hangers shall be replaced / repaired when broken or loose.

4.6.6 New sprinkler / suppression installation shall be designed and installed as required by applicable safety standards and building codes.

4.6.7 Fire detection systems shall be located away from, or by other means protected from, mechanical or physical damage.

4.7 Inspection of Fire Protection Equipment

4.7.1 Inspection of fire protection equipment shall be conducted according to manufacturer's specifications and regulatory requirements.

4.7.2 Inspection, Maintenance, and Testing of Portable Extinguishers

- Refer to the *S3AM-011-ATT1 Portable Fire Extinguishers* for specifics on types.
- The use or discharge of any fire extinguisher by an AECOM employee shall be immediately reported to the Supervisor and in accordance with *S3AM-004-PR1 Incident Reporting, Notifications & Investigation*.
- Extinguishers are to be inspected monthly to ensure that they are still in the proper location, have not been used or tampered with, are still properly charged, and have no obvious external damage. The initials of the inspector and the date of inspection will be noted on the tag attached to the extinguisher.
- Any extinguisher showing damage will be replaced.
- Mounting brackets as well as wheeled mobile brackets should also be inspected for ease of access to the extinguisher and proper operating condition.
- A thorough inspection will be performed annually by personnel specifically trained in the inspection (e.g., extinguisher supplier).
- Extinguishers will be tested and recharged by qualified contractors as required by the applicable regulations and standards.

4.7.3 Inspection, Maintenance, and Testing of Fixed Systems

- Fixed fire protection equipment will be inspected and maintained by personnel specifically trained in the specific procedures to perform these tasks.
- No objects shall be hung from sprinkler / suppression components.
- Records of the testing and inspection of fixed systems will be maintained for at least 3 years.
- Sprinkler / suppression systems will be tested at a minimum as follows**:**
  - Annually – perform a main drain flow test.
  - Every 2 years – open the inspector's test valve to ensure that the system operates properly.
- Any hose and standpipes will be inspected annually by appropriately trained personnel.

- Test fire detection systems (e.g., smoke alarms) annually and record the results of the test. This testing will be performed by personnel specifically trained to do the testing.

5.0 Records

5.1 Fire Extinguisher Inspection reports will be maintained in the location's safety files.

5.2 Fire Extinguisher Inspection tags will be affixed to the extinguisher.

6.0 Attachment

6.1 S3AM-011-ATT1 Portable Fire Extinguisher

Portable Fire Extinguishers

S3AM-011-ATT1

1.0 Portable Fire Extinguishers

1.1 Portable extinguishers will be selected based on the following classifications:

Classification	Type of Fire
Class A	Combustible materials
Class B	Flammable liquid, gas, or grease
Class C	Electrical equipment
Class D	Combustible metal

In addition, portable fire extinguisher selection, placement, and fire protection systems designed for use on a project or in an AECOM office will be made in conjunction with an SH&E Department, the local Fire Department, or a professional fire protection systems contractor. Unless otherwise approved by an SH&E Department, fire extinguishers selected for use will be of the Type A, B, and/or C variety, typically charged with water, carbon dioxide, nitrogen, a dry chemical, or other approved extinguishing agent.

1.1.2 Extinguisher Classifications and Ratings

- For extinguishers rated for Class A fires, the rating number indicates relative effectiveness, the higher the number, the more effective the extinguisher.
- For extinguishers rated for Class B fires, the rating number represents the average size (in square feet) of the fire the extinguisher could put out.
- No number is used for extinguishers rated for Class C fires, because Class C fires are essentially either Class A or B fires involving energized electrical wiring and equipment.

1.2 The materials in a building or area present hazards of varying potential. These hazards are classified. As follows:

1.2.1 Light or Low Hazard – A room or area where, considering the amount of combustible material or flammable liquids present, fires of small size should be anticipated (e.g., change trailers, toilet trailers, and general storage).

1.2.2 Ordinary or Moderate Hazard – A location where, considering the amount of combustibles or flammable liquids present, fires of moderate size should be anticipated (e.g., temporary construction offices and most shops).

1.2.3 Extra or High Hazard – A location where, considering the amount of combustibles or flammable liquids present, fires of severe magnitude should be anticipated (e.g., carpenter shops and storage areas for flammable liquids and lumber).

1.3 Class A Extinguishers – The number of Class A extinguishers will be based on the following:

	Light (low) Hazard Occupancy	Ordinary (moderate) Hazard Occupancy	Extra (high) Hazard Occupancy
Minimum rated single extinguisher	2-A	2-A	2-A
Maximum floor area per unit of A	3,000 sq. ft. 278.7 m^2	1500 sq. ft. 139.4 m^2	1000 sq. ft. 93.0 m^2
Maximum floor area for extinguisher	11,250 sq. ft. 1045.2 m^2	11,250 sq. ft. 1045.2 m^2	11,250 sq. ft. 1045.2 m^2
Maximum travel distance to extinguisher	75 ft. 22.8 m	75 ft. 22.8 m	75 ft. 22.8 m

The availability of Class A extinguishers can be satisfied with the use of extinguishers with multiple ratings (e.g., Class A, B, and C). In addition, where automatic sprinkler systems are present, the maximum floor area for each extinguisher does not apply; however, the 75-foot travel distance does.

1.4 Class B Extinguishers – Class B extinguishers will be provided according to the severity of the hazard as listed below:

Fire extinguishers labeled after June 1, 1969		
TYPE OF HAZARD	**BASIC MINIMUM EXTINGUISHER RATING**	**Maximum Travel Distance to Extinguishers in Feet (m)**
Light	5B, 10B	30 (9.1), 50 (15.2)
Ordinary	10B, 20B	30 (9.1), 50 (15.2)
Extra	20B, 40B	30 (9.1), 50 (15.2)

An open tank in a building having flammable liquids in depth exceeding ¼ inch (6.4 mm) will be provided with sufficient extinguishers to provide 1 numerical unit of Class B or each square foot of tank surface area, the minimum extinguisher being a 5B (using labels after June 1, 1969). For example, a tank with a surface area of 50 square feet (4.6 m^2) will require two Class 20B (or one 40B) and one Class 10B extinguisher. For tanks exceeding 100 square feet (9.3 m^2) in surface area, a fixed extinguisher will be provided, in addition to sufficient portable extinguishers for the numerical unit of Class to equal 100 (e.g., two Class 40B and one Class 20 B).

All Class B extinguishers will be located on the same floor as the hazard, with a travel distance of no more than 50 feet (15.2 meters). For widely separated hazards (e.g., boiler rooms, paint storage areas, kitchens), a separate extinguisher for each class of hazard will be provided if the travel distance is more than 25 feet (7.6 meters).

1.5 Class C Extinguishers – Class C extinguishers (one 15-pound carbon dioxide or equivalent) will be provided within 25 feet (7.6 meters) of a high hazard area containing an electrical distribution source such as a generator, transformer, or main switchgear. Also, the extinguisher size and locations will be determined based on the expected type of fire (combustible-Class A or flammable-Class B) as noted above.

1.6 Class D Extinguishers – A Class D extinguisher for the specific type of combustible metal will be kept within 25 feet (7.6 meters) of the area where the metal is machined or processed.

Americas

Housekeeping

S3AM-013-PR1

1.0 Purpose and Scope

1.1 This procedure provides AECOM's basic housekeeping requirements for offices and work sites, as well as establishes personal hygiene and sanitation standards for housekeeping.

1.2 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 None

3.0 References

3.1 S3AM-208-PR1 Personal Protective Equipment

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Managers / Supervisors**

- Implementation of this procedure at all AECOM sites and offices.
- Confirm inspections are performed at appropriate intervals.
- Confirm the building Property Manager maintains leased facilities effectively.

4.1.2 **SH&E Managers**

- Monitor, assess, and report on housekeeping when visiting AECOM sites.

4.1.3 **Employees**

- Report any areas of concern to their Manager / Supervisor for prompt resolution.
- Maintain office locations that are free from debris, clutter, and slipping or tripping hazards.

4.2 General Housekeeping

4.2.1 All aisles, emergency exits, fire extinguishers, etc., will be kept clear (a minimum of three feet / 0.9 meters of either side) of material storage (temporary and permanent) at all times.

4.2.2 Areas in front of electrical panels will be kept clear and free of debris and materials storage for a minimum distance of 36 inches, or approximately 0.9 meters.

4.2.3 All work areas shall be kept clean to the extent that the nature of the work allows.

4.2.4 Spills shall be promptly cleaned up and resulting waste will be disposed of properly.

4.2.5 Storage areas will be maintained in an orderly manner at all times. When supplies are received, the supplies will be stored properly.

4.2.6 At all times, work areas will be kept free of debris and unused materials, tools and equipment that may affect the safety of employees and visitors.

4.2.7 All sharps, and sharp objects, shall be stored and/or guarded in a manner that prevents injury.

4.2.8 Recyclable material, debris and trash will be collected and stored in appropriate containers (e.g., recycle bins, plastic trash bags, garbage cans, roll-off bins) prior to disposal or recycling.

4.2.9 Containers maintained outdoors shall be provided with lids that are kept closed. Contents shall be removed at appropriate intervals (e.g. garbage weekly, garbage daily in areas with wildlife, monthly recyclable cardboard, etc.).

4.2.10 Take positive control measures for protection against vermin, insects, and rodents.

4.3 Smoking, Eating, and Drinking

4.3.1 Eating and drinking will be permitted in designated areas. These areas shall be located away from the work zone.

4.3.2 Operate and maintain food dispensing facilities established by AECOM in compliance with applicable health and sanitation regulations.

4.3.3 Buildings housing food dispensing facilities shall be floored completely, painted, well lighted, heated, ventilated, fly proof, and sanitary. Equip doors and windows with screens.

4.3.4 Microwave ovens shall be used for food only.

4.3.5 Use refrigerators designated for food storage for food only (i.e., no chemical or samples storage).

4.3.6 Hand washing stations shall be available nearby for employees entering the eating and smoking areas.

4.3.7 Smoking will be permitted only in areas:

- Designated in compliance with applicable local laws, regulations, legislation and ordinances;
- Not in the immediate vicinity of work-related activities or designated eating and drinking areas.
- Free of fire hazard;
- That will not contaminate indoor areas and HVAC systems. Specifically, there shall be no smoking within 5 metres (16 feet) around doorways, windows, air vents, and HVAC intakes and equipment; and
- Supervisors will designate each smoking area giving primary consideration to those employees who do not smoke.

4.3.8 Employees involved in the performance of certain activities will not be permitted to smoke, eat, drink, or use smokeless tobacco, except during breaks (e.g., HAZWOPER-controlled work areas).

4.3.9 Site employees will first wash hands and face after completing work activities which involve potential exposure or contact with hazardous substances and prior to eating or drinking.

4.4 Water Supply

4.4.1 Water will be available for use on all AECOM sites and will comply with the following requirements:

- Potable Water:
  - An adequate supply of drinking water will be available for site staff consumption.
  - Potable water can be provided in the form of approved well or city water, bottled water, or drinking fountains.
  - Water coolers and water dispensers shall be maintained in a sanitary condition and filled only with potable water.
  - Where drinking fountains are not available, individual use cups will be provided as well as adequate disposal containers. Do not use common drinking cups.
  - Potable water containers will be properly identified in order to distinguish them from non-potable water sources.
  - Laboratory-test drinking water obtained from streams, wells, or other temporary sources in accordance with applicable regulations, or often enough to ensure it is suitable for consumption. Maintain records of testing reports and results.

- Non-potable Water:
  - Non-potable water will not be used for drinking purposes.
  - Non-potable water may not be used for hand washing or other personal hygiene activities but may be used for other types of cleaning activities.
  - All containers/supplies of non-potable water used will be properly identified and labelled as such.

4.5 Toilet Facilities

4.5.1 Clean and sanitary toilet facilities in good repair will be available for site and office staff and visitors. For locations without flush toilets readily available, one of the following shall be provided:

- Chemical toilets.
- Combustion toilets.
- Recirculation toilets.

4.5.2 A minimum of one toilet will be provided for every 20 site staff, with separate toilets maintained for each sex, except where there are less than five total staff on site or in an office.

4.5.3 Where toilet facilities will not be used by women, urinals may be provided instead of water closets in accordance with jurisdictional regulations.

4.5.4 Provisions for toilet facilities shall be considered as being met when mobile crews or employees working at normally unattended work locations have transportation immediately available (within 4 minutes travel time) to nearby toilet facilities.

4.5.5 Toilets shall be constructed so that the interior is lighted, by artificial or natural light, adequate ventilation is provided, and all windows and vents are screened.

4.5.6 A means for washing hands shall be provided next to or near toilet areas.

4.5.7 Release sanitary sewage into sanitary sewer lines or to other proper disposal channels.

4.6 Washing Facilities

4.6.1 Hand and Face: As applicable to the individual's potential exposure or contact with hazardous substances, site staff will wash hands and face after completing work activities and prior to breaks, lunch, or completion of workday.

4.6.2 Personal Cleaning Supplies: Cleaning supplies at all AECOM sites will consist of soap, water, and disposable paper towels or items of equal use/application (e.g., anti-bacterial gels, wipes, etc.).

4.7 Work Areas

4.7.1 Worksites which store chemical or environmental samples in refrigerators will clearly label the refrigerators that no food or beverages permitted and will locate refrigerators and sample coolers used for temporary sample storage, away from any food areas.

4.7.2 Every work area shall be maintained, so far as practicable, in a dry condition. Where wet processes are used, drainage shall be maintained and platforms, mats, or other dry standing places shall be provided, where practicable, or appropriate waterproof footgear shall be provided.

4.7.3 Protruding objects or placement of materials on paths or foot traffic areas creates the risk of slips, trips, falls, and puncture wounds. Employees shall eliminate slip, trip, and fall hazards where reasonably practicable.

4.7.4 At no time will debris or trash be intermingled with waste PPE or contaminated materials.

4.8 Break Areas and Lunchrooms

Site staff will observe the following requirements when using break areas and lunchrooms at AECOM sites:

4.8.1 All food and drink items will be properly stored when not in use.

4.8.2 Food items will not be stored in personal lockers for extended periods in order to prevent the potential for vermin infestation.

4.8.3 Perishable foods will be refrigerated whenever possible.

4.8.4 All waste food containers will be discarded in trash receptacles.

4.8.5 All tables, chairs, counters, sinks, and similar surfaces will be kept clean and free of dirt, waste food, and food containers at all times.

4.8.6 All ice dispensing machines for beverages shall be hands free/touchless design to prevent bacterial contamination (no ice scoops or ice bins permitted, closed beverage containers can be stored in portable ice coolers but the ice may not be used in the beverage).

4.8.7 Refrigerators used to store food items will be maintained at 40 degrees Fahrenheit (4 degrees Celsius) and emptied of all unclaimed food items weekly. Refrigerators used to store food will be labelled as such so that only food and drinks are stored within the refrigerator.

4.8.8 Routine cleaning of refrigerators will also be performed on a regular basis.

4.9 Change Rooms and Sleeping Facilities

4.9.1 Heated and ventilated change rooms shall be provided for changing, hanging, and/or drying clothing for operations subjecting employees to prolonged wetting or contact with hazardous materials.

4.9.2 Temporary sleeping quarters shall be heated, ventilated, lighted, and clean with all doors and windows screened.

4.9.3 Keep clean and sanitary, and periodically disinfect bunkhouses, bedding, and furniture.

4.10 Office Areas

Office areas are to be kept neat and orderly. The following general rules apply to prevent injuries and to maintain a professional workplace appearance.

4.10.1 All waste receptacles shall be lined with a plastic trash bag to avoid direct contact with waste during disposal. Employees shall use gloves when handling waste and may use a compaction bar to compress waste when necessary.

4.10.2 Keep file and desk drawers closed when not in use to avoid injuries. Open only one file drawer at a time to prevent tipping of file cabinets. Nothing should be stored on top of high filing cabinets without adequate support.

4.10.3 Telephone cords, electrical cords, wastebaskets, open file cabinets, and other ground-level hazards shall be managed in a manner that protects employees from tripping and obstruction hazards.

- Electrical cords and computer/phone cables will be bundled and stored.
- Cord covers should be used to protect temporary extension cords (used for presentations etc.) where they could be a tripping hazard.
- Small electrical appliances shall not be plugged into portable extension cords.
- Multiple appliances amperage should not exceed the circuit load limits.

4.10.4 Electrical appliances shall not be used in wet areas unless the circuit is equipped with ground fault circuit interrupters (GFCI).

4.10.5 File cabinets, desk drawers, safes, and other doors shall be fitted with handles or other hardware to protect employees from pinch points.

4.10.6 All materials shall be stored in a manner that prevents tipping of storage furniture (e.g. book shelves, file cabinets) and inadvertent falling of overhead material.

4.10.7 Do not stack excessive amounts of papers or other material on shelves to reduce possibility of shelf overload or falling items.

4.10.8 Workstations should be tidied, as a minimum, at the end of each day.

- Paperwork that is not currently needed should be filed appropriately
- Refrain from storing items on the floor as they may become falling or tripping hazards.

4.10.9 In public areas of the office:

- Maintain chairs in good repair.
- Keep rugs clean, in good repair, and free of tripping hazards.
- Clean up spills immediately.
- Pick up objects that may have been left on the floor by others.
- Report loose carpeting, damaged flooring, or other obstructions that are present in walkways.

4.10.10 Broken or damaged office furniture and equipment shall be removed from service. Office equipment shall be repaired and serviced by qualified personnel or contractors.

5.0 Records

5.1 None

6.0 Attachments

6.1 S3AM-013-FM1 Housekeeping Inspection

Americas

Manual Lifting

S3AM-014-PR1

1.0 Purpose and Scope

1.1 This procedure provides the requirements for AECOM employees to use when performing manual materials handling activities (e.g., lifting/handling of items or materials).

1.2 This procedure applies to all staff for AECOM Americas-based operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 **Manual Materials Handling (MMH)** – Moving or handling things by lifting, lowering, pushing, pulling, carrying, holding, or restraining.

2.2 **Team Handling** – Team handling occurs when more than one person is involved during the lift.

3.0 References

3.1 None

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager**

- Administer the procedure, provide resources as required and provide direction on proper lifting/handling techniques.
- Ensure material handling activities are monitored and facilities assessed to ensure compliance with the procedure and proactively identify and correct hazardous conditions.
- Ensure the proper reporting and investigations of any incidents, including those associated with manual material handling.
- Ensure this procedure and any associated or applicable documents are reviewed as part of an investigation and revised as required to prevent future incidents.

4.1.2 **SH&E Manager**

- Ensure material handling activities are monitored and facilities assessed to ensure compliance with the procedure and proactively identify and correct hazardous conditions.
- Assist in identifying activities with a high potential for lifting/handling strains and injuries as well as the associated mitigation strategies.
- Ensure employee training on proper lifting/manual materials handling techniques.
- Assist in any investigations of incidents, including those associated with manual material handling.

4.1.3 **Employees**

- Complete training appropriate to their anticipated manual material handling tasks.
- Review and follow any additional procedures or instructions applicable to the task at hand.

4.2 Mechanical / Engineered Controls

4.2.1 Whenever possible, new operations should be evaluated to engineer out hazards before work processes are implemented.

4.2.2 Mechanical equipment or assistance such as hand carts, dollies, carts, come-alongs, conveyors, rollers, or if appropriate, pallet jacks, skid steers, or telehandlers, are preferable to be used whenever possible rather than the employee physically moving materials.

4.2.3 Mechanical assistance will be of proper size and height, have wheels sized for the terrain, and be designed to prevent pinching or undue stress on joints.

4.2.4 Mechanical equipment or assistance shall be inspected and appropriately maintained. Defective equipment shall be tagged, removed from service, and repaired or replaced.

4.2.5 Objects to be moved will be secured to prevent falling and properly balanced to prevent tipping.

4.2.6 Material handling tasks should be designed to minimize the weight, range of motion, and frequency of the activity.

4.2.7 Alter the task to eliminate the hazardous motion and/or change the position of the object in relation to the employee's body—such as adjusting the height of a pallet or shelf.

4.2.8 Work methods and stations should be designed to minimize the distance between the person and the object being handled.

4.2.9 Confirm well-lit and clear paths of travel.

4.2.10 High-strength push-pull requirements are undesirable, but pushing is better than pulling. Material handling equipment should be easy to move, with handles that can be easily grasped in an upright posture.

4.2.11 Workbench or workstation configurations can force people to bend over. Corrections should emphasize adjustments necessary for the employee to remain in a relaxed upright stance or fully supported seated posture. Bending the upper body and spine to reach into a bin or container is highly undesirable. The bins should be elevated, tilted, or equipped with collapsible sides to improve access.

4.2.12 Repetitive or sustained twisting, stretching, or leaning to one side are undesirable. Corrections could include repositioning bins and moving employees closer to parts and conveyors

4.3 Administrative Controls

4.3.1 Task hazard assessment (THA) must include manual material handling, its associated hazards and the appropriate actions to take to eliminate or reduce the identified risks.

4.3.2 Stage materials close to the applicable work area to minimize carrying distances.

4.3.3 When significant, sustained lifting work is required, it is desirable to rotate employees to spread the work load among several people and thereby avoid fatigue.

4.3.4 Rotation is not simply performing a different job, but is performing a job that utilizes a completely different muscle group from the ones that have been overexerted.

4.3.5 All employees exposed to manual handling hazards shall be trained by competent persons on the hazards associated with manual material handling, and the safe lifting and handling of loads applicable to their anticipated manual handling tasks.

4.3.6 Employees shall not manually handle materials in excess of their personal lifting limit, with no personal lifting limit exceeding 50 pounds (22.7kg).

- Manual handling weight limits may decrease from 50 pounds (22.7kg) depending upon several variables. Refer to *S3AM-014-ATT1 Recommended Weight Limit Calculations.*
- This restriction should also be applied to a team handling or a buddy lift (item lifted by the team should be no more than 50 pounds [22.7kg]). Should one lifter fail, the remaining worker would bear 100% of the load weight.

4.4 Training

4.4.1 Employees who may have MMH as part of their duties are required to receive training that includes the following topics:

- Methods to avoid unnecessary physical stress and strain during MMH operations.
- Signs and symptoms of musculoskeletal injuries and reporting requirements.
- Methods to maintain personal awareness of what the individual can comfortably handle without undue strain.
- Instruction on the proper use of lifting equipment.
- Recognition of potential hazards and how to prevent or correct them.

4.4.2 This training must be completed prior to an employee being assigned to a task that involves MMH activities.

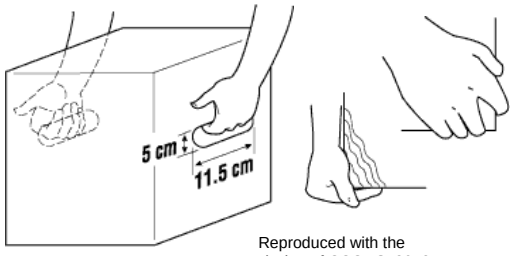
4.4.3 Assistance with training or training materials is available through the Safety, Health and Environment staff.

4.5 General Handling

4.5.1 Before Performing a Lift:

- Check to see if mechanical aids such as hoists, lift trucks/dollies, or wheelbarrows are available.
- Confirm that, based on personal physical capabilities and medical limitations, that the load can be lifted without overexertion. Get help with heavy or awkward loads.
- Confirm that the load is “free” to move.
- Do not lift loads if personal health issues or doctors recommendations prevent it.
- Manual handling weight limits may decrease depending upon several variables. Refer to *S3AM-014-ATT1 Recommended Weight Limit Calculations*.
- Do not manually handle loads if unsure of personal limitations on what load can be handled safely.
- Check that the planned destination and travel path of the load is free of obstacles, personnel and debris.
- Confirm that the travel path and the planned destination of the load are clear of obstacles and debris. Grease, oil, water, litter, and debris can cause slips and falls.
- Particular handling and lifting techniques are needed for different kinds of loads or materials being handled (for example, compact loads, small bags, large sacks, drums, barrels, cylinders, and sheet materials like metal or glass). See additional guidance in this procedure.

4.5.2 Gripping the Load



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- Whenever possible, utilize hand holds or other lifting attachments on objects being handled.
- Use the “hook grip” on loads with cut-out handholds.
- Curl fingers around the edge.
- Do not hold the load with fingertips. The palm grip is much more secure; grip the load with the palm of the hand and fingers.
- Use containers with handles located more than halfway up the side of the container.
- Use the “ledge grip” to handle regularly shaped objects without handles.

- Use vacuum lifters to handle sheet materials or plates.
- Hold the object with hands placed diagonally.

4.5.3 General Lifting Guidelines

- Prepare for the lift by warming up muscles. Frequently re-energize muscles throughout the course of the work.
- Avoid lifting immediately after prolonged sitting or inactivity.
- Confirm personal protective equipment is appropriate to the hazards (e.g. safety toed boots, appropriate gloves, etc.).
- Stand close to the load and face the intended direction of travel.
- Ensure good body balance. Feet should be shoulder width apart, with one foot beside and the other foot behind the object that is to be lifted.
- Bend the knees; do not stoop. Keep the back straight, but not vertical. There is a difference. The neck should be in a natural position with eyes forward.
- Engage (tighten/flex) abdominal muscles. Use legs to start the load moving and continue pushing up with the legs. This makes full use of the strongest set of muscles.
- Keep the arms and elbows close to the body while lifting smoothly without jerking.
- To lower the object, bend the knees. Do not stoop. To deposit the load on a bench or shelf, place it on the edge and push it into position. Confirm that your hands and feet are clear when placing the load.

4.5.4 Carrying/Holding Guidelines

- Manual carrying is an inefficient way of transporting materials in the work place. Where possible, reduce or eliminate manual carrying tasks.
- Never carry a load above the shoulders.
- Do not twist the body while carrying the load. To change direction, shift foot position and turn the entire body.
- Watch direction of travel!
- Carry an object close to the body using both hands. The optimal carry zone should have the elbows at a 90 degree angle with elbows tight to the body. One-handed carries are awkward and tend to unbalance the body.
- Do not carry objects that are so large they will obstruct visibility.
- Do not change grips on an object while carrying or holding an object. Rest the object on a secure surface prior to changing grip.
- If an object is of a size, shape, or mass that it requires two people to carry, use two people of similar size and physique.
    - Ensure the item lifted and carried by the team weighs no more than 50 pounds (22.7kg). Remember manual handling weight limits may decrease from 50 pounds (22.7kg) depending upon several variables. Refer to *S3AM--014-ATT1 Recommended Weight Limit Calculations.*
    - Two-person lifts should be planned and coordinated before performing the lift.
    - Lift the item in unison.
- Avoid carrying objects on stairs, particularly where the line of sight may be obstructed or the object can interfere with leg movement. All travel on stairs requires use of a handrail at all

times, so only carry objects that can be safely handled with one hand. Always maintain handrail contact when carrying an object up or down stairs.

4.6 Specific Handling - Pushing/Pulling Guidelines

4.6.1 Check the condition of the floor, ground, or other surface prior to pushing or pulling an object across it.

4.6.2 Be aware of the “break out” force of the object; this is the force at which a push or pull overcomes the frictional force between the surface and object. Adjust lower body posture to have a solid base in order to avoid losing balance when this point is reached.

4.6.3 Get assistance when moving or guiding a large load.

4.6.4 Where possible, always push rather than pull a load.

4.6.5 When possible push at waist height not shoulder height. The force capability at shoulder height is 50% less than at waist level.

4.6.6 Casters or wheels on carts should be at least 6 inches (15.24 centimeters) diameter for heavier loads in order to exercise adequate control on rough or inclined surfaces. Tire materials should be suitable for the surface of travel.

4.6.7 Never load the cart or load-carrying device in such a manner that visibility is obstructed in the path of travel.

4.6.8 When pushing or pulling an object on an inclined surface, ensure control of the load and direction of travel before proceeding. Obtain additional support to control the load if necessary.

4.6.9 Never leave carts or loads in an area that will present a hazard to other workers. Make sure carts or transport devices are secured in position before leaving them unattended.

4.7 Specific Handling – Square or Rectangular Objects



4.7.1 Place one foot slightly in front of the other.

4.7.2 Squat as close to the object as possible.

4.7.3 Grasp one of the top corners away from the body and the opposite bottom corner closest to the body.

4.7.4 Tilt the object slightly away from the body, tilt forward at the hips, keep the back straight.

4.7.5 Test to confirm that the object is loose from floor and will lift without snagging.

4.7.6 Straighten the legs, keeping the spine straight, pull the object into the body, and stand up slowly and evenly without jerking or twisting.

4.7.7 If turning or change of direction is required, turn with feet without twisting the torso and step in the direction of travel.

4.7.8 To set an object down, reverse the sequence, being sure not to trap the bottom hand between the object and the surface on which the object is set.

4.8 Specific Handling – Cylindrical Objects

4.8.1 When lifting/moving round or cylindrical objects, the objects should be rolled wherever possible.

- Check the integrity of drums of gas cylinders before handling. Confirm lids or caps are secured prior to moving.
- Rolling must be controlled by chute, tagline, or other means of limiting acceleration.

- Workers must not be positioned downhill from rolled objects.
- Use of the legs for pushing and tagline control of rolled objects must be stressed.

4.8.2 Cylindrical objects, such as drums that must remain upright, are to be handled manually by slightly tilting the object, using the legs for control, and balancing the object on the bottom edge. The handler then walks besides the object, with the object tilted toward the body, positioning the hands on the top edge away from the body and moving so they do not cross, thus maintaining balance and a steady, controlled, forward motion. Motion must be controlled so that ceasing to walk and moving the hands will stop forward motion.

4.8.3 Use carts or trucks to transport cylinders. Never attach a lifting or moving device to the cap or lid.

4.8.4 Use two people to transport a cylinder if carts cannot be used. Use lifting straps to improve grip.

4.9 Specific Handling – Bags and Sacks

4.9.1 The best way to handle a bag depends on its size, weight, and how far it is to be carried. When lifting, remember to:

- Straddle the end of the bag.
- Bend the hips and knees.
- Keep the back straight.
- Grasp the bag with both hands under the closer end. Keep elbows inside the thighs.



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- Lean forward, straightening the knees to set the bag upright.
- Readjust the straddle position moving feet closer to the bag.
- Readjust the grasp, with one hand clasping the bag against the body and the other hand under the bag.
- Stand up by thrusting off with the back leg and continuing in an upward and forward direction.
- Thrust the bag up with the knee while straightening the body. If possible place the bag on an intermediate platform to enable the grip / grasp to be readjusted.
- Put the bag on the shoulder opposite the knee used to thrust the bag up.
- Stabilize the bag on the shoulder.
- Move off without bending sideways.

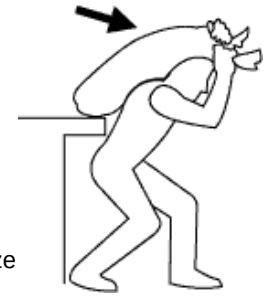
4.9.2 Avoid unloading a bag from the shoulder directly to floor level. Use an intermediate platform or get help from a co-worker, remember to:

- Stand close to the platform.
- Place one foot in front of the platform.
- Bend hips and knees.
- Keep the back straight.
- Ease the bag off the shoulder and put it upright on the platform.
- Pull the bag slightly over the edge of the platform.
- Stand close to the platform with the bag touching the chest.
- Clasp the bag against the body with one hand, the other hand holding bottom of the bag.
- Step back.
- Bend hips and knees, keeping back straight.

- Ease the bag onto the floor.

4.9.3 Bulkier sacks are easier to carry on a worker's back. The worker is to lift the sack to his/her back from a platform:

- Move the sack to the edge of the platform.
- Put back against the sack.
- Grasp with both hands on the upper corners of the sack.
- Ease the sack onto the back, bending hips and knees before taking the weight.
- Keeping the back straight, stand up, straighten hips and knees and stabilize the sack.
- Move away without bending sideways.



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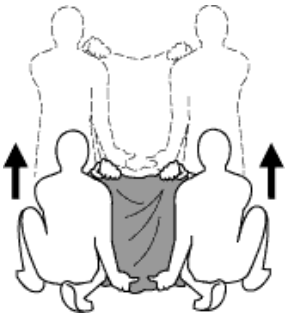
4.9.4 Two-person handling of a sack:

- Position one person on either side of the sack.
- Squat with one foot balancing behind the sack.
- Keeping the back straight, grasp with the outer hand on the upper corner of the sack and the other hand holding the bottom of the sack.
- On one person's command:
  - Stand up and straighten the hips and knees.
  - Move toward the intended location.
  - Put the sack in its intended location.



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4.10 Specific Handling – Sheet Materials

4.10.1 When lifting sheet materials:

- Stand close to the pile of sheets in a walking stance.
- Grasp sheet firmly at the midpoint of its long side with the closer hand.
- Pull sheet up and toward the body.
- Change grip using the other hand and put fingers on top of the sheet.
- Pull sheet up to the vertical position and to the side until one half is off the pile.
- Grasp the lower edge of the sheet with the free hand and support the hand by placing it on your knee.
- Stand up without bending or twisting body.

4.10.2 Whenever moving sheet materials, be cognizant of wind conditions.

4.10.3 To carry sheets (drywall, glass, metal, etc.):

- Use drywall carts or sheet hand trucks to carry sheet materials.
- Get help from another person where carts are not available.
- Apply carrying handles for manual carrying.
- Always use gloves and carrying handle for glass and other materials with sharp edges.

4.10.4 Use team lifting and carrying where other solutions are inappropriate.

- Remember that the combined strength of the team is less than the sum of individual strength. The item lifted by the team should be no more than 50 pounds (22.7kg).

- Select team members of similar height and strength and assign a leader to the team.
- Determine a set of commands to be used such as "lift," "walk," "stop," and "down." Make sure that everyone knows what to do when they hear the command.
- Follow the commands given by the team leader.
- Practice team lifting and carrying together before attempting the task.

4.11 Material Storage

4.11.1 Store materials at a convenient height.

4.11.2 Leave the lowest shelf unused if necessary.

4.11.3 Use vertically mobile shelves or elevating platforms to avoid bending and overhead reaching.

4.11.4 Use bin racks for storing small items.

4.11.5 Store heavy and frequently used materials between knee and shoulder height; preferably waist height.

4.11.6 Do not store materials at floor level.

4.11.7 Use hand trucks with elevating devices in storage and loading areas.

4.11.8 Use trucks with a tilting device to avoid bending.

5.0 Records

5.1 None

6.0 Attachments

6.1 S3AM-014-ATT1 Recommended Weight Limit (RWL) Calculations

Americas

Newly Hired or Transferred Employees

S3AM-015-PR1

1.0 Purpose and Scope

1.1 The purpose of this procedure is to provide direction for the mentoring and oversight of newly hired or transferred employees. It is understood that proportionally more incidents/injuries occur among less experienced staff members. The goal is to prevent incidents involving these employees, and to confirm they have a good understanding of the AECOM Safety for Life Program and Behavior-Based Safety (BBS) expectations.

1.2 This procedure applies to all AECOM Americas based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 **Short Service Employee (SSE)** - SSEs are those who have been newly hired or transferred to a different position in the company (e.g., one with new and possibly unfamiliar hazards and safe operating procedures).

3.0 References

3.1 S3AM-007-PR1 Behavior Based Safety

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager**

- Confirm implementation of this program where applicable.
- Identify Short-Service Employees (SSEs) in their groups. If an employee is designated as an SSE, the manager shall assign mentor to that person.
- Work with the SSE's mentor to designate someone on the field team to provide additional supervision and guidance during the time they are considered an SSE.

4.1.2 **Mentors**

- Confirm SSEs understand what training is required, are familiar with AECOM SH&E program, and know how to access various resources.
- Be available to answer safety-related questions and concerns from the SSEs they are mentoring.
- Work with the managers to identify an experienced field team member to provide temporary mentorship, oversight and guidance to SSEs during field activities. NOTE: The mentor may fill this role when working on the same field project with the SSE.

4.1.3 **Employees**

- Comply with this procedure and complete any required training.
- As applicable, subcontractors will comply with this procedure and complete any required training.

4.2 SSE Designation

4.2.1 An employee may be designated as an SSE. The requirements of this procedure will be applicable to a designated SSE, based on the following SSE Status Schedule:

- 0- to 6-Month SSE Status – Field employees who are new to AECOM or who are new to their current job assignment (e.g., someone who has experience in groundwater monitoring who transfers to a unit that performs stack sampling).
- 0- to 3-Month SSE Status – Non-field employees who are new to AECOM. This requirement acknowledges that approximately one-third of AECOM incidents occur in an office, rather than a field environment.
- Former employees who return to AECOM within 12 months and are placed into the same job assignment may not be designated as SSEs.

4.2.2 Managers will notify the appropriate safety representative of employees who have been designated an SSE, along with the end date for the SSE status.

4.2.3 The status of employees who have been designated as a SSE shall be monitored by the SSE's manager. *S3AM-015-FM1 SSE Record for Field Staff* or *S3AM-015-FM2 SSE Record for Office Staff* to document progress of designated SSEs.

4.2.4 The SSE status will be removed based on the schedule contained in this procedure if the employee's mentor determines the SSE has worked safely, followed AECOM and client Safety requirements, and has not been involved in an incident involving an injury, property damage, or a significant business interruption. *S3AM-015-FM1 SSE Record for Field Staff* or *S3AM-015-FM2 SSE Record for Office Staff* shall be used to document the removal.

4.2.5 SSEs shall be easily identified in the field environment, such as through wearing a specific colored hardhat, a manufacturer-approved orange stripe applied to their hardhat, or be clearly identified by some other system. In the event a client has an existing SSE program, AECOM will defer to the identification system required by the client. When required by a client, AECOM will notify the client of a SSE working onsite.

4.2.6 It is preferred that staff monitoring an SSE in the field will be assigned no more than one SSE at a time, and that crew sizes of five employees or fewer should have no more than one SSE assigned to the team. SSEs working in the field should not be assigned to work alone.

4.2.7 Mentors shall confirm SSEs assigned to them know:

- How to access information on the AECOM SH&E Management System and the appropriate SH&E procedures for the work they will be assigned to do.
- Their roles and responsibilities with respect to safety.
- What training they are required to have (e.g., computer-based training, classroom sessions, outside courses) and how to register for this training.
- Who their AECOM SH&E resources are.
- How to report an incident, near miss, at-risk behavior, or unsafe condition.
- AECOM's Life Preserving Principles
- The basic principles of the AECOM Behavior-Based Safety Program.
- How to prepare a basic task hazard assessment (THA).

4.3 Exemption or variance

4.3.1 In general, the SSE status schedule of this procedure should be followed.

4.3.2 Specific circumstances may warrant the extension of the SSE designation, reduction of the required time identified in the schedule, or an exemption.

4.3.3 Extension to the schedule may be necessary if it is determined the employee does not meet the requirements identified in the applicable *Record for Field Staff*, or *S3AM-015-FM2 SSE Record for Office Staff.* The extension shall be recorded on the same report.

4.3.4 Based on experience, knowledge of the AECOM SH&E program, and the tasks to be performed, the manager may recommend a reduction from the SSE time period specified in this procedure, or a full exemption form the time period. *S3AM-015-FM1 SSE Record for Field Staff*, or *S3AM-015-FM2 SSE Record for Office Staff* should be used to document the exemption or variance, and approval of the applicable SH&E Manager obtained.

4.3.5 Managers should notify the safety representative of any approved variances or exemptions from the SSE schedule.

4.3.6 Due to the wide variety of AECOM operations, a competency-based alternative system for SSE may be used. A competency-based system requires adequate training and safety skill demonstration for the specific tasks an individual is deemed competent to perform. An example of a competency-based system would be the project hiring of an experienced and well-trained heavy equipment operator. Competency-based systems shall be approved by the applicable SH&E Manager.

5.0 Records

5.1 The following documentation will be maintained in the employee's file:

5.1.1 *S3AM-015-FM1 SSE Record for Field Staff* or *S3AM-015-FM2 SSE Record for Office Staff*.

6.0 Attachments

6.1 S3AM-015-FM1 SSE Record for Field Staff

6.2 S3AM-015-FM2 SSE Record for Office Staff

AECOM

Americas

SSE Record for Field Staff

S3AM-015-FM1

Employee Name: _____ **Employee Number:** _____

Manager Name: _____ **Date:** _____

1.0 Training

☐ Yes ☐ No Employee Safety Orientation completed
☐ Yes ☐ No Vehicle Safety completed
☐ Yes ☐ No Other required training:
☐ Yes ☐ No Other required training:

2.0 Manager / Mentor Assessment

☐ Yes ☐ No Understands AECOM SH&E expectations and how to access the AECOM SH&E website
☐ Yes ☐ No Demonstrates ability to prepare a Task Hazard Assessment
☐ Yes ☐ No Complies with safety plan during work
☐ Yes ☐ No Ability to conduct initial and daily safety briefings
☐ Yes ☐ No Understands incident / injury reporting requirements
☐ Yes ☐ No Demonstrates experience in near miss and safety observation reporting
☐ Yes ☐ No Understands emergency signals and evacuation and shelter requirements
☐ Yes ☐ No Understands personal protective equipment (PPE) requirements and always wears correct PPE
☐ Yes ☐ No Willing to stop work if conditions do not appear safe

3.0 Field Experience

Dates	Type of Project	Hazards

4.0 Comments

5.0 Employee Statement

I am familiar with the AECOM SH&E Management System, the roles and responsibilities for SH&E as outlined in that system, and the AECOM Behavior-Based Safety Program. I have been instructed on SH&E resources available to me and how to access the program and associated information.

☐ SSE Scheduled time period completed

☐ Reduction to scheduled time period

☐ Extension to scheduled time period

☐ Employee exempted from the SSE schedule

Employee Signature: _____ **Date:** _____

Mentor Signature: _____ **Date:** _____

Manager Signature: _____ **Date:** _____

Americas

SSE Record for Office Staff

S3NA-015-FM2

Employee Name: _____ **Employee Number:** _____

Manager Name: _____ **Date:** _____

1.0 Training

☐ Yes ☐ No Employee Safety Orientation completed

☐ Yes ☐ No Vehicle Safety training completed

☐ Yes ☐ No Ergonomics training completed

2.0 Manager / Mentor Assessment

☐ Yes ☐ No Understands AECOM SH&E expectations and how to access the AECOM SH&E website

☐ Yes ☐ No Demonstrates the ability to work safely and correct observed safety hazards

☐ Yes ☐ No Understands emergency signals and evacuation and shelter requirements

☐ Yes ☐ No Understands incidents / injury reporting requirements

☐ Yes ☐ No Has conducted a self-ergonomic evaluation of workstation

☐ Yes ☐ No Demonstrates experience in near miss and safety observation reporting

☐ Yes ☐ No Willing to stop work if conditions do not appear safe

3.0 Comments

4.0 Employee Statement

I am familiar with the AECOM SH&E Management System, the roles and responsibilities for SH&E as outlined in that system, and the AECOM Behavior-Based Safety Program. I have been instructed on SH&E resources available to me and how to access the program and associated information.

☐ SSE Scheduled time period completed

☐ Reduced schedule complete months

☐ Extended schedule complete months

☐ Employee exempted from the SSE schedule

Employee Signature: _____ **Date:** _____

Mentor Signature: _____ **Date:** _____

Manager Signature: _____ **Date:** _____

Americas

Injury & Illness Recordkeeping

S3AM-017-PR1

1.0 Purpose and Scope

1.1 Provide the process for compliance with AECOM internal recordkeeping and reporting requirements of occupational injuries and illnesses, outside the scope of workers' compensation reporting requirements.

1.2 This procedure delineates the roles and responsibilities in the maintenance of injury and illness recordkeeping requirements and in determination of injuries and illnesses that are included in the Company injury and illness statistics.

1.3 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 **Days Away from Work** – (This definition is for recordability purposes only and does not apply to workers' compensation claims.) The number of calendar days the employee was unable to work as a result of the injury or illness, regardless of whether or not the employee was scheduled to work on those day(s). Weekend days, holidays, vacation days or other days off are included in the total number of days.

2.2 **Establishment** – A physical location where business is conducted or where services or industrial operations are performed. Distinctly separate activities performed at a single location are each treated as a separate establishment for recordkeeping purposes. Therefore, each AECOM permanent office, long-term project office (defined to include project offices that are active for 12 months or more on a continuous basis) and/or laboratory is considered a separate establishment.

2.3 **First Aid** – Any AECOM work-related injury or illness that results in any of the following:

- Using a non-prescription medication at non-prescription strength (for medications available in both prescription and non-prescription form, a recommendation by a physician or other licensed health care professional to use a non-prescription medication at prescription strength is considered medical treatment for recordkeeping purposes);
- Administering tetanus immunizations (other immunizations, such as Hepatitis B vaccine or rabies vaccine, are considered medical treatment);
- Cleaning, flushing or soaking wounds on the surface of the skin;
- Using wound coverings such as bandages, Band-Aids™, gauze pads, etc., or using butterfly bandages or Steri-Strips™ (other wound closing devices such as sutures, staples, etc., are considered medical treatment for recordkeeping purposes);
- Using hot or cold therapy;
- Using any non-rigid means of support, such as elastic bandages, wraps, non-rigid back belts, etc. (devices with rigid stays or other systems designed to immobilize parts of the body are considered medical treatment for recordkeeping purposes);
- Using temporary immobilization devices while transporting an accident victim (e.g., splints, slings, neck collars, back boards, etc.);
- Drilling of a fingernail or toenail to relieve pressure, or draining fluid from a blister;
- Using eye patches;
- Removing foreign bodies from the eye using only irrigation or a cotton swab;
- Removing splinters or foreign material from areas other than the eye by irrigation, tweezers, cotton swabs or other simple means;

- Using finger guards;
- Using massages (physical therapy or chiropractic treatment are considered medical treatment for recordkeeping purposes);
- Drinking fluids for relief of heat stress;
- Treating first degree burn(s);
- Applying non-prescription ointments;
- Receiving negative X-ray diagnosis; and
- Conducting a brief observation of injury during visit to medical personnel.

2.4 **Medical Treatment** – Any medical treatment beyond first aid.

2.5 **Restriction of Work** – Occurs when an employee, after the initial day of injury, because of an AECOM work-related injury or illness:

- Is assigned to another job on a temporary basis;
- Works at their permanent job less than full time;
- Works at their permanent job but cannot perform all duties normally performed at least once per week; or
- Performs light duty work at the direction of a Supervisor.

2.6 **Recordable Injuries or Illnesses** – Any AECOM work-related injury or illness that results in any of the following:

- A fatality;
- Medical treatment (beyond first aid);
- Days away from work;
- Restricted work or transfer to another job;
- Loss of consciousness;
- A significant injury or illness as diagnosed by a physician or licensed health care professional; and/or
- Recordable injuries or illnesses determined under criteria established in this procedure.

2.7 **Significant Diagnosed Injury or Illness** – Significant progressive diseases, such as silicosis and some types of cancer, may not require medical treatment or work restrictions at the time of diagnosis, but are generally considered significant and must be recorded at the initial diagnosis. Likewise, injuries such as a fractured or cracked bone (including teeth), or a punctured eardrum must always be recorded when diagnosed by a medical professional.

2.8 **Work-Related** – Arising from an exposure or occurrence on the employer's premises or other locations where employees are engaged in AECOM work-related activities.

3.0 References

3.1 S3AM-004-PR1 Incident Reporting, Notifications and Investigation

4.0 Procedure

4.1 Roles and Responsibilities

4.1.5 **Operations Managers**

- Assure that the recordkeeping requirements are performed within their facility.

4.1.6 **SH&E Managers**

- Provide guidance and support relative to recordkeeping requirements.
- Track injuries and illnesses within their regions reported to them by Supervisors within their region.
- Reconcile the log on a weekly basis with the recordable incidents via the on-line incident management system (e.g., IndustrySafe).
- Create appropriate reports to the Executives on a quarterly basis, or as necessary, to keep them apprised.
- For U.S.-based offices, review accuracy of the OSHA 300 Log and post in establishments within their area of responsibility.

4.2 Recordability Determination

4.2.1 AECOM shall follow the U.S. Occupational Safety and Health Administration (OSHA) recordkeeping standard for all workplace injuries/illnesses regardless of jurisdiction.

4.2.2 Supervisors are expected to log potential work-related illnesses and injuries to the SH&E Manager in accordance with *S3AM- 004-PR1 Incident Reporting, Notifications and Investigation*. Recordable injuries and illnesses must be reviewed by the SH&E Manager within six calendar days after receiving information of the injury or illness.

4.2.3 Where there is any doubt and/or debate as to the recordability of a particular case, the SH&E Manager shall always enter the case as a recordable injury in the on-line incident management system at the end of the six-calendar-day period.

4.2.4 For injuries that cross the recordable threshold in a subsequent year, that injury shall be entered on the log for the year the injury was first evident, up to the 5 years previous.

4.2.5 Business groups VP's of SH&E may establish a Recordability Review Committee (RRC). The RRC meets once each quarter or as needed. The intent of the RRC is to review the relevant facts surrounding uncertain recordable and non-recordable cases to make a final determination of recordability. The decisions shall be documented and the summary of the decision shall be placed in the injury case in the on-line incident management system.

4.2.6 Reviews shall include, but not be limited to:

- Finalized investigations and facts/information that were not available at original time of determination,
- Current information from the workers' compensation claims adjuster
- Current information from applicable licensed health care practitioners
- Related detailed analysis of the OSHA recordkeeping handbook, letters of interpretation, and settlement agreements

4.2.7 In order to assist in documenting the decisions made by each team relative to recordability of a case, *S3AM-017-FM1 Recordability Review Form* will be completed and included in the on-line incident management system's permanent case file for incidents requiring review

4.2.8 If an employee receives medical treatment beyond first aid and the injury / illness is determined as not recordable, a full explanation of why it is not recordable must be documented in IndustrySafe.

4.3 Injury and Illness Recordkeeping

4.3.1 Additional recordkeeping requirements may be required by applicable regulatory agencies and according to services provided (e.g., United States – maintain a Sharps Injury Log for occupations with potential exposure to bloodborne pathogens from accidental needlestick injuries) . Those requirements must be complied with in addition to the requirements of this procedure.

4.3.2 Recordable Injuries and Illnesses will be maintained in the on-line incident management system (e.g., IndustrySafe).

4.3.3 Required recordkeeping forms

Specific requirements of this standard include the recording of each Recordable Injury and Illness on the following forms as references:

- OSHA 300 Log (Log of Work-Related Injuries and Illnesses) – One log must be maintained for each establishment.
- OSHA 301 Form (Injury and Illness Incident Report or an equivalent state "employer's first report of injury" form) – One form must be completed for each Recordable Injury and Illness. Incidents need to be classified and recorded upon entry into the log. Final determination needs to be made within 6 calendar days. If there is any doubt, incident will be classified as recordable until further information is received.
- OSHA Form 300A (Annual Summary of Work-Related Injuries and Illnesses) – One form must be completed for each establishment and posted from 1 February to 30 April each year for each site that has been or will be in continuous operation for one year. The form shall be returned to a permanent establishment file beginning in May.

4.3.4 If an employee is seconded (daily supervision is not provided by AECOM) and the Recordable Injury / Illness is the responsibility of another party (e.g., client/contractor), the other party's acknowledgement of the requirement to place the injury on their 300 log shall be verified by AECOM. This verification shall be recorded in IndustrySafe. If approval has not been verified, the injury must be recorded on AECOM's OSHA log.

4.3.5 Final determination of recordability is the responsibility of the person who is signing the OSHA 300A.

4.3.6 All OSHA Form 300A summaries shall be signed annually in the month of January by the Operations Executive (or highest ranking official working at the project, site or office) responsible for the operation.

4.3.7 Copies of the applicable OSHA 300 and OSHA 300A will be maintained at each establishment for a period of 5 years.

4.3.8 The data used to produce these OSHA forms will be maintained centrally by the SH&E Manager in the on-line incident management system.

4.4 OSHA Recordkeeping for Areas Outside of U.S.

Although OSHA does not apply outside of the United States, AECOM applies the OSHA recordkeeping regulations globally to maintain a level of consistency with reporting. Even outside of the U.S., OSHA 300 logs are maintained for contracts and programs that are issued under U.S.-contracting agencies. The OSHA 300 logs are not required to be posted in locations outside of the U.S.

5.0 Records

5.1 Maintained by the SH&E Department and in the on-line incident management system.

6.0 Attachments

6.1 S3AM-017-FM1 Recordability Review Form

Americas

Recordability Review Form

S3AM-017-FM1

Name of Injured Employee:	**Business Group:**
Date of Occurrence:	**Date Reported:**
Cause of Injury/Illness:	
Examined/Treated by Medical Professional: Yes ☐ No ☐	**Date:**
Name/Address of Treating Medical Professional or Clinic:	
Diagnosis or Nature of Injury/Illness:	
Injury/Illness <u>is Recordable</u> because: (Check and complete ALL that apply)	
☐ The condition is categorized as a work-related injury or illness and has been diagnosed as a specific recordable medical condition.	
☐ The condition is categorized as an injury or illness and required days away from work, hospitalization, or restriction of work. Describe in detail: Hospitalized: Total # of Days: Period of Lost Time: Total # of Work Days: Period of Restriction: Total # of Work Days:	
☐ Other Reason. Describe in detail:	
Injury/Illness <u>is Not Recordable</u> because:	
☐ The injury was minor and required first aid only. Describe in detail:	
☐ The injury/illness is not work-related. Describe in detail:	
☐ Other reason. Describe in detail:	
Completed by SH&E Manager: **Print Name** **Signature** **Date**	
Completed by Operations Manager (if applicable): **Print Name** **Signature** **Date**	

Supporting documentation shall be attached, where applicable.

Americas

Substance Abuse Prevention

S3AM-019-PR1

1.0 Purpose and Scope

1.1 This policy and procedure is consistent with the U.S. Drug-Free Workplace Act of 1988 and in accordance with federal, state / provincial / territorial, and local laws and regulations. It sets out practices for a drug-free, healthy, productive, safe and secure workplace and provides guidance for employees and supervisors with respect to their responsibilities. Drug and alcohol abuse pose a serious threat to the health and safety of employees, clients, and the general public as well as the security of our job sites, equipment and facilities. The Company is committed to the elimination of illegal drug use and alcohol abuse in its workplace and regards any misuse of drugs or alcohol by employees to be unacceptable.

1.2 This policy and procedure apply to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

1.3 AECOM prohibits the use, possession, presence in the body, distribution, manufacture, concealment, transportation, promotion or sale of the following items or substances on company premises:

- Illegal drugs (or their metabolites), designer and synthetic drugs, mood- or mind-altering substances and drug use related paraphernalia unless authorized for administering currently prescribed medication;
- Controlled substances that are not used in accordance with physician instructions or non-prescribed controlled substances;
- Alcoholic beverages while at work or while on any customer or AECOM controlled property. This prohibition on alcohol applies whenever an employee is on-duty, including during meal or break periods, while on Company premises, or while representing AECOM. AECOM may make exceptions and permit the consumption of alcohol beverages at work-related events, such as Company-sponsored or approved business meals, conferences, or holiday events. Employees who choose to consume alcohol on approved occasions are expected to exercise good judgment and to refrain from becoming intoxicated or impaired. If an employee has consumed alcohol and needs transportation home, the Company will reimburse the cost of a taxicab or other reasonable costs of transportation so that the employee may avoid driving.
- This policy does not prohibit lawful use and possession of current medication prescribed in the employee's name or over-the-counter medications. Employees shall consult with their health care provider about any prescribed medication's effect on their ability to perform work safely. An employee who has work restrictions due to his or her consumption of a prescribed medication shall disclose these restrictions to their supervisor.

1.4 Substance abuse testing procedures shall meet requirements of various U.S. regulatory agencies and / or those of the applicable jurisdiction, with regard to testing employees for the possession and use of illegal drugs (and their metabolites), mood- or mind-altering substances, synthetic and designer drugs, unauthorized use of prescription drugs and the unauthorized use of alcohol on AECOM or client premises or during working hours. The procedures will also comply with applicable laws and regulations by federal, state / provincial / territorial, and local law. If the law of a particular location differs from the practices expressed in this policy and procedure, AECOM will implement this policy and procedure in accordance with applicable law.

1.5 Although some states may pass laws legalizing medical or recreational marijuana use, the use, sale, distribution and possession of marijuana are violations of federal law. Similarly, the use sale, distribution, presence in the body and possession of marijuana or the presence of marijuana on company premises or while on duty including during lunch and breaks violates the *S3AM-019-ATT1 Substance Abuse Policy Statement* (policy) and will subject an employee to disciplinary action up to and including termination in accordance with controlling law.

1.6 This policy and procedure have been developed to provide employees, managers, supervisors and administrative support personnel with guidelines and procedures for the implementation, administration, and enforcement of this policy and procedure. The company policy statement for substance abuse prevention is included as Attachment 1 of this document and a copy of the included policy statement shall be posted on employee information boards. New employees shall receive and sign *S3AM-019-FM1 Acknowledgement and Consent Form* upon hire or transfer between sites or clients as acknowledgement of the program requirements. A signed or electronic copy of this form should be kept as part of the employee personnel file.

1.7 This policy and procedure do not prohibit employees from the lawful use and possession of current legally prescribed or over-the-counter medications. Employees shall consult with their health care providers about any prescribed medication's effect on their ability to perform work safely. Employees shall disclose any relevant work duty restrictions to their supervisor. Employees are required only to provide information necessary for the Company to make an informed decision regarding the ability to perform required work safely, and to evaluate whether the employee may be entitled to a reasonable accommodation. Employees who shall bring current prescribed medications to work shall carry the medication in the original packaging bearing a current label from a licensed pharmacist for the person in possession of the drugs.

1.8 Compliance with this policy is a condition of initial and continued employment. Failure to comply with these requirements will be grounds for disciplinary action, up to and including termination of employment.

1.9 This procedure will be administered by the Business Group Substance Abuse Prevention (SAP) Program Administrator in conjunction with Safety, Health & Environment (SH&E) and Human Resources (HR).

1.10 This procedure may be further supplemented by Business Group specific and/or client specific Substance Abuse Prevention procedures. These supplementary programs shall either meet or exceed the requirements contained in this document.

2.0 Terms and Definitions

2.1 **Adulterated Sample** – A urine sample provided by an applicant, employee or contractor that has been intentionally altered to mask the analysis for illegal substance use. Any applicant or employee who knowingly provides a false sample or attempts to adulterate a sample will be terminated or disqualified from employment.

2.2 **Confidentiality** – The principle that the information associated with an individual's participation in the AECOM Substance Abuse Prevention program is private and has limits on how and when it can be disclosed.

2.3 **Designated Employer Representative (DER)** – Another name for the drug and alcohol program administrator. The DER provides oversight and manages the applicable Business Group's Substance Abuse Prevention Program(s) in coordination with the requirements of this document.

2.4 **Employees/Applicants** – The SAP program will apply to all individuals who may be: regular full-time, part-time, probationary, temporary, craft (direct hires), casual, contract or leased employees, and applicants of employment as permitted by applicable laws

2.5 **Employee Assistance Program (EAP)** – All AECOM employees, eligible dependents and family members living in the same household are eligible to utilize the EAP in accordance with Human Resources policy. Check with your HR manager for eligibility for EAP.

2.6 **Illegal Drugs, Controlled Substances and Unauthorized Items** – Illegal drugs, designer and synthetic drugs, substances that impair job performance or safety and drug-related paraphernalia: Controlled substances such as medications when usage is abused; Unauthorized alcoholic beverages

2.7 **Medical Review Officer (MRO)** – The MRO is a designated Medical Doctor (MD) with experience and certification in the interpretation of urinalysis test results for drug testing. The MRO examines the positive test results with consideration of whether there is a legitimate medical reason for the result. This is accomplished by telephone interviews with the donor and also with their prescribing physician or pharmacist when prescription or over the counter medications are possibly involved.

2.8 **Negative Test** – A personal sample (urine, blood, hair, breath, saliva or other permitted by law) that indicates a concentration(s) of any drug on the panel which is below the cut-off limit and also meets all quality control requirements (e.g., temperature, pH) and no evidence of adulterants.

2.9 **Positive Test Result** – A personal sample (urine, blood, hair, breath, saliva or other permitted by law) that indicates a concentration(s) of any drug on the panel which is above the cut-off limit and/or the gas chromatography – mass spectrometry (GCMS) confirmation level of that applicable regulation or requirement.

2.10 **Prohibited Substances** – Illegal or unprescribed drugs (or their metabolites), controlled substances and mood or mind-altering substances (i.e. any synthetic derivative/product that produces a marijuana-type high and any herbal products not intended for human consumption); or any prescribed drugs used in a manner inconsistent with the prescription, and alcoholic beverages.

2.11 **Reasonable Suspicion** – Suspicion based upon the observation of objective facts or specific and articulable behavior. Supervisor should complete a Reasonable Suspicion training course and be able to document the process and observations.

2.12 **Refusal to Test** – Refusing to provide a sample, refusing to cooperate, leaving the testing area, or refusing to accept and sign the testing consent form, is considered a breach of company policy and subject to disciplinary action up to termination of employment.

2.13 **Safety Sensitive** – A task or position is designated as safety sensitive when the task or position is such that an action would endanger the life of the employee and/or the lives of others. AECOM Business Groups may further define safety sensitive as it applies to their applicable line of work or to a specific project. When identifying safety-sensitive tasks or positions, consideration shall be given to applicable factors such as, but not limited to, the relevant industry (e.g., transportation, railroad, pipeline, etc.), regulatory requirements (e.g., covered tasks) of the given jurisdiction, an employee's direct involvement in the task or position's responsibilities, level of supervision, etc. Examples, but not a complete list, of positions that may be determined to be "safety-sensitive" based upon the applicable factors include:

- Drivers of Commercial Motor Vehicles (CMV)
- Workers on pipelines carrying fuels or toxic or corrosive substances
    - Example – US requirements: *S4AM(US)-019-ATT1 PHMSA Covered Tasks Flowchart* provides additional guidance for tasks related to pipeline or liquified natural gas (LNG) facilities.
- Workers at nuclear power plants
- Employees that operate -regulated devices (e.g., nuclear density gauges)
- Operators of industrial mobile equipment
- Workers handling hazardous substances.

2.14 **Substance Abuse Prevention Program Administrator (SAP Administrator)** – a person that administers policies for the company and acts as the Designated Employer Representative (DER).

3.0 References

3.1 None

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **SAP Administrator**

- Engage and coordinate appropriate parties as necessary to execute the SAP Program.
- Receive test results and other Substance Abuse Prevention related communications for AECOM.
- Function as DER

- The DER is authorized by AECOM to take immediate action(s) to remove employees from safety sensitive duties, or cause employees to be removed from these covered duties, and to make decisions required in the testing and evaluation process, such as in the case of a shy bladder or shy lung situation.
- The DER will also refer employees to the Substance Abuse Professional and facilitate the return to duty process of employees who have successfully completed the Substance Abuse Professional's recommendations or identified program, as permitted by AECOM, and as applicable, the client.
- All Service Agents (TPAs, MRO's Labs and Collection Agencies) shall know who the DER is so that they may speak to them if problems arise and/or to include the DER name on the testing forms. A Service Agent may not be a DER for a company.
- The DER is the person that will work with directly with auditors during an inspection, including providing all the information about the program and any compliance issues. Therefore, the DER shall be someone who carries some authority and has access to needed resources and is familiar with the company's operation.

- Provide SAP Program related guidance concerning AECOM requirements and report as appropriate on SAP Program status to the applicable party. Refer to *S3AM-019-ATT2 Substance Abuse Prevention Communication Guidelines*.

4.1.2 **Supervisors and Managers**

- Obtain any client - specific SAP Program related requirements associated with the project as early in the project lifecycle as possible (e.g., contract negotiations).
- Provide SAP Program related guidance and requirements applicable to the respective client and/or project(s) to the SAP administrator as soon as received. Refer to *S3AM-019-ATT2 Substance Abuse Prevention Communication Guidelines*.
- Has received the required and approved Supervisor Reasonable Suspicion training and: knows the signs and symptoms of abuse, knows the required documentation, understands procedures regarding confrontation of the individual, and the importance of confidentiality and has authority to refer an employee for drug and alcohol testing as required.
- Observe and document employee behavior which appears to violate this policy and procedure and refer employees for drug and alcohol testing as required.
- Ensure all employees have been orientated to this procedure and are knowledgeable about, and in compliance with this procedure, associated policy and applicable programs.
- Make appropriate referrals for a drug and/or alcohol test as per this procedure as well as any client contractual agreements or governmental regulation.
- Be current with the Employee and Supervisor Training and education programs so as to be knowledgeable about the use of alcohol and drugs and be able to recognize the signs and effects of alcohol and drug uses.
- Alert and involve Human Resources (HR), the Corporate Safety, Health and Environment (SH&E) Occupational Health Director and the Substance Abuse Program Administrator when an employee is believed to be unfit for duty due to drugs or alcohol use in violation of this policy and/or if an employee is tested for a reasonable suspicion use of drugs or alcohol.
- If any illegal drugs or drug paraphernalia are located on company premises, do not handle the items and immediately notify the following as necessary: HR, Resilience Group, the police department and the applicable Substance Abuse Program Administrator.
- Guide employees who voluntarily seek assistance for a personal substance abuse problem to appropriate resources such as the EAP or other local resource.

4.1.3 **Employees**

- Commit to a safe and drug-free workplace by complying with this policy and procedure and understanding their responsibilities.
- Read and understand the *S3AM-019-ATT1 Substance Abuse Policy Statement* detailing the Company's commitment to a drug free workplace. The signed *S3AM-019-FM1 Acknowledgement and Consent Form* attests that they have reviewed and are familiar with this procedure and understand that compliance is a condition of employment. Any questions should be directed to the Substance Abuse Administrator.
- Follow the instructions of their supervisor or Substance Abuse Administrator when informed that they have been chosen for a random or client drug test as allowed by federal, state / provincial / territorial, or local law and regulations. Failure to do so may result in discipline up to and including termination.
- Participate in substance abuse training programs as directed.
- Report for work Fit for Duty and remain Fit for Duty while on Company premises and worksites and adhere to the standards set out in this procedure and any applicable program.
- Notify your supervisor, HR or SH&E representative if you believe another employee or subcontractor is not Fit for Duty or exhibits conduct suggesting substance abuse.
- If having a valid driver's license is a condition of employment, report any loss of license related to drug or alcohol use immediately (no later than 24 hours after losing the license) to your supervisor.
- Consult with health care provider about any prescribed medication's effect on the ability to perform work safely and disclose work restrictions due to consumption of prescribed medications to their supervisor to determine if reasonable accommodation is needed.
- Bring legally prescribed medicine in the original packaging bearing a current label in the employee's name from a licensed pharmacist if the employee carries more than a single day of prescribed medications to work.
- An employee who has been convicted of a felony under a criminal drug statue for a violation occurring on Company property or during the employee's working hours shall notify Human Resources no later than five (5) calendar days after the felony conviction becomes final under the law.

4.2 Confidentiality

4.2.1 Information and records relating to drug screen test results, drug and alcohol dependencies and medical information shared with the Company in the course of administering this Policy and Procedure shall be treated as confidential and shared with HR and managers on a need-to-know basis. Information will not be released to third parties except with the consent of the individual or where relevant to a grievance, charge, claim, or other legal proceeding initiated by or on behalf of an employee or applicant, or as may be required by law or legal process.

4.3 Types of Testing

4.3.1 Employees undertaking Safety-Sensitive tasks or in a Safety Sensitive position may be required to undergo drug and alcohol testing.

4.3.2 Pre-employment Testing - Applicants extended a conditional offer of employment may be required to take, and pass, a pre-hire drug test before beginning work. Individuals who test positive or refuse the test will not be hired and will be ineligible to reapply for a minimum period of six months or longer as defined by the applicable Business Group. Employees who transfer from one company Business Group or project to another are not required to take a pre-employment drug test if their employment is without interruption, they are not subject to client testing or safety sensitive testing requirements, and they would have been expected to have taken a pre-hire or client mandated drug test.

4.3.3 Random and Annual Testing - Employees may be subject to random drug and/or alcohol testing in accordance with federal, state / provincial / territorial, and local laws. In addition, employees may be subject to random or annual drug tests to meet contract requirements.

- Selections for random testing will be made by the Substance Abuse Program Administer or a Certified Third Party Administrator using employee identification numbers and a random selection process. They will be unannounced and once selected for testing, an individual may not be waived from the testing process unless approved by the Substance Abuse Prevention program administrator.
- Employees will be notified to report for random tests at a time when they should be able to stop working and report immediately to the collection site. Failure to report for a test promptly when instructed to do so may be considered a refusal to test.
- Employees who may be required to submit to random or annual tests will be so notified at the time that they are hired into an applicable position, when they transfer into such a position, or when random or scheduled testing becomes applicable to their position.

4.3.4 Reasonable Suspicion Testing - Employees are subject to drug and/or alcohol testing whenever AECOM supervision has reason to believe that the employee may have violated this policy and procedure. Requests for tests will be based upon contemporaneous, articulable observations from supervisors suggesting that the employee may be under the influence of illegal drugs, controlled substances, or alcohol.

- Examples of observations that may lead or further substantiate reasonable suspicion testing can include the employee's appearance, behavior, speech, body odors, absenteeism, job performance, tardiness, etc. The SAP administrator should be consulted when guidance is required, who will engage HR as necessary. Observations shall be documented before the individual is asked to submit to a test.
- An employee asked to take a drug and/or alcohol test will be suspended without pay until test results are received. They may use Paid Time Off (PTO) time during this period. An employee who has negative test results will be returned to work status and the employee will then be paid or have their PTO restored for any lost time during that period.

4.3.5 Post Incident/Accident Testing - Employees may be subject to drug and alcohol testing in accordance with federal, state / provincial / territorial, and local law whenever:

- An employee is subject to post-incident testing in accordance with applicable client requirements and/or regulations or laws that contain specific requirements for testing (e.g., Department of Transportation, state / provincial / territorial, workers' compensation laws);
- An employee sustained or potentially caused or contributed to an injury or illness requiring off-site medical treatment beyond first aid, and there is a reasonable possibility the employees' drug or alcohol use may have contributed to the incident. Employees will not be tested post-incident if management determines that potential drug and/or alcohol use likely did not contribute to the incident such as in the cases or animal or insect bites, repetitive strain injury, poison ivy, etc;
- An employee may have caused or contributed to property damage estimated (including to Company vehicles or equipment) of $2,500 or more (a lower cost of damage requiring testing may be identified in Business Group specific programs); and
- An employee may have caused or contributed to an incident or serious near miss, whether or not they sustained an injury or illness, or whether property damage resulted. Testing may be appropriate in these circumstances if there is a reasonable possibility the employees' drug or alcohol use may have contributed to the incident and results may provide insight to the root causes of the incident.

In either of these instances, the investigation and substance abuse testing shall take place immediately following the incident and at a minimum within 8 hours for alcohol and 36 for drug testing, except that no investigation or request for test will delay the provision of urgent medical

care to any person in need of assistance. Employees will not be allowed to return to work until a negative drug/alcohol test result is received.

4.3.6 Return-to-Work and Follow-up Testing - Employees who test positive for drugs or alcohol or who have otherwise violated this Policy and Procedure are subject to discipline, up to and including discharge. Depending on the eligibility, the Company may offer an employee who violates this Policy and Procedure the opportunity to seek assistance in lieu of termination through an approved counseling program as per Business Group policy. Employees offered this opportunity will be required to be evaluated by a substance abuse professional, and to complete any course of education or treatment prescribed before returning to work. In addition, employees shall have a negative drug/alcohol test prior to their return to work and follow-up drug and/or alcohol testing may be required as a condition of continued employment, for a period of up to two years following the return to work. If subject to a client-specific substance abuse policy, employees who have had a positive test result will not be permitted to return to work on the client site or facility. Return-to-Work Agreements will be tailored to the individual's circumstances and job responsibilities.

4.4 Collection and Testing

4.4.1 Consent and Refusals to Test: No sample will be collected, or test conducted on any sample, without the consent of the person being tested. AECOM will pay the costs of all drug and/or alcohol tests it requires. A refusal to submit to a test will be treated as an admission of a policy violation and will usually result in termination of employment. Job applicants who refuse a test will have their job offers withdrawn.

- Attempts to tamper with, substitute, adulterate, dilute or otherwise falsify a test sample are considered refusals to submit to a test, as is a refusal to accept transportation to the testing facility, failure to appear at the testing location promptly after being asked to submit to a test, or other conduct that has the effect of hindering the testing process.

4.4.2 Test Methods: Drug test samples may include urine, hair, swab or saliva (oral fluids). All drug test samples will be screened and all presumptive positive drug tests will be confirmed using gas chromatography/ mass spectrometry (GC/MS) (or an equally accurate methodology). Drug tests will be performed by a laboratory certified by the U.S. Substance Abuse and Mental Health Services Administration for federal workplace testing, or as required by the applicable jurisdiction. Breath, blood, swab or urine tests may be used to detect the presence of alcohol. An alcohol test will be considered positive if it shows the presence of .04 percent or more alcohol in a person's system.

- Dilute or invalid results may require a recollection, and the Company may require the individual to provide an alternative test specimen as may be available and consistent with the underlying purpose of the test.

4.4.3 Collection and Chain-of-Custody: Persons being tested will be asked to provide a test sample to a trained collector. Procedures for the collection of specimens will allow for reasonable individual privacy. Urine specimens will be tested for temperature and may be subject to other validation procedures as appropriate. The collector and the person being tested will follow chain-of-custody procedures for specimens at all times. Tests will seek only information about the presence of drugs and alcohol in an individual's specimen and will not test for any medical condition.

4.4.4 Notification and Medical Review: Any individual whose test sample is confirmed positive for a drug or drugs will be contacted by a Medical Review Officer ("MRO") (a medical professional with an expertise in toxicology) and offered an opportunity to explain in confidence any legitimate reasons he or she may have that would explain the positive test (such as, for example, evidence that the individual holds a valid prescription for the substance detected). The MRO may also review suspected adulterated, substituted, and dilute specimens and make determinations about their validity.

- If the individual provides an explanation acceptable to the MRO that a drug test result is due to factors other than the consumption of illegal drugs, the MRO will order the positive test result

to be disregarded and will report the test as negative to AECOM. Otherwise, the MRO will verify the test as positive and report that test result.

4.4.5 Right to Explain and Retest: Within three working days after notice of a verified positive drug or alcohol test result on a confirmatory test conducted under this Policy, the tested individual may submit information to the MRO to explain the positive result. An individual who tests positive for drugs also may ask to have his or her remaining or split test sample sent to an independent certified laboratory for a second confirmatory test, at the individual's expense, and provided that a written request is made within five business days of the date the individual of the positive test result. the MRO will notify the original testing laboratory that the employee or applicant has requested that the laboratory conduct a confirmatory retest or arrange for transfer of the sample to the laboratory selected by the individual to perform the confirmatory retest. Tested individuals will be required to pay the testing laboratory for any confirmatory retest they request. AECOM may suspend, transfer, or take other appropriate employment action against an employee pending the results of any such re-test. However, if the re-test fails to confirm as positive the individual will be reimbursed for the cost of the re-test and the prior test results disregarded.

4.4.6 The Company will provide drug and alcohol tests results to candidates and employees automatically, where applicable law so requires, and otherwise upon written request as may be required by law or as approved by legal counsel.

4.5 Workplace Searches and Inspections

4.5.1 The Company reserves the right to inspect and search all portions of its premises for drugs and other contraband. All employees, contract workers, and visitors may be asked to cooperate in inspections of their persons, work areas, and property brought on site in connection with an inspection. Testing may be warranted based on search or disclosure of evidence obtained on a work site or company controlled property. Employees who refuse to cooperate in any such inspections are subject to discipline, up to and including discharge**.**

4.6 Employee Assistance Program and Drug Free Awareness

4.6.1 Illegal drug use and alcohol misuse result in a number of adverse health and safety consequences. Information about those consequences and source of help for drug/alcohol problems is available from HR representatives who can also refer employees to the EAP for assistance with drug/alcohol related problems. Information about the EAP program is available on the Company intranet.

4.6.2 The Company will provide support to employees who voluntarily seek help for drug or alcohol problems. Depending upon the eligibility, the employee may be referred for evaluation and allowed to use accrued paid time off or be placed on leave as may be necessary to complete any prescribed education and/or treatment. Employees also may be required to document that they are successfully following a prescribed education and/or treatment plan and pass return to duty and follow-up drug and/or alcohol testing. A request for assistance will be considered voluntary only if made before the employee becomes subject to disciplinary action for violating this or another Company policy, and cannot excuse substandard performance, so AECOM encourages employees who may need assistance to seek it promptly:

4.6.3 In conjunction with the EAP, the Company will promote a drug-free workplace and provide awareness concerning the AECOM SAP program to inform employees about:

- The dangers of substance abuse in the workplace.
- Available counseling, rehabilitation, and EAPs (both for self-referral or supervisory referral).
- The penalties that may be imposed for violations of this procedure.
- The Company's commitment to promoting a drug-free workplace.

5.0 Records

5.1 None.

6.0 Attachments

6.1 S3AM-019-ATT1 Substance Abuse Policy Statement

6.2 S3AM-019-ATT2 Substance Abuse Prevention Communication Guidelines

6.3 S3AM-019-FM1 Acknowledgement & Consent Form

6.4 S4AM(US)-019-ATT1 Pipeline & Hazardous Materials Safety Administration (PHMSA) Covered Tasks Flowchart

Americas

Toxic & Hazardous Substances

S3AM-110-PR1

1.0 Purpose and Scope

1.1 The purpose of this procedure is to provide guidance to control occupational exposures to toxic or hazardous substances (gas, vapor, aerosol [dust, mist, fume, fog, fiber, smoke) to the lowest level practicable, including those specified under applicable jurisdictional legislation.

1.2 This procedure applies to all AECOM Americas based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

1.3 While this procedure contains specific requirements related to Ammonia, Benzene, Cadmium, Chromium (VI), Hydrogen Sulfide, and Lead, it also includes general requirements applicable to these substances as well as any other toxic or hazardous substances that may be encountered by AECOM employees (e.g., arsenic, coal dust, isocyanates, mercury, etc.).

1.4 Refer to *S3AM-109-PR1 Asbestos* for Asbestos specific requirements and *S3AM-129-PR1 Silica* for Silica specific requirements.

2.0 Terms and Definitions

2.1 **Action Level (AL)** – An airborne concentration of a potentially toxic or hazardous substance, measured in parts per million by volume (ppm), microgram per cubic meter ($\mu g/m^3$) milligram per cubic meter (mg/m^3) or fibres per cubic centimetre (f/cc), that triggers certain provisions as required by the applicable jurisdictional legislation. In many cases the action level is 50% of the established exposure limit.

2.2 **Demolition** – The wrecking or taking out of any load-supporting structural members and any related razing, removing, or stripping of any fixed building or structure or any part thereof.

2.3 **Established Exposure Limit** – The maximum regulatory exposure concentration to which an individual may be exposed to for an 8- hour time weighted average (TWA).

- This limit is referred to by different terminology depending upon the given jurisdiction (e.g. Permissible Exposure Limit (PEL), Contamination Limit, Occupational Exposure Limit (OEL), Threshold Limit Value (TLV), etc.).
- Acceptable methods of adjusting this limit to correspond to a different exposure period (e.g. 10 hours) vary by jurisdiction and substance.

2.4 **Established Exposure Limit: Ceiling Value** – The maximum exposure concentration during any part of the working exposure assuming direct reading instruments are used. Ceiling exposure limits "C", shall at no time exceed the exposure limit given for that substance. If instantaneous monitoring is not feasible, then the ceiling shall be assessed as a 15-minute time weighted average exposure which shall not be exceeded at any time during the working day.

2.5 **Exposure Mitigation Plan** – A comprehensive document which describes the controls necessary to mitigate the risk for exposure to a specified toxic or hazardous substance. This plan is referred to by different terminology depending upon the given jurisdiction (e.g. Compliance Program, Exposure Control Plan, etc.).

2.6 **HAZWOPER (Hazardous Waste Operations and Emergency Response) –** Any onsite contamination investigation, hazardous waste clean-up activities, hazardous substance emergency response and hazardous waste treatment, storage and disposal (TSD) is subject to the operational requirements of *S3AM-117-PR1 Hazardous Waste Operations*.

2.7 **SH&E Plan** – A document prepared for a specific project that details the hazards, precautions, emergency planning, medical, and training requirements for that project.

2.8 **Regulated Area** – Any area where concentrations of airborne toxic or hazardous substances exceed or can reasonably be expected to exceed, the allowable employee exposure limits, either the 8-hour time-weighted average exposure limit or the short-term exposure limit as averaged over a sampling period of 15 minutes.

2.9 **Renovation** – The modifying of any building component that does not impact structural supports.

2.10 **Short-term Exposure Limit (STEL)** – The maximum regulatory exposure concentration to which a worker may be exposed during any one 15-minute period, even if the 8-hour TWA established exposure limit has not been exceeded.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-004-PR1 Incident Reporting, Notifications & Investigation

3.3 S3AM-010-PR1 Emergency Response Planning

3.4 S3AM-109-PR1 Asbestos

3.5 S3AM-115-PR1 Hazardous Materials Communication

3.6 S3AM-117-PR1 Hazardous Waste Operations

3.7 S3AM-123-PR1 Respiratory Protection

3.8 S3AM-127-PR1 Exposure Monitoring

3.9 S3AM-128-PR1 Medical Screening & Surveillance

3.10 S3AM-129-PR1 Silica

3.11 S3AM-208-PR1 Personal Protective Equipment

3.12 S3AM-209-PR1 Risk Assessment & Management

3.13 S3AM-301-PR1 Confined Spaces

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **SH&E Manager**

- Provide technical assistance in the identification and evaluation of toxic and hazardous substance exposure hazards as requested by management personnel.
- Review and approve all exposure hazard assessments applicable to the identified toxic or hazardous substance(s) prior to the start of work activities.
- Review and approve all planning documentation, including exposure mitigation plans, and exposure monitoring activities applicable to the identified toxic or hazardous substance(s) to confirm compliance with federal, provincial, territorial, state, and/or local regulations. Plans should be updated if significant changes have occurred.
- Monitor compliance with the various aspects of this procedure and provide technical assistance regarding implementation of the requirements set forth in this procedure.
- Maintain records and notify employees of the results of any required exposure monitoring, in accordance with *S3AM-127-PR1 Exposure Monitoring.*

4.1.2 **Manager**

- Confirm the presence of toxic or hazardous substance exposure hazards at AECOM work sites are identified (where reasonably possible) and evaluated prior to commencing activities.

- Confirm that planning documentation, including exposure hazard assessments and any necessary exposure mitigation plans, applicable to the identified toxic or hazardous substance(s) are developed and approved by the SH&E Manager prior to the start of work activities.
- Confirm the applicable SDSs are made available to Employees.
- As required by the applicable jurisdiction, confirm notification(s) of the appropriate agencies or governing bodies is provided within the required timeframe prior to commencing the associated work activities.
- Confirm that the applicable requirements are observed for each task where the toxic or hazardous substance exposure assessment indicates airborne concentrations can exceed the Action Level (AL) or when other significant toxic or hazardous exposure hazards are present.
- Confirm that employees assigned to perform any work activities involving toxic or hazardous substances have been trained in the job-specific hazards of exposure, associated control measures, monitoring methods, emergency response, proper procedures, applicable client requirements and are trained and properly fit tested in the use of any designated respiratory protection devices. Refer to *S3AM-003-PR1 SH&E Training.*
- As required, confirm employees assigned to perform any work activities involving toxic or hazardous substances participate in provided exposure monitoring and applicable medical surveillance.
- Confirm that employees developing work procedures and/or conducting work activities involving toxic or hazardous substances possess any required jurisdictional specific registrations or certifications.
- Confirm employee training, registration and/or certifications are up to date.
- Notify SH&E Manager if any significant changes have occurred, including the presence or suspected presence of previously unidentified toxic or hazardous substances in the workplace.
- Confirm appropriate emergency response resources and procedures are in place. Refer to *S3AM-010-PR1 Emergency Response Planning.*
- If a toxic or hazardous substance is detected above the AL and/or direct reading instrumentation alarms, stop work, evacuate Employees from the affected area, and assess the work area in order to implement engineering or administrative controls, or to don personal protective equipment.
- Investigate and implement corrective actions to all incidents and reports of non-conformance with this procedure and legislation. Refer to *S3AM-004-PR1 Incident Reporting, Notifications & Investigation.*

4.1.3 **Employee**

- Maintain training appropriate to the toxic or hazardous substance exposure and the applicable tasks, and competency in the associated procedures (e.g. communication, rescue, etc.) and use of the necessary personal protective equipment (PPE) for entry and rescue. Refer to *S3AM-003-PR1 SH&E Training.*
- As appropriate to the anticipated or encountered toxic or hazardous substance exposure(s) and as addressed in the applicable planning documentation, utilize appropriate personal protective equipment (PPE) and applicable training in the job-specific hazards of the toxic or hazardous substance(s) exposure and associated procedures.
- Participate in applicable personal monitoring and medical surveillance, and perform appropriate respirator fit testing.

- Immediately notify the Manager of the presence or suspected presence of previously unidentified toxic or hazardous substances in the workplace, and cease all work activities involving disturbance or contact with the materials or substances until further direction is received.
- Evacuate the area when directed by the Manager or supervisor, or when a toxic or hazardous substance is detected above the AL and/or direct reading instrumentation alarms.

4.2 Requirements - General

4.2.1 This section applies to all toxic or hazardous substances AECOM employees may come in contact with, and also includes the toxic or hazardous substances detailed within this document with substance-specific requirements.

4.2.2 As required by the applicable jurisdiction, notify the appropriate agencies or governing bodies within the required timeframe prior to commencing the work activities associated with the toxic or hazardous substance(s).

4.2.3 Incorporate proper housekeeping to minimize the potential for toxic or hazardous substances (e.g. lead, silica, etc.) to accumulate on tables and lateral surfaces to protect workers.

4.2.4 All confined space entries will assess the potential of toxic or hazardous substance exposures and will be conducted according to *S3AM-301-PR1 Confined Spaces*.

4.2.5 Review project documents and SDSs to identify materials, operations or tasks that have a potential of exposing Employees to toxic or hazardous substances.

4.2.6 AECOM Employees in the vicinity of concurrent toxic or hazardous substance related activities shall be protected from exposure. Inadequate toxic or hazardous substance containment may require an initial exposure assessment or removal of Employees from the affected area until the exposure hazard has been adequately controlled.

4.2.7 HAZWOPER (US) or Hazardous Waste Activities

- Toxic or hazardous substances may be present as a soil or groundwater contaminant, in wastes stored or processed at the site, and as a building material.

4.2.8 Other Activities

- Various activities undertaken by AECOM personnel (e.g., construction, maintenance, demolition, renovation, production, etc.) may present potential toxic or hazardous substance exposure hazards. These exposures may be a result of materials disturbed, products handled or by-products of activities performed (e.g., welding, drilling, grinding, etc.).

4.2.9 If the presence of toxic or hazardous substances is identified or suspected at any work location and there is potential for Employee exposure during planned work activities the following requirements will be observed:

- Contact SH&E Manager and/or Manager to determine whether historical air monitoring data are available that accurately represents exposure conditions for the initial determination of the location's hazards.
- Thorough inspection and sampling / testing will be completed as necessary to identify the presence of any toxic or hazardous substances as part of the hazard assessment process.
- The hazard assessment and site-specific SH&E Plan will provide a specific analysis of the toxic or hazardous substance exposure hazard(s) for each task identified as having a potential exposure hazard. Refer to *S3AM-209-PR1 Risk Assessment & Management.* The hazard assessment and SH&E Plan will be reviewed and approved by the SH&E Manager.
- Prior to the commencement of work activities that may result in exposure and where possible, the toxic or hazardous substance shall be removed. Investigate materials substitution and process changes to avoid the use of products containing toxic or hazardous substances.

- If any potential is identified for worker toxic or hazardous substance exposures to exceed the applicable AL (or if applicable, established exposure limit) or as defined by the applicable jurisdiction, specific exposure control and monitoring procedures will be developed for the substance, and included in the SH&E Plan as an exposure mitigation plan. Exposure mitigation plans may include:
  - Location description.
  - Responsibilities.
  - Description of associated environmental conditions and proposed work activity.
  - Engineering controls, including instruction on setup and operation (e.g. ventilation, containment, etc.).
  - Air monitoring practices (include specific jurisdictional requirements) and data (initial and ongoing). Refer to *S3AM-127-PR1 Exposure Monitoring.*
  - Administrative controls, including scheduling requirements, and crew sizes.
  - Work practices (e.g. specific PPE, housekeeping requirements, inspection requirements, hygiene practices, etc.).
  - Procedures to be followed in regulated areas where the chemical hazards are present (e.g., restricted access, signage and instruction, contamination control, emergency response procedures).
  - As applicable, location of required hygiene facilities, emergency equipment / supplies, change rooms, etc.
  - Maintenance and decontamination practices to be followed for servicing and cleaning equipment and disposing of waste.
  - Reporting and recordkeeping requirements.
  - Methods of communication to inform affected Employees of potential exposures, including contractors on multi-contractor sites.
  - Medical surveillance program requirements. Refer to *S3AM-128-PR1 Medical Screening & Surveillance*.
  - As applicable, the name of the Competent Person who will be responsible for performing regular inspections of the job site, materials, and equipment during the job. Refer to *S3AM-202-PR1 Competent Person Designation.*
- Exposure mitigation plans will be reviewed and approved by the SH&E Manager prior to implementation.
- SH&E Plan and mitigation plan content, including any air monitoring results, will be communicated and made available to affected Employees.
- The site specific emergency response plan shall include emergency procedures applicable to the toxic or hazardous substances workers may be exposed to. Appropriate emergency equipment or supplies shall be available.
- Applicable engineering controls are to be in place prior to work commencing.
- If there is a change in conditions the SH&E Plan and, as applicable, exposure mitigation plan may require revision, SH&E Manager review, approval and communication thereof to affected Employees.
- If Employees may potentially be exposed in excess of a toxic or hazardous substance AL, they shall complete applicable training (refer to *S3AM-003-PR1 SH&E Training*) and may be required to complete baseline medical surveillance in accordance with jurisdictional requirements.

- Disposal of toxic or hazardous substance containing materials must meet federal, provincial, territorial, state, and local regulatory requirements. The Manager is required to address this in the applicable work plan.

4.3 Worker Exposure Control Program - General

This section applies to all toxic or hazardous substances AECOM employees may come in contact with, and also includes the toxic or hazardous substances detailed within this document with substance-specific requirements.

The following requirements pertain to all workers performing tasks where the associated toxic or hazardous substance exposure assessment indicates the potential for exposures to exceed the AL (or if applicable, established exposure limit).

4.3.1 Exposure Monitoring

- Operations involving the potential airborne exposure to toxic or hazardous substances shall be required to conduct initial and, as applicable, ongoing personal air monitoring or sampling to represent Employee exposure. Refer to *S3AM-127-PR1 Exposure Monitoring.*
- Establish the testing protocols and select the appropriate equipment to measure the potential hazards.
- Personnel trained in accordance with this procedure and with manufacturer's procedures for the given equipment shall perform verification of equipment as follows:
  - Conduct or confirm calibration of combustible gas meters, as applicable, using appropriate span gas for the detectors to be used. (This span gas calibration shall be performed at frequencies determined by the manufacturer).
  - Conduct alarm checks (field or bump checks) using the appropriate span gas for the detectors to be used each time the instrument is turned on.
  - Check detector tube pumps for leakage using the manufacturer's procedures.
  - Calibrate photo ionization detectors (PID) using isobutylene or other material in accordance with the manufacturer's directions.
  - Calibrate any other instrumentation to be used in accordance with manufacturer's directions.
- Determine the acceptable values for the toxic or hazardous substances being measured, based on the equipment in use and the AL (or if applicable, established exposure limit).
- As applicable, use air samplers that indicate the toxic or hazardous substance concentration in the affected Employees' breathing zone.
- Quarterly, biannual, and baseline sampling may be required depending upon the toxic or hazardous substance, exposure levels, jurisdictional requirements and client specifications.
- Air sampling results shall be accessible to all potentially affected Employees at each applicable site.
- Ongoing personal monitors used to warn workers of potentially hazardous levels of a toxic or hazardous substance should be set to provide both a visible and audible alarm.

4.3.2 Medical Surveillance Requirements

- As defined by AECOMS's Medical Provider and in accordance with the applicable jurisdictional requirements, Employees will complete a medical baseline evaluation prior to commencing work where toxic or hazardous exposure may exceed the AL (or if applicable, established exposure limit). Refer to *S3AM-128-PR1 Medical Screening & Surveillance*.
- Ongoing medical surveillance may be required as determined by the exposure(s), jurisdictional requirements and medical direction.

4.3.3 Medical Removal

- AECOM will temporarily remove an Employee from work where there has been an excessive exposure to a toxic or hazardous substance based on biological or medical monitoring results as determined by a physician's medical examination.
- The physician's determination to remove an Employee from such work may be based on monitoring results, the Employee's inability to wear a respirator, evidence of illness, other signs or symptoms of toxic or hazardous substance-related dysfunction or disease, or any other reason deemed medically sufficient by the physician.

4.3.4 Training

- Employees who have potential or are exposed at or above the AL are required to complete and maintain appropriate training related to the particular toxic or hazardous substance in accordance with the jurisdictional legislation and any applicable client requirements. Refer to *S3AM-003-PR1 SH&E Training*.
- Training will be provided prior to or at the time of initial assignment, upon any substantial changes to the operation covered, and at intervals determined by the applicable jurisdiction thereafter (e.g. U.S. annual Lead Awareness refresher).
- Training will be documented and provided at no cost to the Employees.
- Content of the training may include, but not be limited to:
    - Employee's specific duties and responsibilities (e.g., spill reporting, decontamination, etc.).
    - Exposure limits and other regulatory requirements specific to the toxic or hazardous substance.
    - Job-specific toxic or hazardous exposure hazards (including local and systemic toxicity) and exposure prevention measures.
    - The health hazards and symptoms associated with specific toxic or hazardous substance exposure.
    - Recognition and evaluation of potential hazardous situations.
    - The proper procedures and use of specific equipment for atmospheric testing and personal monitoring as applicable to the task and responsibility.
    - The purpose and a description of any required exposure monitoring.
    - The quantity, location, manner of use, release, and storage of specific toxic or hazardous substance in the workplace and the specific nature of operations that could result in exposure, especially exposures above the established exposure limit.
    - The job-specific engineering controls and work practices associated with the employee's job assignment. As applicable, review of the applicable Exposure Mitigation Plan.
    - Regulated areas: authorizations, entrance restrictions, signs and warnings.
    - Container contents identification.
    - The measures Employees can take to protect themselves from exposure to the toxic or hazardous substance(s), including modification of such habits as smoking and personal hygiene.
    - Specific procedures that AECOM has implemented to protect Employees from exposure to the toxic or hazardous substance, such as appropriate decontamination procedures, hygiene practices, warning signs and labels, and the provision of personal protective equipment.
    - As applicable, client requirements.

- The purpose, proper selection, fitting, proper use, and limitations of respirators and protective clothing.
- Substance technical guidelines for the toxic or hazardous substance, applicable substance safety data sheet (SDS) information.
- Emergency (including first aid) practices and procedures, and identification of Employee's specific role.
- The purpose, description and requirements of the medical surveillance program. This may include self-examination.
- The Employee's rights of access to records, such as monitoring results and medical records.

- Employees shall complete any additional training related to the potential toxic or hazardous substance exposure (e.g., confined space, respiratory protection, etc.) prior to or at the time of initial assignment, upon any substantial changes to the operation covered, and at intervals determined by the applicable jurisdiction thereafter.

4.3.5 Respiratory Protection

- Respiratory protection is required for those operations in which engineering controls or work practice controls are not feasible to reduce toxic or hazardous substance exposure at or below the AL (or if applicable, established exposure limit).
- Where respiratory protection is specified for use in controlling worker exposures to toxic or hazardous substances refer to *S3AM-123-PR1 Respiratory Protection* for requirements. Each Employee will:
  - Be medically cleared for use of the specified respiratory protection.
  - Complete respirator training and fit testing.
  - Be assigned an appropriate and approved respirator for use during applicable operations.
  - Use and maintain the respirator in accordance with *S3AM-123-PR1 Respiratory Protection.*
- Escape-only respirators have a single function: to allow a person working in a normally safe environment sufficient time to escape from suddenly occurring respiratory hazards. Selection should include consideration of factors such as maximum expected concentration, escape time (i.e., exposure duration), breathing rate, respirator service life, and eye irritation.

4.3.6 Personal Protective Equipment (PPE) and Hygiene Facilities

- In any operation where workers may experience airborne toxic or hazardous substance concentrations above the AL, or where the possibility of skin or eye irritation exists, and where exposure cannot be controlled by other means, Employees shall be provided with appropriate personal protective equipment that prevents contamination of the Employee and the Employee's garments, refer to *S3AM-208-PR1 Personal Protective Equipment*. Requirements may include, but are not limited to:
  - Respiratory protection.
  - Chemical or particulate protective coveralls or similar full-body work clothing.
  - Gloves, head protection / hoods, and boots or disposable work-boot coverlets.
  - Face shields, splash-proof goggles, chemical aprons or other appropriate protective equipment necessary for safe job performance.
  - Clean change rooms equipped with separate storage facilities to prevent cross contamination from protective work clothing and equipment to street clothes.
  - Shower and/or hand and face washing facilities.

- All protective clothing shall be cleaned, laundered, properly disposed of, and repaired or replaced as necessary.
- AECOM will provide all necessary PPE that is incidental to the work at no cost to the Employee.

4.3.7 Regulated Area

- A regulated area may be established where the concentration of an airborne toxic or hazardous substance exceeds or can reasonably be expected to exceed the AL (or if applicable, established exposure limit).
- Access to regulated areas will be limited to authorized persons. Rosters may be maintained of all persons entering such areas.
- Regulated areas will be demarcated from the rest of the workplace in any manner that minimizes the number of Employees exposed to the associated toxic or hazardous substance within the regulated area.
- Where regulated areas are required, signs will be posted at entrances to regulated areas appropriate to the associated toxic or hazardous substance. Clean and illuminate signs as necessary for visibility.
- No food or beverages shall be present or consumed in the regulated area.
- No tobacco products shall be present or used and cosmetics shall not be applied in the regulated area.
- Employees shall not enter or remain in regulated areas when any of the required safety systems such as ventilation or containment are not functional.
- Contaminated protective equipment, such as respirators, airline hoses, etc., shall not be removed from the regulated area until it has been cleaned.

4.3.8 Containers

- Toxic or hazardous substances in containers in the workplace shall be appropriately labelled in order to identify the product and provide suitable warnings. Refer to *S3AM-115-PR1 Hazardous Materials Communication*.

4.3.9 Emergency Preparedness

- The site specific emergency response shall include relevant procedures to the potential emergencies presented by the toxic or hazardous substances.
- Appropriate emergency equipment shall be available (e.g., rescue equipment, spill containment, neutralizers, etc.).
- Employees shall be trained in the use of the fire extinguishers, the emergency notification provisions of the SH&E Plan, and evacuation routes and muster points.
- As applicable, determine the local wind direction and identify the appropriate emergency egress route taking Employees out of the toxic or hazardous substance exposure area via a cross wind direction.

4.4 Anhydrous Ammonia – Specific Requirements

4.4.1 The following substance-specific requirements supplement the *Requirements – General* and *Worker Exposure Control Program – General* sections as contained in this document.

4.4.2 As applicable, work scope and environment shall be evaluated for potential worker exposure. Anhydrous Ammonia may be encountered during tasks associated with industrial refrigeration equipment or piping, petroleum refineries, and agricultural fertilizer.

- Anhydrous Ammonia is a colorless gas with a sharp, pungent odor, and readily combines with water. As a gas under normal conditions, it is commonly stored in a pressurized state as a liquid.

- Anhydrous Ammonia presents a skin / eye contact hazard and an inhalation hazard. While Anhydrous Ammonia can displace oxygen and be suffocating, it is highly irritating and can cause burns and blisters at concentrations lower than that which would cause suffocation. See the table below for vapor concentration and health effects:

Concentration of Anhydrous Ammonia Vapor.

PPM (parts per million)	% by volume	Effects on the human body
5	0.005	Detectable by almost all persons. Some people complain of nose irritation after 5 minutes
134	0.0134	Most people experience dryness and irritation of nose, throat and eyes.
700	0.07	Coughing. Severe eye irritation, if not treated, may lead to partial or total loss of sight.
1700	0.17	Serious lung damage, death unless treated.
2000	0.2	Burns and blisters skin after a few seconds of exposure.
5000	0.5	Death by suffocation within minutes.

4.4.3 Employees shall be provided, and shall use, appropriate PPE (e.g., impervious clothing, gloves, face shields, etc.) when:

- There is potential of skin contact with liquid anhydrous ammonia or aqueous solutions of ammonia containing more than 10% by weight of ammonia.
- Skin may be frozen from contact with vessels containing liquid anhydrous ammonia.

4.5 Asbestos – Specific Requirements

4.5.1 Please refer to *S3AM-109-PR1 Asbestos* for Asbestos specific requirements.

4.6 Benzene – Specific Requirements

4.6.1 The following substance-specific requirements supplement the *Requirements – General* and *Worker Exposure Control Program – General* sections as contained in this document.

4.6.2 Benzene is a naturally occurring organic compound that has become a major industrial chemical. As a pure chemical, it is a clear, colorless liquid with an aromatic odor.

- Other characteristics of benzene are low vapor pressure, high flammability, and vapors heavier than air.
- Benzene has solubility in water in the range of 700 mg/Liter, and liquid benzene is lighter than water.
- Benzene evaporates very quickly and inhalation is the most likely route of exposure.
    - Brief exposure to high concentrations of benzene can cause drowsiness, dizziness, and headaches.
    - Long-term exposures to benzene can affect normal blood production, resulting in leukemia, and can impair the body's immune system. Benzene is a known human carcinogen.
- Benzene is considered a skin hazard and requires precautions to reduce or preclude direct skin contact.
    - Chemical gloves and boots may be required and only polyvinyl alcohol (PVA) or Viton coated gloves (or other materials approved by the manufacturer for use with benzene containing products) should be used.
    - Do NOT use rubber, neoprene or nitrile gloves or boots.

4.6.3 Benzene is typically encountered by AECOM as an environmental contaminant, where it is usually a constituent of petroleum fuels or other refined petroleum products that have been released. Benzene can be found in retail gas stations, refineries natural gas processing systems, oil & gas production fields, chemical manufacturing plants, and in products used by Employees such as gasoline and solvent systems

4.6.4 Benzene Action Level (AL) – An airborne benzene concentration of 0.5 parts per million (ppm) by volume (ppm) (or more stringent as required by the country / provincial / territorial / state legislation), calculated as an 8- hour time weighted average (TWA).

4.6.5 Established Exposure Limit – The established exposure limits for benzene vary by jurisdiction. The applicable SH&E Plan shall identify the appropriate AL and established exposure limit. Refer to *S3AM-110-ATT1 Established Exposure Limits*.

4.6.6 Regulated Area – As specified by the applicable jurisdiction, any area where concentrations of airborne benzene exceed or can reasonably be expected to exceed, the AL (or if applicable, established exposure limit).

- Where benzene regulated areas are required, signs will be posted at entrances to regulated areas with the following legend:

    DANGER
    BENZENE

MAY CAUSE CANCER
HIGHLY FLAMMABLE LIQUID AND VAPOR
DO NOT SMOKE
WEAR RESPIRATORY PROTECTION IN THIS AREA
AUTHORIZED PERSONNEL ONLY

4.6.7 Short term Exposure Limit (STEL) – A regulatory concentration that should not be exceeded during any one 15-minute period, even if the established exposure limit 8-hour TWA is not exceeded. The STEL for benzene is 2.5 ppm (or more stringent as required by the country / provincial / territorial / state legislation). Refer to *S3AM-110-ATT1 Established Exposure Limits*.

4.6.8 Exposure Monitoring

- Determinations of Employee exposure to Benzene shall be made from representative breathing zone air samples. Representative 8-hour TWA Employee exposures shall be determined on the basis of one full shift exposure sample in the work area.
- Determinations of STEL compliance shall be made from 15-minute Employee breathing zone samples. These samples shall be taken at work areas where it is reasonable to expect higher Benzene concentrations, such as:
  - Where tanks are opened, filled unloaded or gauged;
  - Where containers or process equipment are opened, and
  - Where Benzene is used for cleaning or as a solvent in an uncontrolled environment.
- The remaining elements of monitoring, such as minimum time frames for initial and periodic monitoring and Employee notification shall meet jurisdictional requirements.

4.6.9 Benzene - Work Practices

- Only use air purifying respirators with chemical cartridges approved for the benzene concentration expected and only for the length of time calculated for expected time of useable life.
- Workers shall be provided with potable water for washing exposed skin prior to leaving the project area, eating, drinking, and/or smoking.
- When draining equipment containing Benzene materials, draining must be performed in a closed system.
- Equipment containing Benzene materials must be cleaned by appropriate method prior to opening.
- Use Benzene-free purchased products when possible. Types of products, which may contain Benzene, include paints, thinners, degreasers, cleaners, etc. Under no circumstances are aerosol products containing Benzene allowed to be used. Consult the Safety Data Sheet (SDS) to determine if the product is Benzene-free.
- Fire extinguishers shall be available at project sites where liquid benzene or benzene vapors might be present.

4.7 Cadmium-Containing Material -

4.7.1 The following substance-specific requirements supplement the *Requirements – General* and *Worker Exposure Control Program – General* sections as contained in this document.

4.7.2 Cadmium containing material

- Paint or other surface coatings that contain cadmium equal to or in excess of 0.1 milligram per centimeter squared (1.0 mg/cm2) or 0.05% by weight; or
- Bulk materials containing cadmium in excess of 0.01%, or for soils any cadmium-in-soil concentration in excess of 100 mg/kg.

- Airborne cadmium may be encountered as a result of burning fossil fuels, smelting of zinc, copper or lead and may be released in welding fumes (cadmium coatings are often used to prevent rust on steel pipe).

4.7.3 The health effects of cadmium exposure vary due to duration and level of exposure.

- Acute or short term exposures to high levels of cadmium may cause effects such as chills, fever and muscle pain. Acute exposure may also cause lung damage.
- Chronic or long term cadmium exposure may cause effects such as lung, kidney or bone disease.
- Cadmium is identified as carcinogenic to humans.

4.7.4 Cadmium Action Level (AL) – An airborne cadmium concentration of 0.002 mg/m^3 (2.0 µg/m^3) or more stringent as required by the local regulations (e.g. 50% of established exposure limit), calculated as an 8-hour time weighted average (TWA), irrespective of mitigation provided by any respiratory protection that might be used.

4.7.5 Established Exposure Limit – The established exposure limits for cadmium vary by jurisdiction. The applicable SH&E Plan shall identify the appropriate AL and established exposure limit. Refer to *S3AM-110-ATT1 Established Exposure Limits*.

- In each work area where the AL is exceeded, the following warning sign shall be posted:

  DANGER
  CADMIUM
  MAY CAUSE CANCER
  CAUSES DAMAGE TO LUNGS AND KIDNEYS
  WEAR RESPIRATORY PROTECTION IN THIS AREA
  AUTHORIZED PERSONNEL ONLY

- Disposable equipment such as protective clothing and hoods, waste scrape and debris shall be disposed of in containers labelled as follows:

  DANGER
  CONTAINS CADMIUM
  MAY CAUSE CANCER
  CAUSES DAMAGE TO LUNGS AND KIDNEYS
  AVOID CREATING DUST

- Employees exiting cadmium regulated areas shall wash their hands and face with soap and water, and may be required to shower. Refer to the *S3AM-117-PR1 Hazardous Waste Operations.*
- Removal of cadmium from protective clothing or equipment by blowing, shaking, or any other means which could disperse cadmium into the air is prohibited.
- No food, tobacco, or beverages shall be present or consumed in the regulated area.
- During the operation, all Employees shall be required to wash their hands and face prior to eating, drinking, smoking, or applying cosmetics.
- Whenever possible, wet methods shall be used when handling or processing cadmium compounds. Water spray, fogging, or water collection systems, etc., shall be used. (e.g., cadmium-contaminated soil shall be thoroughly wetted for excavation operations.)
- Dry sweeping of cadmium or cadmium-contaminated materials is prohibited. When wet methods cannot be used, HEPA filter vacuum cleaners shall be required. Filters will be checked periodically as needed.

4.8 Chromium (VI) – Specific Requirements

4.8.1 The following substance-specific requirements supplement the *Requirements – General* and *Worker Exposure Control Program – General* sections as contained in this document.

4.8.2 Exposures to Chromium (VI), (or hexavalent chromium) could result from the application and removal of paint containing Chromium (VI), welding, cutting, grinding and chrome plating.

4.8.3 Direct skin contact with concrete and concrete products (as Chromium (VI) may be present in portland cement) may result in skin irritation and ulceration. Suitable gloves and boots should be used when handling dry powder or wet concrete materials. Eye protection is also required when mixing concrete materials.

4.8.4 AL and established exposure limits for Chromium (VI) vary considerably by jurisdiction. The applicable SH&E Plan shall identify the appropriate AL and established exposure limit.

4.8.5 As applicable, utilize the associated SDS to determine if Chromium (VI) is a material constituent. For example, if chromium trioxide, chromic acid, chromate, dichromate, polychromate, chrome VI, chromium 6, chromium (VI), Cr VI, Cr (VI), chromium anhydride, or hexavalent chromium is listed on an SDS, the material will be treated as containing Chromium (VI).

4.8.6 Complete baseline assessments for Chromium (VI) levels at each applicable site as soon as reasonably possible after the start of work involving Chromium (VI) materials.

4.8.7 Until demonstrated otherwise, assume that paint on military vehicles, aircraft, vessels, and other equipment contains Chromium (VI).

4.8.8 Changes in the work activities, methods, or materials may indicate the need for a new Chromium (VI) baseline. For example, a change in the ventilation system where work is performed, or a change in the type of military vehicle serviced may elevate the Chromium (VI) levels and require a new baseline.

4.8.9 Affected areas will be decontaminated to prevent Chromium (VI) ingestion at the site, contamination of other work areas, and contamination of the Employee's home.

4.8.10 Action Level (AL) – An airborne concentration of 50% of the applicable jurisdiction's established exposure limit of Chromium (VI), calculated as an 8-hour time weighted average (TWA), irrespective of mitigation provided by any respiratory protection that might be used.

4.8.11 Established Exposure Limit – The established exposure limits for Chromium (VI) vary by jurisdiction. The applicable SH&E Plan shall identify the appropriate AL and established exposure limit. Refer to *S3AM-110-ATT1 Established Exposure Limits.*

4.8.12 Regulated Area – Any area where concentrations of Chromium (VI) exceed or can reasonably be expected to exceed, the AL.

4.8.13 A respirator is the PPE appropriate for reducing inhalation exposures to Chromium (VI).

- If there is any potential for hexavalent chromium exposure, involved workers must wear gloves and a half-face respirator with a P100 HEPA cartridge / filter as a minimum.
- Various operations may require use of respiratory protection providing a greater protection factor.
- Respirator selection shall be included in the applicable SH&E Plan.

4.8.14 Where protective clothing is required, change rooms shall be provided with separate storage areas for street clothes and protective clothing.

4.8.15 Where skin contact with Chromium (VI) is anticipated, washing facilities will be provided with hot and cold running water, cleanser, and individual hand towels. Soap and water is not adequate thus a cleanser or wipe designed specifically to remove heavy metals is required.

4.9 Hydrogen Sulfide (H_2S) – Specific Requirements

4.9.1 The following substance-specific requirements supplement the *Requirements – General* and *Worker Exposure Control Program – General* sections as contained in this document.

4.9.2 Synonyms: Hydrosulfuric acid, Sewer gas, Sulfuretted hydrogen**.**

4.9.3 H_2S is a colorless, flammable, extremely hazardous gas with a "rotten egg" smell. Sense of smell becomes rapidly fatigued at low levels of H_2S and cannot be relied upon to warn of the continuous presence of H_2S**.**

4.9.4 H_2S is shipped as a liquefied compressed gas and is soluble in water. Its boiling point is -77 degrees F (-60 degrees C). The flammable limits in air are 4% - 44%. H_2S is a flammable gas. H_2S is heavier than air and may accumulate in low-lying areas.

4.9.5 H_2S often results from the bacterial breakdown of organic matter in the absence of oxygen, such as in swamps and sewers; this process is commonly known as anaerobic digestion.

4.9.6 H_2S is also found in petroleum drilling and refineries as well as natural gas extraction and processing.

4.9.7 Established Exposure Limit – The established exposure limits for H_2S vary by jurisdiction. The applicable SH&E Plan shall identify the appropriate AL and established exposure limit. Refer to *S3AM-110-ATT1 Established Exposure Limits*.

4.9.8 Immediately Dangerous to Life and Health (IDLH) - An atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere. Atmospheres containing high concentrations (greater than 100 ppm) of H_2S are considered IDLH.

4.9.9 The health effects of exposure to H_2S are provided by the United States Department of Labor (Occupational Safety and Health Administration) and described in the table below:

Concentration (ppm)	**Symptoms/Effects**
0.00011-0.00033	Typical background concentrations
0.01-1.5	Odor threshold (when rotten egg smell is first noticeable to some). Odor becomes more offensive at 3-5 ppm. Above 30 ppm, odor is described as sweet or sickeningly sweet.
2-5	Prolonged exposure may cause nausea, tearing of the eyes, headaches or loss of sleep. May cause airway problems (bronchial constriction) in some asthma patients.
20	Possible fatigue, loss of appetite, headache, irritability, poor memory, dizziness.
50-100	Slight conjunctivitis ("gas eye") and respiratory tract irritation after 1 hour. May cause digestive upset and loss of appetite.
100	Coughing, eye irritation, loss of smell after 2-15 minutes (olfactory fatigue). Altered breathing, drowsiness after 15-30 minutes. Throat irritation after 1 hour. Gradual increase in severity of symptoms over several hours. Death may occur after 48 hours.
100-150	Loss of smell (olfactory fatigue or paralysis).
200-300	Marked conjunctivitis and respiratory tract irritation after 1 hour. Pulmonary edema may occur from prolonged exposure.
500-700	Staggering, collapse in 5 minutes. Serious damage to the eyes in 30 minutes. Death after 30-60 minutes.
700-1,000	Rapid unconsciousness, "knockdown" or immediate collapse within 1 to 2 breaths, breathing stops, death within minutes.
1,000-2,000	Nearly instant death.

4.9.10 The Manager will assume H_2S is present for specific activities including, but not limited to:

- Oil and gas due diligence, remedial investigation, or other defined activities planned in a sour well field, compressor facility, or downstream refining or storage facility;
- Sanitary sewer projects requiring entry into confined spaces;
- Confined space entry into any chemical process vessels, tanks, pits, etc.;
- Entry into client-designated H_2S areas at wastewater treatment plants; and
- Subsurface investigation/disturbance activities at municipal or other potential H_2S -generating landfills.

4.9.11 The following sign may be posted near area where H_2S is present.

WARNING HAZARDOUS AREA
HYDROGEN SULFIDE
EXTREME HEALTH HAZARD
FATAL OR HARMFUL IF INHALED

4.9.12 All ignition sources must be controlled when H_2S is present**.**

4.9.13 All personal H_2S detectors will be set to alarm at the AL (e.g. 10 ppm) or lower as dictated by jurisdictional and/or client requirements.

4.9.14 Appropriate respiratory protection used in an H_2S environment shall be determined according to the exposure hazard, the applicable jurisdictional requirements and any client specifications and included in the SH&E Plan. Refer to *S3AM-123-PR1 Respiratory Protection.*

- Air purifying respirators should not be used in concentrations above 50 ppm without an industrial hygienist's approval. It is important to calculate cartridge life limits of air purifying respirators.
- Workers without respiratory protection should never be exposed to concentrations above the applicable established exposure limit.
- Supplied air or self-contained breathing apparatus respirators are often required for H_2S conditions.

4.10 Lead – Specific Requirements

4.10.1 The following substance-specific requirements supplement the *Requirements – General* and *Worker Exposure Control Program – General* sections as contained in this document.

4.10.2 Determine whether any surface to be disturbed or altered contains lead or has a surface coating that contains lead.

4.10.3 Lead Containing Material -

- Structural or decorative components containing lead in excess of 1% by weight.
- Paint or other surface coatings that contain lead equal to or in excess of 1.0 milligram per centimeter squared (1.0 ug/cm2).
- Bulk materials containing lead in excess of 0.1% or for soils any lead-in-soil concentration in excess of 1,000 mg/kg.
- "Lead" means metallic lead, all inorganic lead compounds, and organic lead soaps. Excluded from this definition are all other organic lead compounds.
- Demolition and renovation activities may reveal lead containing materials such as pipes, leaded paints, leaded solders, etc. Lead may be present at HAZWOPER sites as a soil or groundwater contaminant or as a building material.

4.10.4 The health effects of lead exposure vary due to duration and level of exposure.

- Acute or short term exposures to high levels of lead may cause such effects as irritability, headaches, weakness, fatigue, constipation, vomiting, abdominal pain, sleep loss, loss of appetite, memory loss, muscle aches or tingling and even anemia, kidney damage or brain damage. Extremely high lead exposure can be fatal.
- Chronic or long term lead exposure may cause effects such as irritability, depression, forgetfulness, distractedness, constipation, abdominal pain, nausea, and vomiting. Prolonged exposure may also result in systemic damage; reproductive, urinary, nervous and blood-forming systems.

4.10.5 Established Exposure Limit – The maximum exposure concentration to which an individual may be exposed to for an 8-hour time weighted average (TWA) without experiencing adverse health effects. For normal work shifts (8 hours or less), the established exposure limit for lead is 0.05mg/m^3 (50 µg/m^3), or more stringent as per local regulations.

4.10.6 Action Level (USA) – Employee exposure, without regard to the use of respirators, to an airborne concentration of lead of 0.03mg/m^3 (30µg/m^3) calculated as an 8-hour time-weighted average (TWA).

4.10.7 Action Level (Canada) – Employee exposure, without regard to the use of respirators, to an airborne concentration of lead of 0.025mg/m^3 (25µg/m^3) calculated as an 8-hour time-weighted average (TWA). (50% of the established exposure limit or 50µg/m^3)

4.10.8 Whenever possible, Employees shall not disturb lead containing materials.

4.10.9 Until the initial exposure assessment can be conducted, the following respiratory protection must be in place:

- Provide half face air purifying respirators with high efficiency cartridges where lead coatings or paint is present and any of the following activities will occur:
  - Manual demolition of structures.
  - Manual scraping.
  - Manual sanding.
  - Heat gun applications.
  - Power tool cleaning with dust collection applications.
  - Spray painting with lead paint
- Provide full face air purifying or powered air purifying respirators with high efficiency filters, or full face supplied air respirator operated in a demand mode when performing tasks involving:
  - Lead-containing mortar.
  - Lead burning.
  - Rivet busting.
  - Power tool cleaning without dust collection systems.
  - Cleanup activities where dry expendable abrasives are used.
  - Abrasive blasting enclosure movement and removal.
- Provide full face supplied air respirators operated in pressure demand or other positive pressure when performing tasks involving:
  - Abrasive blasting.
  - Welding.
  - Cutting.
  - Torch burning.

4.10.10 If initial air monitoring indicates levels of lead above the action level, monitoring shall be conducted every six months, at a minimum, until two consecutive monitoring results are recorded below the action level.

4.10.11 Employees shall wash hands and face if contact has been made with lead containing materials.

4.10.12 Regulated Area – Any area where the lead AL is exceeded.

- Where lead regulated areas are required, the following warning sign shall be posted:

  DANGER
  LEAD WORK AREA
  POISON
  MAY DAMAGE FERTILITY OR THE UNBORN CHILD
  CAUSES DAMAGE TO THE CENTRAL NERVOUS SYSTEM

DO NOT EAT, DRINK OR SMOKE IN THIS AREA

- Contaminated protective equipment such as respirators, airline hoses, etc., shall not be removed from the regulated area until it has been cleaned.
- Employees shall not be permitted to exit the regulated area until:
  - Contaminated equipment and clothing have been removed in accordance with the preceding bullets; and,
  - As determined by jurisdictional requirements, Employees have showered and/or washed their hands and face with soap and water.
- Removal of lead from protective clothing or equipment by blowing, shaking, or any other means which could disperse lead into the air is prohibited.
- No food or beverages shall be present or consumed in the regulated area.
- No tobacco products shall be present or used and cosmetics shall not be applied in the regulated area.
- During the operation, all Employees shall be required to wash their hands and face prior to eating, drinking, smoking, or applying cosmetics.
- Whenever possible, wet methods shall be used when handling or processing lead compounds. Water spray, fogging, or water collection systems, etc., shall be used (e.g., lead contaminated soil shall be thoroughly wetted for excavation operations).
- Dry sweeping of lead or lead-contaminated materials is prohibited. When wet methods cannot be used, HEPA filter vacuum cleaners shall be required.
- Containers of contaminated protective clothing and equipment are to be labelled as follows:

  CAUTION: CLOTHING CONTAMINATED WITH LEAD. DO NOT REMOVE DUST BY BLOWING OR SHAKING. DISPOSE OF LEAD CONTAMINATED WASH WATER IN ACCORDANCE WITH APPLICABLE LOCAL, STATE OR FEDERAL REGULATIONS

- A Competent Person will be appointed who is responsible for performing regular inspections of the job site, materials, and equipment during the job. Refer to *S3AM-202-PR1 Competent Person*.
- The Competent Person is to inspect the job site at least daily on those days when lead operations are performed.

4.11 Silica – Specific Requirements

4.11.1 Please refer to *S3AM-129-PR1 Silica* for silica specific requirements.

5.0 Records

5.1 Medical surveillance, Employee monitoring, and training records shall be maintained as specified by *S3AM-003-PR1 SH&E Training*, *S3AM-127-PR1 Exposure Monitoring* and *S3AM-128-PR1 Medical Screening & Surveillance*.

6.0 Attachments

6.1 S3AM-110-ATT1 Established Exposure Limits

6.2 S3AM-110-FM1 Toxic & Hazardous Substance Checklist

Americas

Bloodborne Pathogens

S3AM-111-PR1

1.0 Purpose and Scope

1.1 Define the AECOM procedures for eliminating and/or controlling occupational exposure to Bloodborne Pathogens on AECOM projects and activities.

1.2 A written Exposure Control Plan shall be developed and implemented during all AECOM operations where there is a reasonable potential for occupational exposure of AECOM employees and/or subcontractors to bloodborne pathogens as a regulated waste.

1.3 This procedure's requirements apply to all AECOM Americas employees and operations and any other entity and its personnel contractually required to comply with this document's content. Any jurisdictional requirements exceeding those identified in this procedure shall be met when conduction work in the given jurisdiction.

2.0 Terms and Definitions

2.1 **Blood** – Human whole blood; human blood components such as plasma or platelets; and human blood products such as clotting factors.

2.2 **Bloodborne Pathogens (BBP)** – Pathogenic microorganisms that are present in human blood and that can infect and cause disease in persons who are exposed to blood containing these pathogens including but not limited to hepatitis B virus (HBV), human immunodeficiency virus (HIV), hepatitis C, malaria, syphilis, babesiosis, brucellosis, leptospirosis, arboviral infections, relapsing fever, human T-lymphotropic virus Type I, and viral haemorrhagic fever (Ebola).

2.3 **Exposure Control Plan** *(S3AM-111-ATT1)* – A plan that addresses the requirements applicable to specific AECOM projects and activities designed to eliminate or minimize employee exposure. The Exposure Control Plan shall be incorporated into the location specific SH&E Plan and shall be accessible to all employees. The Exposure Control Plan shall include:

- Exposure determination.
- The schedule and method of implementation for:
  - Methods of compliance;
  - Hepatitis B Vaccination;
  - Post exposure Evaluation;
  - Communications of Hazards to employees; and
  - Record Keeping.
- Documentation methods for exposure incidents, to include:
  - Routes of exposure; and
  - The circumstances for which and exposure incident occurred.

Note: In the State of California this plan shall also address exposures to airborne pathogens.

2.4 **SH&E Plan** – A document prepared for a specific project or program that details the hazards, precautions, emergency planning, medical, and training requirements for that project or program.

2.5 **Occupational Exposure (Exposed) –** Reasonably anticipated skin, eye mucous membrane, or parenteral contact with blood or other potentially infectious materials that may result from the performance of an employee's duties. Employees will be considered to be potentially exposed, even though they are using the universal precautions specified for the project or program.

2.6 **Other Potentially Infectious Materials (OPIM)** – Body fluids and tissues including: semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid, amniotic fluid, saliva, and any other body fluid that is visibly contaminated with blood. When it is difficult or impossible to differentiate between body fluids, all body fluids should be treated as if they are potentially infectious.

Note: In the State of California airborne pathogens are also considered infectious materials.

2.7 **Regulated Waste** – (1) liquid or semi-liquid blood or other potentially infectious materials; (2) contaminated items that would release blood or other potentially infectious materials in a liquid or semi-liquid state if compressed; (3) items that are caked with dried blood or other potentially infectious materials and are capable of being released during handling; (4) objects contaminated with blood that can pierce the skin; and (5) pathological and microbiological wastes containing blood or other potentially infectious materials.

2.8 **Source Individual** – An individual, typically one who has been injured, whose blood or saliva has come in contact with another individual, typically one who has rendered first aid or Cardio Pulmonary Resuscitation (CPR) to the injured party.

2.9 **Universal Precautions** – All body fluids and materials potentially contaminated by body fluids will be considered to be infectious unless the fluids were from the person performing the clean up or decontamination activities. All employees coming in contact with another person's body fluids shall assume that the fluids are infectious and shall wear prescribed Personal Protective Equipment.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-004-PR1 Incident Reporting, Notifications & Investigation

3.3 S3AM-017-PR1 Injury & Illness Recordkeeping

3.4 S3AM-128-PR1 Medical Screening & Surveillance

3.5 S3AM-208-PR1 Personal Protective Equipment

3.6 S3AM-209-PR1 Risk Assessment & Management

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Occupational Health Manager**

- Will review and maintain all medical records generated as a result of post-exposure follow-up and maintain all medical records related to the follow-up.
- Will, where appropriate, consult with AECOM's local medical providers about follow-up recommendations.

4.1.2 **SH&E Manager**

- Will review project / program-specific Exposure Control Plans (normally part of the SH&E Plan) prior to the initial mobilization, at least annually for continuing projects or programs, and whenever necessary to reflect modified tasks or procedures that affect occupational exposure to bloodborne pathogens.
- Will consult with the Occupational Health Manager regarding all bloodborne pathogens exposure incidents.
- Will maintain training records and post-exposure follow-up information.
- Will confirm that site-specific training is conducted for all employees working at sites where regulated wastes were disposed or for employees who may be occupationally exposed while working at a facility that handles regulated wastes.

- Will confirm the Hepatitis B vaccine is made available to all employees with a potential occupational exposure (e.g. paramedic, medical laboratory employee, etc.).
- Will review all incident reports and arrange for post-exposure follow-up with AECOM's local medical provider.
- Will offer recommendations on how to prevent an incident from recurring.

4.1.3 **Manager**

- See that all recommendations made by the SH&E Manager are implemented.
- Support the SH&E Manager in their efforts to prevent occupational and non-occupational exposures to bloodborne pathogens.

4.1.4 **Employee**

- Use all PPE and universal precautions required to prevent exposure to infectious materials.
- Follow the exposure control methods outlined in their Exposure Control Plan.
- Report potential exposure incidents to their Supervisor or Manager immediately.

4.2 Potential Exposure Situations

4.2.1 There are a few activities within AECOM where potential occupational exposures to blood or other potentially infectious materials are of concern. These activities may include:

- Investigations of properties that received regulated wastes.
- Site visits or audits at Treatment Storage and Disposal facilities where medical waste is handled.
- Site visits or audits at medical or health care facilities.
- The provision of first-aid or cardiopulmonary resuscitation (CPR) to AECOM, subcontractor, or client personnel (if the action is part of the employee's occupations duties [e.g. paramedic] and not provided as a voluntary action).

4.2.2 Although AECOM does offer first-aid and CPR training to its employees on a regular basis, providing such aid is often on a voluntary basis and not directed by AECOM. As such, potential exposures may not be considered occupational exposures within the context of the OSHA Bloodborne Pathogens Standard. Site-specific Exposure Control Plans shall differentiate voluntary first-aid duties from occupational exposures as a component of the exposure determination. Refer to *S3AM-209-PR1 Risk Assessment & Management.*

4.3 Unforeseen Exposure Situations

4.3.1 Occasionally, potentially infectious material is encountered during a activity where none was expected; when this happens, the work shall be stopped, employee training conducted, and an exposure control plan prepared prior to resuming activities with potential exposures.

4.4 Employee Training

4.4.1 All personnel who will work on projects or programs which involve potential contact with regulated wastes will be required to attend a training class prior to the start of the project or program and annually for continuing projects or programs. Refer to *S3AM-003-PR1 SH&E Training.* The specific requirements and provisions of the written Exposure Control Plan shall be provided to each AECOM Employee and subcontractor assigned to work at the program / project.

4.4.2 Either of the following two sources of employee training will be used by AECOM to educate Employees on the hazards of exposure to bloodborne pathogens:

- The local chapter of the American Red Cross or other recognized training provider.
- AECOM's in-house training program.

4.4.3 Training sessions will review the following:

- Requirements of OSHA's Bloodborne Pathogens Standard or equivalent, applicable jurisdictional requirements.
- Review of AECOM's Bloodborne Pathogen Procedure (this document).
- Situations within AECOM that may involve exposure to bloodborne pathogens.
- Bloodborne diseases and symptoms of disease.
- Means of transmission.
- Work practice controls to reduce risk.
- Use of personal protective equipment to reduce risk.
- Incident reporting.
- AECOM's Post-Exposure Medical Follow-Up Procedures:

4.4.4 When contracting for CPR and first-aid training sessions, AECOM will request that each session include a section on the hazards associated with exposure to bloodborne pathogens and protective measures that shall be followed when administering first aid, CPR, or other emergency medical care. At the end of the session, Employees will be provided with a copy of this procedure. This procedure will be reviewed and a question-and-answer session will be conducted at the end of the presentation.

4.4.5 If the training provider cannot provide such training, AECOM will conduct a Blood Borne Pathogen training session prior to the start of the first aid or CPR class.

4.4.6 AECOM has and will have little control over employees who have not received AECOM provided first aid or CPR training, but who choose to perform Good Samaritan acts. Any Employee who does perform a Good Samaritan act that results in exposure to blood or other potentially infectious materials will, however, be provided with post-exposure medical follow-up as described in this procedure.

4.5 Personal Protective Equipment

4.5.1 All body fluids and materials potentially contaminated by body fluids will be considered to be infectious. All Employees coming in contact with another person’s body fluids shall assume that the fluids are infectious and shall wear prescribed personal protective equipment (PPE), refer to *S3AM-208-PR1 Personal Protective Equipment*.

4.5.2 The use of PPE to prevent exposure is more appropriate for the types of occupational and non-occupational exposures Employees might encounter than is the use of engineering or work practice controls that are more effectively instituted in medical care or laboratory facilities where employees are actually handling blood and other potentially infectious materials.

4.5.3 PPE such as Tyvek coveralls, shoe covers, and gloves will be provided to all field team members involved in site activities where regulated wastes may be present. Site-specific PPE requirements will be identified in the written Exposure Control Plan. The same type of PPE will also be available, if it is deemed necessary, for Employees involved with activities at TSD facilities that handle regulated wastes.

4.5.4 PPE will be provided to affected Employees at no cost.

4.6 Universal Precautions Kits

4.6.1 In those work areas where there is the potential for exposure to infectious materials, a universal precaution kit shall be readily available. The kit shall permit the clean-up, neutralization, transportation, and disposal of up to 1 litre of blood or body fluids. The kit shall contain the following items at a minimum:

- Safety shield/mask combination
- Liquid proof apron
- Medical-grade vinyl/nitrile gloves
- Liquid solidifier/deodorizer
- Pickup scoop with scraper
- Red biohazard waste bag with tie
- Germicidal solution with dry wipe
- Antimicrobial hand wipe
- ID tag
- Instructions for use

4.7 Personal Hygiene

4.7.1 Special provisions will be made so that hand washing facilities are available on-site for sites that are known to be contaminated with regulated wastes. Alcohol wipes will be available in the event that hand washing facilities are not immediately available.

4.7.2 To reduce the potential for infection, if skin contact with blood or other potentially infectious materials occurs, the exposed area should be washed with non-abrasive soap and water as soon as possible. Hand washing will also help to prevent the transfer of contamination from the hands to other areas of the body or other surfaces that may be contacted later. Even when protective gloves are worn, hands should be washed with non-abrasive soap and running water as soon as possible after the gloves are removed.

4.7.3 The use of an alcohol wipes should not be relied upon as the primary means of personal hygiene. Hands should be thoroughly washed with soap and running water as soon as possible.

4.7.4 If mucous membranes, such as the eyes, come in direct contact with blood or other potentially infectious materials, the area should be washed or flushed with water as soon as possible and reported immediately.

4.8 Reporting Exposure Incidents

4.8.1 All incidents in which an employee has been exposed to blood or other potentially infectious materials shall be reported to the employee's Supervisor and to the SH&E Manager immediately. An IndustrySafe on-line report shall be completed in accordance with *S3AM-004-PR1 Incident Reporting, Notifications & Investigation*. After reviewing the report, the SH&E Manager will provide recommendations, when appropriate, for preventing recurrence of the incident.

4.9 Medical Follow-Up to Exposure Incidents

4.9.1 Once notified, the SH&E Manager will in turn discuss the incident with AECOM's Occupational Health Manager and/or medical provider and make arrangements for an evaluation, refer to *S3AM-128-PR1 Medical Screening & Surveillance*. Prompt medical attention is important in the event of an exposure incident. If the incident occurs in the field, the Employee will either be asked to visit the local hospital or, if he/she chooses, return immediately to the office to visit AECOM's local medical provider.

4.9.2 An attempt will be made to test the affected employee, and if applicable, the source individual's blood, for bloodborne pathogens. No testing will be performed without the written consent of the exposed Employee or the source individual. If initially, the exposed Employee or the source individual does not consent to HIV serological testing, but does consent to HBV serological testing, AECOM will make provisions with the local medical provider to preserve the blood sample for at least 90 days in the event that after counselling efforts, the Employee voluntarily consents to HIV testing.

4.9.3 AECOM will rely on the professional judgment of its Occupational Health Manager and/or local medical providers in the event of an exposure incident. Evaluations and follow-up procedures will be provided according to the recommendations of the United States Public Health Service (USPHS), World Health Organization, or other Public Health organization in Canada and other countries in the Americas current at the time these evaluations and procedures take place. Minimally, a post-exposure evaluation and follow-up will include the following elements:

- Documentation of the route(s) of exposure
- Circumstances under which the exposure incident occurred
- Identification and documentation of the source individual in the case of first aid or emergency medical treatments
- Collection and testing of source individuals and exposed employee's blood for HBV and HIV serological status as soon as feasible and upon consent
- Post-exposure vaccination when medically indicated, as recommended by the USPHS
- Counselling, if necessary
- Evaluation of reported illnesses

4.9.4 Any and all follow-up recommendations offered by the physician will be immediately instituted by the SH&E Manager with the guidance of the Occupational Health Manager and/or the local medical provider and at no cost to the affected Employee. Repeat testing, counselling, and follow-up, if recommended, will also be provided at no cost to the Employee. AECOM will rely on the Occupational Health Manager and/or the local medical provider to provide counselling to Employees concerning infection status, including results of and interpretation of medical tests and advising the Employee about the protection of personal contacts.

4.9.5 All medical providers shall submit to AECOM's Occupational Health Manager and the affected Employee a written opinion of the post-exposure evaluation within 15 days of the completion of the evaluation.

4.9.6 All medical records generated as a result of the post-exposure evaluation will be retained in the office of the Occupational Health Manager, and as applicable AECOM's medical services provider, under lock and key and will be maintained with the strictest confidentiality. Refer to *S3AM-017-PR1 Injury & Illness Recordkeeping.*

4.10 Hepatitis Vaccination

4.10.1 Prior to performing site visits or field investigations where regulated wastes are stored, processed, or known to have been disposed of, AECOM will consult with the Occupational Health Manager and/or the local medical providers to determine if a hepatitis A or B vaccination is appropriate given the site conditions and the proposed scope of work. Where possible the first Hepatitis B vaccinations will be given prior to working at sites with known, potential occupational exposures.

4.10.2 Although AECOM does offer first-aid and CPR training to its Employees on a regular basis, providing such aid is often voluntary and not as a specified job duty of an Employee. As such, potential exposures may not be considered occupational within the context of the government Bloodborne Pathogens Standard. Pre-exposure hepatitis vaccinations will not typically be offered for voluntary roles.

4.10.3 Post-exposure hepatitis vaccination will be offered to Employees involved in an exposure incident within 24 hours of possible exposure.

4.10.4 The vaccinations discussed above shall be provided to Employees at no cost if required by the exposure determination.

4.11 Housekeeping

4.11.1 Other than through the provision of first aid or CPR, there is no potential for occupational exposure to blood or other potentially infectious materials within any of the AECOM offices. Therefore, the housekeeping requirements and requirements for warning signs and labels contained in the OSHA Bloodborne Pathogens standard are not applicable to our office operations.

4.11.2 When working at a site where regulated wastes have been disposed of, the specific housekeeping and warning sign requirements will be prescribed by the client and/or in the site-specific HASP.

4.11.3 When working at a client's facility, AECOM will review the facilities plan for compliance with all the requirements of the Bloodborne Pathogens Standard and will observe all housekeeping requirements, wear required PPE, and acknowledge all warning signs and labels as specified in the client's plan. If the client does not have an effective plan, AECOM will prepare a plan as part of the written Exposure Control Plan.

4.12 Regulated Waste Generated by AECOM

4.12.1 Any regulated waste generated by AECOM as a result of first aid activities or clean-up of potentially infectious material will be collected in sealed, watertight containers and disposed of according to the Host Employer's BBP program or disposed of through a permitted regulated waste facility.

4.12.2 Disposal manifests shall be maintained in accordance with local or governmental regulations.

4.13 Material Decontamination

4.13.1 Any areas or equipment that are contaminated by potentially infectious material will be decontaminated using a 10% solution of household bleach. Utilize appropriate personal protective equipment to control exposure to the bleach (e.g. safety goggles, gloves, etc.). Refer to *S3AM-208-PR1 Personal Protective Equipment*.

4.14 Procedure and Plan Review

4.14.1 All Exposure Control Plans for projects or programs extending over one year shall be reviewed annually by the SH&E Manager and affected Employees.

5.0 Records

5.1 Each SH&E Manager will maintain records and provide copies of the records to the Occupational Health Manager, related to bloodborne pathogens in accordance with the provisions of the standard and *S3AM-017-PR1 Injury & Illness Recordkeeping.*

5.2 Records maintained in accordance will include bloodborne pathogens exposure incidents, post-exposure follow-up, vaccination status, and training for all Employees with potential occupational exposure.

5.3 Employee medical and training records required by this procedure shall be provided upon request for examination and copying to the Employee, to anyone having written consent of the subject employee, or to State, Province, or Federal Occupational Safety and Health regulatory agencies.

6.0 Attachments

6.1 S3AM-111-ATT1 Bloodborne Pathogens Exposure Control Plan

6.2 S3AM-111-FM1 Hepatitis B Vaccination Declination

Americas

Hepatitis B Vaccination Declination

S3AM-111-FM1

I understand that due to my occupational exposure to blood or other potentially infectious materials, I may be at risk of acquiring Hepatitis B virus (HBV) infection.

I have been given the opportunity to be vaccinated with Hepatitis B vaccine, at no charge to myself; however, I decline Hepatitis B vaccination at this time. I understand that by declining this vaccine, I continue to be at risk of acquiring Hepatitis B, a serious disease.

If, in the future, I continue to have occupational exposure to blood or other potentially infectious materials and I want to be vaccinated with the Hepatitis B vaccine, I can receive the vaccine series at no cost to me.

Name: _____

Date: _____

Witness: _____

Date: _____

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Bloodborne Pathogens Exposure Control Plan

S3AM-111-ATT1

1.0 Introduction

Employees are at risk for exposure to and possible transmission of infectious diseases each time they are in contact with blood or body fluids. Bloodborne pathogens are microorganisms present in human blood and other body fluids that can cause serious disease in humans and include, but are not limited to Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), and Human Immunodeficiency Virus (HIV). Therefore, this exposure control plan (ECP) has been established to ensure that employees are effectively informed concerning potential workplace health hazards, and that protective measures necessary to eliminate or minimize bloodborne exposure incidents are used whenever possible.

2.0 Exposure Determination

2.1 The Medical Screening Evaluation form will be used to evaluate which employees may incur occupational exposure to blood or other potentially infectious materials when performing routine tasks and procedures. Refer to *S3AM- 128-PR1 Medical Screening & Surveillance*. These exposure determinations will be made without regard to the use of personal protective equipment, and regardless of exposure frequency.

2.1.1 The employees in the following job classifications may have occupational exposure to bloodborne pathogens, and are covered by this program:

- Occupational health nurse
- Paramedics
- Registered nurses
- Designated first aid providers (providing first aid identified as part of the employee's occupational duties and not a voluntary action)
- Medical laboratory employees
- Janitorial workers in medical facilities and clinics.

2.1.2 Tasks and procedures that may expose the above employees to bloodborne pathogens include:

- Treating cuts, abrasions, and burns
- Cleaning contaminated environmental surfaces
- Administering cardiopulmonary resuscitation (CPR).

3.0 Exposure Control

3.1 "Universal precautions" are a required method of control to prevent exposure to blood and body fluids. This term refers to the concept that all human blood and certain human body fluids are treated as if known to be infectious for HIV, HBV, HCV, and other bloodborne pathogens, regardless of the perceived risk status of another individual. Universal precautions apply to blood, other body fluids containing visible blood, semen, and vaginal fluids. Universal precautions do not apply to feces, nasal secretions, saliva, sweat, tears, sputum, urine, and vomitus unless they contain visible blood. Although these fluids have an extremely low or nonexistent risk for bloodborne pathogens, they are a potential source for other infectious diseases, and precautions shall also be followed when these body fluids are present.

3.2 Engineering and Work Practice Controls

3.2.1 The following engineering controls will be in place in all areas of occupational exposure:

- Containers for disposable contaminated sharps shall be puncture-resistant, labeled a biohazard, leak-proof, and have a closable top.

- Containers for storage, transport, or shipment of blood or other potentially infectious materials, regulated waste, and contaminated laundry will be labeled with the biohazard symbol and site address, and have a securely closing lid.
- Engineering controls will be reviewed and maintained on a regular basis to ensure effectiveness.

3.2.2 The following work practice controls (administrative and personal protective equipment) shall be strictly followed to minimize exposure, and isolate or remove bloodborne pathogens from the workplace:

- Accessible handwashing facilities. If soap and running water are not available, an antiseptic hand cleaner in conjunction with clean paper towels or antiseptic towelettes are acceptable temporary alternatives to running water. When this alternative method is used, employees shall wash their hands with soap and running water as soon as feasible.
- Personal protective equipment (PPE) will be provided at no cost to the employee, and will be chosen based on the anticipated exposure to blood. PPE is considered appropriate if it does not permit blood or other potentially infectious materials to reach or pass through clothes, skin, or mucous membranes of the eyes or mouth under normal conditions of use, and for the duration of time the equipment will be used. PPE shall be readily accessible and will be removed prior to leaving the work area.
- Disposable single-use gloves shall be used as a protective barrier in all situations in which contact with body fluids is anticipated. Gloves of the correct size will be provided. Disposable gloves will not be washed or disinfected for reuse, and will be replaced between employees, and if they become torn or punctured. Gloves are especially important if the employee has cuts, abraded skin, chapped hands, or dermatitis.
- Liquid-impermeable gowns, boots, and masks, in combination with eye-protective devices such as goggles and shatterproof glasses with solid-side shields or chin-length face shields, shall be worn whenever splashing, spraying, or spattering of blood droplets or body fluids can be reasonably anticipated.
- Disposable pocket mask ventilation devices shall be provided in all first aid kits and used to avoid mouth-to-mouth contact during emergency cardiopulmonary resuscitation.
- Examples of Recommended PPE (depending on task, more PPE may be needed).

Task	Gloves	Gown	Mask	Goggles
Bleeding control w/ minimal bleeding	Yes	No	No	No
Bleeding control w /spurting blood	Yes	Yes	Yes	Yes
Cardiopulmonary resuscitation	No	No	Yes	No
Decontamination/clean-up	Yes	No	No	No
Medical laboratory activities	Yes	Yes	Yes	Yes

3.2.3 Eating, drinking, smoking, applying cosmetics, and handling of contact lenses is prohibited in work areas where there is a reasonable likelihood of occupational exposure. Food and drink cannot be kept in refrigerators, freezers, shelves, cabinets, or on counter tops where blood or body fluids are present.

3.2.4 Contaminated needles and other sharps shall not be bent or recapped unless a one-handed technique is used. They shall be disposed of in an appropriate sharps container.

3.2.5 All regulated biohazardous waste will be placed in a waste receptacle that has designated red biohazard bags and a closable top controlled by a foot peddle. When full, the bags shall be removed with gloved hands, tied off, and placed in a biohazard shipping carton, to be held for pick-

up. If any biohazard bag appears to be leaking, it shall be double-bagged. The waste will be incinerated per federal, provincial/territorial/state regulations.

3.3 Housekeeping

3.3.1 Universal precautions shall be used when cleaning or decontaminating any surface or equipment that may be contaminated. Appropriate PPE shall be used for protection during decontamination.

3.3.2 All contaminated environmental work surfaces such as countertops or floors will be cleaned according to regulatory requirements or with a household bleach solution diluted 1:10 with water directly following contamination with blood or body fluids.

3.3.3 Instruments such as tweezers, bandage scissors, and thermometers shall be disposable rather than reusable equipment, and shall be disposed of in an appropriate manner.

3.3.4 Broken, contaminated glassware shall not be picked up directly with the hands. It shall be cleaned up using a mechanical means such as a brush and dustpan or tongs.

4.0 Hepatitis B Vaccination

4.1 Within 10 working days of placement, all employees assigned to tasks with potential occupational exposure to bloodborne pathogens shall be offered the Hepatitis B vaccination at no cost to the employee, unless the employee has had a previous Hepatitis B vaccination series, antibody testing reveals the employee is immune, or the vaccine is contraindicated for medical reasons. Further, this vaccination series shall be made immediately available to employees who have an occupational exposure, whether as a result of their assigned tasks, or occurring from an incidental contact.

4.2 The local occupational medical facility used for routine medical surveillance will administer the vaccinations.

4.3 Employees who decline the Hepatitis B vaccine shall sign a copy of the waiver form located at the end of this Work Instruction. The signed waiver will be stored in the employee's medical record with the Occupational Health Manager. Employees may initially decline the vaccination, but may decide to take them at a later date, while still covered under this plan. The vaccinations will be made available to the employee at that time.

4.4 Employees choosing to take the vaccination series will sign a consent form at the occupational clinic prior to receiving the injections, and are advised to read the package insert regarding the efficacy, safety, method of administration, and benefits of the vaccine. Employees may also ask questions directly of the Medical Service Provider or local occupational physician. Employees are not required to participate in a prescreening program (to determine immunity) before receiving the vaccinations. If a routine booster of Hepatitis B vaccine is recommended by the U.S. Public Health Service at a future date, such booster dose(s) will be made available to affected employees.

5.0 Post-Exposure Incident Evaluation And Follow-Up

5.1 All occupational bloodborne pathogen exposures shall be reported to the HSE representative and Occupational Health Manager immediately after initial decontamination first aid is accomplished. Following the report of an exposure incident, a confidential medical evaluation with an occupational physician will be arranged as soon as possible, ideally no later than 1 to 2 hours after the incident has occurred. In some jurisdictions, depending on applicable workers' compensation law, employees may choose treatment from their personal physician. A copy of the OSHA Bloodborne Pathogen Standard, if applicable to the jurisdiction, will be provided if the physician does not have a copy. A written incident report shall be completed as soon as possible, fully describing the incident.

5.2 First aid protocol for treatment immediately after an exposure incident:

5.2.1 Lacerations, punctures, and abrasions should be washed under cool running water for at least 5 minutes, allowing free bleeding. Cleanse area well with soap or iodine solution. Apply sterile dressing as needed. Give tetanus booster if indicated (7 to10 years since last booster).

5.2.2 Ocular exposure requires irrigation of the eye with water or sterile normal saline solution for 15 minutes.

5.2.3 Mucous membrane exposure requires rinsing mouth with ½ strength 3 percent hydrogen peroxide for 30 seconds, four separate and consecutive times.

5.3 Confidential Medical Evaluation

5.3.1 The treating occupational physician will receive documentation of the routes of exposure, the circumstances surrounding the incident, and identification of the source individual (the individual the employee was exposed to). The blood of the source individual will be tested if possible, and after consent is obtained. When legally permissible, results of the source individual's tests will be made available to the exposed employee, with the exposed employee informed about the applicable laws and regulations concerning the disclosure of the identity and infectivity of the source individual.

5.3.2 Testing of the exposed employee's blood, if consented to (the employee may consent to baseline blood collection, but may request that the sample not be tested for HIV for up to 90 days, if at all), is recommended.

5.3.3 Post-exposure medical treatment will be offered in accordance with the current recommendations of the U.S. Public Health Services. This may include, but is not limited to:

- A series of HIV post-exposure blood tests
- Hepatitis B vaccination and/or Hepatitis B immune globulin
- HIV post-exposure prophylactic medications
- Evaluation of acute febrile illnesses following exposure
- Employee counseling concerning precautions to take during the period after the exposure incident, and information on signs and symptoms of potential illnesses.

5.4 Healthcare Professional's Written Opinion

5.4.1 The Occupational Health Manager shall obtain and provide the employee with a copy of the evaluating physician's written opinion within 15 days of the completion of the medical evaluation. A copy will be maintained in the employee's confidential medical record. The written opinion shall be in accordance with the requirements of the OSHA Bloodborne Pathogens Standard indicating that the employee has been informed of any medical conditions resulting from exposure that require further evaluation or treatment. All other findings or diagnoses shall remain confidential and will not be included in the report.

6.0 Hazard Communication

6.1 Fluorescent red or orange-red warning labels bearing the universal biohazard symbol and the legend BIOHAZARD shall be firmly affixed to all containers (e.g., waste cans, sharps containers, and refrigerators) used for the storage or shipment of blood or other potentially infectious materials.

6.2 All employees designated to perform tasks involving occupational exposure shall receive bloodborne pathogens training at the time of initial assignment to the job. This training will be given during working hours and at no cost to employees. Refresher courses will be provided annually (within 1 year of previous training), and if new tasks or procedures are implemented. Material appropriate in content and vocabulary to education level, literacy, and language of the employees shall be used for all required training.

6.3 Training will include: making accessible a copy of the regulatory text of the standard and explanation of its contents, general discussion on bloodborne diseases and their transmission, exposure control plan, engineering and work practice controls, personal protective equipment, Hepatitis B vaccine, response to emergencies involving blood, how to handle exposure incidents, the post-exposure evaluation and follow-up program, signs/labels/color-coding, and question and answer time with the trainer.

7.0 Exposure Incident Investigation

7.1 The SH&E Manager will review the circumstances of any exposure incident to determine corrective actions. The incident report will include:

7.1.1 Engineering controls in use at the time

7.1.2 Work practices followed

7.1.3 A description of any equipment being used

7.1.4 A description of the work being performed

7.1.5 PPE that was used at the time of the incident

7.1.6 Date, time, and location of the incident

7.1.7 Employee's training.

7.2 An incident report shall be completed within four hours of the incident and entered into AECOM's on-line incident reporting system (e.g., IndustrySafe) in accordance with *S3AM-004-PR1 Incident Reporting, Notifications & Investigations*. A copy of this incident report will be forwarded to the Occupational Health Manager, who will evaluate what follow-up actions should be addressed, including if revisions need to be made to the Exposure Control Plan.

8.0 Recordkeeping

8.1 The Occupational Health Manager will be responsible for establishing and maintaining accurate, confidential workers' compensation medical records for each employee with occupational exposure for the duration of employment plus 30 years, in accordance with OSHA 29 CFR 1910.1020 – Access to Employee Exposure and Medical Records.

8.2 The SH&E Manager will be responsible for maintaining the bloodborne pathogens training class records for at least 3 years from the date of training. The records will include the date of the training class, a summary of the class contents, the names of the qualified instructors, and the names and job titles of personnel attending the training.

8.3 Employee medical records shall be made available to employees (or their designated representative) with written consent by the employee within 15 working days of request.

8.4 An exposure incident will be evaluated by the Occupational Health Manager and SH&E Manager to determine if the case meets OSHA's Recordkeeping Requirements (29 CFR 1904).

Americas

Cold Stress

S3AM-112-PR1

1.0 Purpose and Scope

1.1 To protect employees from the severest effects of cold stress (hypothermia) and cold injury and to identify exposures to cold working conditions under which it is believed nearly all employees can be repeatedly exposed without adverse health effects.

1.2 This procedure applies to all AECOM Americas based employees and operations, and any other entity and its personnel contractually required to comply with this document's content, working outdoors in damp and cool (below 50 degrees Fahrenheit [°F] or 10 degrees Celsius [°C]) conditions or anytime temperatures are below 32°F or 0°C.

2.0 Terms and Definitions

2.1 **Cold Stress** – The production of physiological effects due to cold temperatures and\or wind chill.

2.2 **Equivalent Chill Temperature (ECT)** – Also known as Wind Chill (see below).

2.3 **Frostnip** – Superficial cooling of tissues without cellular destruction.

2.4 **Frostbite –** Freezing of tissue, resulting in tissue destruction.

2.5 **Hypothermia –** Condition of reduced core body temperature to 95ºF (35ºC) resulting in loss of dexterity, loss of mental alertness, collapse, and possible death.

2.6 **Wind Chill –** The combined effect of air temperature and wind. Also expressed as "equivalent chill temperature" (ECT), wind chill is defined as heat loss resulting from the effects of air temperature and wind velocity upon exposed skin.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-128-PR1 Medical Screening & Surveillance Program

3.3 S3AM-208-PR1 Personal Protective Equipment

3.4 S3AM-314-PR1 Working Alone

3.5 S3AM-315-PR1 Working On or Near Water

3.6 S3AM-333-PR1 Marine Safety & Vessel Operations

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager**

- Ensuring the safety of employees on their project sites, consistent with regulatory standards.
- Implement cold stress prevention measures as applicable at each work site.
- Develop/coordinate a work-warning regimen, as applicable.
- Confirm cold stress hazard assessments/evaluations were completed for the planned activities.
- Assign employees physically capable of performing the assigned tasks. Consider acclimation to cold weather when evaluating employee capability.

- Confirm employees are properly trained to recognize the symptoms of cold stress.

4.1.2 **Safety, Health and Environment (SH&E) Manager**

- Conduct/support cold stress assessments/evaluations.
- Conduct/support incident investigations related to potential cold stress-related illnesses.
- Assist project teams develop appropriate work-warming regimens.
- Provide cold stress awareness training.

4.1.3 **Supervisor**

- Identify the tasks that may be most impacted by cold stress and communicate the hazard to the assigned employees.
- Confirm that employees have been trained on the recognition of cold stress-related illnesses.
- Confirm that adequate supplies of warm fluids/drinks are readily available to employees.
- Confirm that a warm/sheltered rest area is available, as applicable.
- Conduct cold stress monitoring, as applicable.
- Implement the work-warming regimen.
- Confirm that first aid measures are implemented once cold stress symptoms are identified.
- Confirm that employees are physically capable of performing the assigned tasks and are not in a physically compromised condition.

4.1.4 **Employee**

- Observe each other for the early symptoms of cold stress-related illnesses.
- Maintain an adequate intake of available fluids.
- Report to work in a properly rested condition.
- Report all suspected cold stress-related illnesses.

4.2 Requirements

4.2.1 Carefully plan work anticipated to be performed in cool or cold conditions. If possible, heavy work should be scheduled during the warmer parts of the day or when the wind is most calm. Include costs in project budgets for specialized equipment and supplies needed to complete the field activities.

4.2.2 Staff working in extreme cold (wind chill or ECT below 10ºF or -12ºC) shall not work alone. The Buddy System shall be utilized to keep an eye on each other and to watch for signs of cold stress. Refer to *S3AM-314-PR1 Working Alone*. Watch for symptoms and signs of hypothermia

4.2.3 Monitor weather forecasts and weather conditions such as ambient temperature, wind speed, and precipitation. Use observations prior to entering and while in the field to ensure appropriate protections are in place:

- If possible, move the work to a warm location.
- If possible and as applicable, erect shelters or screens around the work area.
- If possible, heat the work area.
- If possible, adjust schedule according to the cold conditions, work level and worker acclimatization.
- Implement a work-warming regimen by taking breaks out of the cold. As applicable, consult *S3AM-112 ATT1 Temperature Thresholds* to determine wind chill and work-warming schedule.
- Take frequent short breaks in warm dry shelters to allow your body to warm up. Limit time of exposure to the cold. If shelter is not readily available, consider supplying temporary shelters.

- Provide assistance to prevent body heat loss, such as:
    - Providing appropriate sources of heat (e.g. warm packs, portable heaters, etc.).
    - Use of insulating materials on equipment handles when temperatures drop below 30°F (-1°C).

4.2.4 All staff working in extreme cold or snow conditions should understand the following guidelines for preventing and detecting hypothermia and frostbite; refer to *S3AM-112-ATT2 Symptoms & Treatment*:

- Ensure appropriate PPE requirements are established and adhered to.
- Avoid exhaustion or fatigue because energy is needed to keep muscles warm.
- Because prolonged exposure to cold air or to immersion in cold water at temperatures even well above freezing can lead to dangerous hypothermia, whole-body protection shall be used.
- Eat high calorie snacks to help maintain body metabolism.
- Confirm extra blankets or sleeping bags are on-site.
- Drink plenty of warm liquids. It is easy to become dehydrated in cold weather.
- Avoid caffeine and alcohol, which can act as diuretics. Alcohol consumption, depending upon quantity, can dilate blood vessels enhancing body heat loss or constrict blood vessels decreasing heat delivery to extremities.
- NEVER IGNORE SHIVERING. Persistent or violent shivering is a clear warning that you are on the verge of hypothermia.
- If you experience frost bite or hypothermia, find shelter and warmth and contact a medical practitioner if symptoms persist, refer to *S3AM-128-PR1 Medical Screening & Surveillance*.

4.3 Training

Before they begin work in a cold environment, employees that might be exposed to cold stress will be informed of the potential for cold stress and how to prevent cold stress. Employees that have not had the training within the twelve prior months shall repeat the training before exposure to cold stress, refer to *S3AM-003-PR1 SH&E Training*. Employees potentially exposed to cold stress will receive training including, but not limited to:

4.3.1 Sources of cold stress, the influence of protective clothing, and the importance of acclimatization.

4.3.2 How the body loses heat.

4.3.3 Recognition of cold-related illness symptoms.

4.3.4 Cold stress preventative/corrective measures including, but not limited to:

- Weather monitoring.
- Proper eating and drinking practices.
- Work-warming schedules and proper re-warming techniques.
- Buddy system.
- Safe cold work practices appropriate to the work that is to be performed.
- Proper use of cold environment personal protective clothing.

4.3.5 The harmful effects of excessive alcohol consumption in a cold stress environment.

4.3.6 The hazards associated with unstable snow or ice build ups.

4.3.7 First aid procedures for symptoms related to cold stress.

4.4 Personal Protective Equipment (PPE)

Wearing the right clothing is crucial to avoiding cold stress. The type of fabric also makes a difference. Cotton loses its insulation value when it becomes wet. Wool, on the other hand, retains its insulation even when wet. Adequate insulating dry clothing will be required in air or wind chill temperatures below 40 °F (4.4°C)

All PPE will comply with the requirements of *S3AM-208-PR1 Personal Protective Equipment* and consider the following requirements:

4.4.1 Wear at least 3 layers of clothing to help prevent cold stress. It is important to preserve the air space between the body and the outer layer of clothing to retain body heat.

- Wear a middle layer of down, wool, or similar materials to provide insulation.
- Avoid cotton, especially blue jeans.
- Wear an outer layer to break the wind and allow some ventilation (e.g., Gortex® or nylon)
- Do not wear tight clothing. Loose clothing allows better ventilation.

4.4.2 Wear proper clothing, including head coverings and gloves or mittens for cold, wet, and windy conditions.

4.4.3 Wear a hat or hardhat liner. Up to 40 percent of body heat can be lost when the head is left exposed.

4.4.4 Use insulated footwear with adequate traction to prevent slips and falls.

4.4.5 Wear insulated boots or other insulated footwear, and insulated gloves to help reduce the chance of frostbite.

4.4.6 Keep a change of dry clothing available in case work clothes become wet.

4.4.7 Eye and face protection for employees employed outdoors in a snow and/or ice-covered terrain should be supplied.

- Sunglasses (with UVA and UVB protection) and sunscreen should be used when there is a persistent combination of snow and direct sun.
- Special safety goggles to protect against blowing ice crystals and ultraviolet light and glare (which can produce temporary conjunctivitis and/or temporary loss of vision) should be required when there is an expanse of snow coverage causing a potential eye exposure hazard.
- Ensure face guards are used to protect skin in cold, windy conditions, including riding on an unshielded vehicle.

4.5 General Cold Stress Prevention Measures

4.5.1 In order to prevent hypothermia:

- Wear appropriate clothing and PPE as determined by the weather conditions.
- When active, ventilate excess heat by opening or removing outer layers of clothing to avoid sweating.
    - Start with the mitten or gloves, unless protection from ice, snow, or cold metal surfaces is needed.
    - Next remove head gear and neck wrappings.
    - Then coats/parkas should be opened at the waist and sleeves.
    - Finally, layers of clothing should be taken off.
    - When resting or tired, or colder conditions are encountered, add additional layers of clothing/ close outer layers in the reverse of the above order, or get out of the cold. Have a sweet drink but do not indulge in heavy eating.

- Garments worn to keep out rain and spray should also allow water vapor to escape.
- Take advantage of heat from the sun and stay out of the wind as much as possible.
- Have available emergency shelter providing protection from wind and rain and insulation from the ground.
- Replace wet clothing. If wet clothing cannot be replaced, then cover it with a layer of non-breathing material to prevent evaporation. Place an insulation layer over this non-breathing material.
- Get adequate rest; conserve energy.
- Get adequate nutrition to replenish energy stores; rest after meals.
- Drink adequate fluids to avoid dehydration.
- If any project / location staff member shows signs of hypothermia, stop and treat him/her.

4.5.2 In order to prevent frost bite:

- Dress to prevent hypothermia and protect the feet and hands.
- Avoid obstruction of circulation by, for example, tight boots or tightly fitting clothing.
- Avoid nicotine (particularly cigarettes) and do not consume alcohol.
- Keep ears and nose covered and out of the wind.
- Frostbite of the corneas of the eyes can be prevented by protective goggles.
- Adopt a “buddy system” of constantly watching the faces of others in the party for white skin tissue, which is evidence of frostbite (frostnip).
- Practice constant personal vigilance for signs of trouble in one’s own fingers and toes; when in doubt, investigate thoroughly before it is too late.

4.5.3 Adequate, insulating dry clothing that will help maintain core temperatures above 96.8°F (37°C) shall be provided to employees if work is performed in air temperatures below 40°F (4.4°C). Wind chill cooling rate and the cooling power of air are critical factors. The higher the wind speed and the lower the temperature in the work area, the greater the insulation value of the protective clothing required.

4.5.4 An Equivalent Chill Temperature (ECT) chart relating the actual dry bulb air temperature and the wind velocity is presented in *S3AM-112-ATT1 Temperature Thresholds*. Unless unusual or extenuating circumstances exist, cold injury to other than hands, feet, and head is not likely to occur without the development of the initial signs of hypothermia. Superficial or deep local tissue freezing will occur only at temperatures below 32°F (0°C) regardless of wind speed. However, older employees, those with circulatory problems and those with previous cold injuries require special precautionary protection against cold injury. The use of extra insulating clothing and/or a reduction in the duration of the exposure period are among the special precautions that should be considered.

4.5.5 Continuous exposure of skin should not be permitted when the air speed and temperature results in an ECT of –25°F (-32°C) or below.

4.5.6 At air temperatures of 40°F (4.4°C) or less, it is imperative that employees who become immersed in water or whose clothing becomes wet be immediately removed from the cold environment, provided a change of clothing, and be treated for hypothermia.

4.5.7 If the air velocity at the job site is increased by wind, draft, or artificial ventilating equipment, the cooling effect of the wind should be reduced by shielding the work area or by wearing an easily removable windbreak garment.

4.5.8 Adequate protection, such as general ventilation, shall be incorporated into any warming shelter design to prevent carbon monoxide poisoning.

4.5.9 Operation of internal combustion or similar devices within warming shelters is prohibited.

4.5.10 If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work should be modified or suspended until adequate clothing is made available or until weather conditions improve.

4.5.11 Walking and working surfaces shall be cleared of ice and snow to prevent slips and falls.

4.5.12 Confirm that employees carry fire starter materials if working in remote areas.

4.5.13 Supplies such as PPE, fuels, enclosures, de-icing, traction aids, warm drinks, and batteries will be specified by the SH&E Manager and/or the Manager and made available. These supplies will be inspected at least weekly during cold weather projects and replaced when necessary.

4.6 Cold Stress Prevention Measures for the Hands

4.6.1 Special protection of the hands is required to maintain manual dexterity for the prevention of accidents including, but not limited to the following:

- If fine work is to be performed with bare hands for more than 10 to 20 minutes in an environment below 60ºF (15ºC), special provisions should be established for keeping the employees' hands warm. For this purpose, warm air jets, radiant heaters (fuel burner or electric radiator), or contact warm plates may be utilized. Metal handles of tools and control bars should be covered by thermal insulating material at temperatures below 30ºF (-1º C).
- If the air temperature falls below 60ºF (15ºC) for sedentary work, 40ºF (4.4º C) for light work, or 20ºF (-6ºC) for moderate work, and fine manual dexterity is not required, employees should use gloves.

4.6.2 To prevent contact frostbite, employees should wear anti-contact gloves:

- When cold surfaces below 20°F (-6°C) are within reach, each employee should be warned to prevent inadvertent contact by bare skin.
- If the air temperature is 0°F (-18°C) or less, employees should protect their hands with mittens or appropriate gloves. Machine controls and tools for use in cold conditions should be designed so that they can be handled without removing the mittens or gloves.
- Ensure an adequate supply of dry gloves is available to replace wet gloves.

4.6.3 Provisions for additional total body protection are required if work is performed in an environment at or below 40ºF (4.4ºC). The employees should wear cold protective clothing appropriate for the level of cold and physical activity.

4.6.4 Additional Cold Stress Prevention Measures:

For work practices at or below 10ºF (-12ºC) ECT, the following will apply:

- The employee should be under constant protective observation (buddy system or supervision).
- The work rate should not be so high as to cause heavy sweating that will result in wet clothing. If heavy work is being performed, rest periods should be taken in heated shelters and opportunities to change into dry clothing should be provided.
- New employees should not be required to work full time in the cold during the first days of employment until they become acclimated to the working conditions and required protective clothing. Refer to *S3AM-112-ATT1 Temperature Thresholds* for guidance.
- The weight and bulkiness of clothing should be included in estimating the required work performance and weights to be lifted by the employee.
- The work should be arranged in such a way that sitting still or standing still for long periods is minimized. Unprotected metal chair seats should not be used. The employee should be protected from drafts to the greatest extent possible.

4.6.5 Employees handling evaporative liquid (gasoline, alcohol, or cleaning fluids) at air temperatures below 40ºF should take special precautions to avoid soaking of clothing or gloves with the liquids because of the added danger of cold injury due to evaporative cooling. Special note should be taken of the particularly acute effects of splashes of “cryogenic fluids” or those liquids with a boiling point that is just above ambient temperature.

4.6.6 Trauma sustained in freezing or subzero conditions requires special attention, because an injured employee is predisposed to cold injury. Special provisions should be made to prevent hypothermia and freezing of damaged tissue in addition to providing for first aid treatment.

4.7 Hypothermia in Water

4.7.1 Loss of body heat heat to the water is a major cause of deaths in boating and working near water incidents. Often the cause of death is listed as drowning; however, the primary cause is often hypothermia. It should also be noted that alcohol lowers the body temperature around 2 to 3 degrees by dilating the blood vessels. Do not drink alcohol around cold water. The following table shows the effects of hypothermia in water:

WATER TEMPERATURE		EXHAUSTION	SURVIVAL TIME
32.5°F	(0°C)	Under 15 minutes	Under 15 to 45 minutes
32.5 to 40°F	(0 to 4°C)	15 to 30 minutes	30 to 90 minutes
40 to 50°F	(4 to 10°C)	30 to 60 minutes	1 to 3 hours
50 to 60°F	(10 to 16°C)	1 to 2 hours	1 to 6 hours
60 to 70°F	(16 to 21°C)	2 to 7 hours	2 to 40 hours
70 to 80°F	(21 to 27°C)	3 to 12 hours	3 hours to indefinite
Over 80°F	(27°C)	Indefinite	Indefinite

4.7.2 Some points to remember when water is a potential hazard:

- Wear a personal flotation device when drowning is a potential hazard. Refer to *S3AM-315-PR1 Working On or Near Water*, and *S3AM-333-PR1 Marine Safety & Vessel Operations*.
- If the water is less than 50°F (10°C), wear a wet suit or dry suit for work in water (e.g., wading, or if a significant potential to fall in water exists).
- While in the water, do not attempt to swim unless to reach nearby safety. Unnecessary swimming increases the rate of body heat loss. Keep the head out of the water. This will increase survival time.
- Keep a positive attitude about rescue. This will increase chances of survival.
- If there is more than one person in the water, huddling is recommended to conserve body heat.

4.7.3 If an employee or equipment is to work on ice and the water beneath the ice is or may be more than 3¼ feet (1m) deep at any point:

- Test the ice prior to commencing to ensure it will support the load to be placed on it. Ongoing testing may be necessary.
- If there is any risk of falling through the ice employees must wear personal protective equipment that will ensure buoyancy and protect against hypothermia at all times while on the ice.

4.8 Work-Warming Regimen

4.8.1 If work is performed continuously in the cold at an equivalent chill temperature (ECT) at or below 19ºF (–7ºC), heated warming shelters (tents, cabins, rest rooms, etc.) should be made available nearby. The employees should be encouraged to use these shelters at regular intervals; the frequency will depend on the severity of the environmental exposure. Refer to *S3AM-112-ATT1 Temperature Thresholds* for guidance.

4.8.2 The onset of heavy shivering, minor frostbite (frostnip), the feeling of excessive fatigue, drowsiness, irritability, or euphoria are indications for immediate return to the shelter.

4.8.3 When entering the heated shelter, the outer layer of clothing should be removed and the remainder of the clothing should be loosened to permit sweat evaporation or a change of dry work clothing provided.

4.8.4 A change of dry work clothing should be provided as necessary to prevent employees from returning to the cold environment with wet clothing.

5.0 Records

5.1 Exposure assessments will be documented in the location's files.

6.0 Attachments

6.1 S3AM-112-ATT1 Temperature Thresholds

6.2 S3AM-112-ATT2 Symptoms & Treatment

Americas

Temperature Thresholds

S3AM-112-ATT1

1.0 Purpose and Scope

1.1 The following Tables 1 and 2 give apparent temperatures (wind chill of equivalent chill temperature [ECT]) for various combinations of wind and air temperature, as well as guidelines to the danger of skin exposure.

Table 1. Wind Chill Chart (C)

Actual Temp (°C)	Wind Speed in km/hour									
	8	16	24	32	40	48	56	64	72	80
	Ambient Temperature (°C)									
0	-2	-8	-11	-14	-16	-17	-18	-19	-19	-20
-5	-7	-14	-18	-21	-23	-25	-26	-27	-28	-28
-10	-12	-20	-25	-28	-31	-33	-34	-35	-36	-36
-15	-18	-26	-32	-35	-38	-40	-42	-43	-43	-44
-20	-23	-32	-38	-43	-46	-48	-50	-51	-52	-52
-25	-28	-38	-45	-50	-53	-56	-57	-59	-59	-60
-30	-33	-45	-52	-57	-61	-63	-65	-67	-67	-68
-35	-39	-51	-59	-64	-68	-71	-73	-75	-75	-76
-40	-44	-57	-65	-71	-75	-79	-81	-83	-83	-84
-45	-49	-63	-72	-78	-83	-86	-89	-90	-91	-92
-50	-54	-69	-79	-85	-90	-94	-96	-98	-99	-100

Note: A. Little Danger: if less than one hour of exposure to dry skin.
B. Danger: Exposed flesh freezes within one minute.
C. Great Danger: Flesh may freeze within 30 seconds.

*Source: *2014 Threshold Limit Values (TLV™) and Biological Exposure Indices (BEI™) booklet; published by ACGIH, Cincinnati, Ohio.*

Table 2. Equivalent Chill Temperature Chart (F)

Estimated Wind Speed (mph)	Actual Temperature Reading (°F)									
	50	40	30	20	10	0	-10	-20	-30	-40
	Equivalent Chill Temperature (°F)									
Calm	50	40	30	20	10	0	-10	-20	-30	-20
5	48	37	27	16	6	-5	-15	-26	-36	-47
10	40	28	16	4	-9	-24	-33	-46	-58	-70
15	36	22	9	-5	18	-32	-45	-58	-72	-85
20	32	18	4	-10	-25	-39	-53	-67	-82	-96
25	30	16	0	-15	-29	-44	-59	-75	-88	-104
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109
35	27	11	-4	-20	35	-51	-67	-82	-98	-113
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116
Wind speeds >40 mph have little additional effect	LITTLE DANGER				INCREASING DANGER			GREAT DANGER		
	Trenchfoot and immersion foot may occur at any point on this chart.									

1.2 How fast a person's body cools in cold weather depends on: air temperature, wind speed, heat of the sun, and work being done.

1.2.1 The following Table 3 provides guidelines for establishing periods of work to warming break periods based on ambient temperature and wind speed for workers wearing dry clothing.

1.2.2 Notes following the Table take into account additional factor such as physical exertion, whether workers are acclimatized, etc.

Table 3. Work-Warming Schedule Guidelines

Air Temp. (Sunny Sky) °F	No Noticeable Wind		5 mph Wind (8 km/h)		10 mph Wind (16 km/h)		15 mph Wind (24 km/h)		20 mph Wind (32 km/h)		25 mph Wind (40 km/h)		Air Temp. (Sunny Sky) °C
	Max. Work Period	Breaks	Max. Work Period	Breaks	Max. Work Period	Breaks	Max. Work Period	Breaks	Max. Work Period	Breaks	Max. Work Period	Breaks	
above 5°	Normal Work Schedule		Normal Work Schedule		Normal Work Schedule		Normal Work Schedule		Normal Work Schedule		Normal Work Schedule		above -15°
5° to -1°											100 min	2	-15° to -17°
0° to -4°									100 min	2	75 min	2	-18° to -20°
-5° to -9°							100 min	2	75 min	2	55 min	3	-21° to -22°
-10° to -14°					100 min	2	75 min	2	55 min	3	40 min	4	-23° to -25°
-15° to -19°			100 min	2	75 min	2	55 min	3	40 min	4	30 min	5	-26° to -28°
-20° to -24°	100 min	2	75 min	2	55 min	3	40 min	4	30 min	5	Cease Work		-29° to -31°
-25° to -29°	75 min	2	55 min	3	40 min	4	30 min	5	Cease Work				-32° to -34°
-30° to -34°	55 min	3	40 min	4	30 min	5	Cease Work						-35° to -37°
-35° to -39°	40 min	4	30 min	5	Cease Work								-38° to -39°
-40° to -44°	30 min	5	Cease Work										-40° to -42°
-44° & below	Cease Work												-43° & below

Modified from ACGIH 2014 Threshold Limit Values for Chemical Substances and Physical Agents.

Note 1: Schedule describes the maximum continuous duration of work and number of 10-15 minute breaks to be observed during any 4-hour work period and assumes that period will be followed by an extended warm-up period (e.g., lunch). Allowed breaks should be taken in a warm environment.

Note 2: Schedule applies to moderate to heavy work performed by acclimated workers wearing appropriate layered clothing. For light to moderate work apply the schedule for conditions one step lower. For unacclimated workers apply the schedule for conditions two steps lower. These modifications are additive.

Note 3: For work under 25%–50% overcast/clouds, apply the schedule for conditions one step lower. For work at night or under greater than 50% overcast/clouds, apply the schedule for conditions two steps lower. These modifications are additive with any applicable modifications from Note 2.

Note 4: For wind speeds in excess of 25 mph (40 km/h), cease all nonemergency work when temperatures fall below 5°F (-21°C).

Note 5: When the work involves riding on an unshielded vehicle or some other activity that generates wind, the number of breaks should be increases appropriately.

Note 6: If effective protection against the wind can be provided by shields or screens, work modifications or measures, then the work warm-up schedule for “No Noticeable Wind” would apply.

Note 7: If reliable weather reports are not available, use the following as a guide to estimate wind velocity:

- A 5 mph (8 km/h) wind will move a light flag
- A 10 mph (16 km/h) wind will fully extend the flag
- A 15 mph (24 km/h) wind will raise a newspaper sheet
- A 20 mph (32 km/h) wind will produce blowing and drifting snow.

Symptoms & Treatment

1.0 Cold Stress-related Illnesses

1.1 Frostbite

1.1.1 Frostbite is a localized cold injury characterized by freezing of the tissues with ice crystal formation. There are several degrees of damage. Frostbite can be categorized into:

- **Frost Nip or Initial Frostbite**: (1st degree frostbite) Characterized by blanching or whitening of skin.
- **Superficial Frostbite**: (2nd degree frostbite) Skin has a waxy or white appearance and is firm to the touch, but tissue beneath is resilient. Blistering and peeling of the frozen skin will follow exposure.
- **Deep Frostbite**: (3rd degree frostbite) Tissues are cold, pale, and solid; extremely serious injury with possible amputation of affected area.

1.1.2 Frostbite injury is almost always limited to the upper and lower extremities (finger and toes) or to such appendages as the ears, nose or cheeks.

1.1.3 Conditions conducive to frostbite include sub-zero temperatures, hypothermia, dehydration, obstruction of the blood supply to the extremities (by constricting clothing, especially on the feet or at the wrists or ankles), contact with cold metal, contact with organic liquids (such as gasoline or solvents that have been left outdoors in sub-zero temperatures), use of substances that cause vasoconstriction (such as smoking tobacco), or other injury or shock.

1.1.4 Frostbite can occur without hypothermia when the extremities do not receive sufficient heat. Frostbite occurs when there is freezing of the fluids around the cells of the affected tissues.

1.1.5 Contact by the skin with tools or other metal objects below 20°F (-7°C) may result in contact frostbite.

1.1.6 The first symptom of frostbite is an uncomfortable sensation of coldness and pain, followed by numbness. There may be tingling, stinging, or cramping. Ongoing symptoms of frostbite include:

- Sudden and complete cessation of cold or discomfort in affected fingers or toes, often followed by a pleasant feeling of warmth;
- Subsequently the only symptom may be the absence of any sensation in the frozen part;
- Paleness in the affected tissues;
- Firm or hard tissues; and
- Purple tissue, if a large area, such as an entire hand or food, is frostbitten.

1.1.7 If exposure occurs in temperatures that are below freezing (32ºF or below), frostbite or trench foot (immersion foot) may accompany or complicate the symptoms of hypothermia. Frostbite is the freezing of living tissues with a resultant breakdown of cell structure. Symptoms due to frostbite may include, but is not limited to:

- Superficial redness of the skin;
- Slight numbness;
- Blisters;
- Obstruction of blood flow (ischemia);
- Blood clots (thrombosis); and
- Skin discoloration due to insufficient oxygen in the blood (cyanosis).

1.1.8 Frostbite may occur if the skin comes into contact with objects with a surface temperature below freezing, such as metal tool handles. Trench foot is caused by continuous exposure to cold combined with persistent dampness or immersion in water. Injuries in this case include permanent tissue damage due to oxygen deficiency, damage to capillary walls, severe pain, blistering, tissue death, and ulceration.

1.1.9 Additionally, cold exposures may either induce or intensify vascular abnormalities. These include chilblain (a swelling or sore), Raynaud's disease, acrocyanosis (blueness of hands and feet) and thromboangiitis (inflammation of the innermost walls of blood vessels with accompanying clot formation). Workers suffering from these ailments should take particular precautions to avoid chilling.

1.2 Hypothermia

1.2.1 Hypothermia is a lower than normal body temperature that occurs when outer cold cools the body faster than the body can produce heat to stay warm. When this situation first occurs, blood vessels in the skin constrict in an attempt to conserve vital internal heat. Hands and feet are the first affected.

- If the body continues to lose heat, involuntary shivers begin. This is the body's way of attempting to produce more heat, and it is usually the first real warning sign of hypothermia.
- Further heat loss produces speech difficulty, confusion, loss of manual dexterity, collapse, and finally death.

1.2.2 Hypothermia can be caused by exposure to wind, cold, and/or moisture. The combination of wind, cold, and moisture can be deadly. Wet clothes or immersion in cold water greatly increases the hypothermia risk. The progressive clinical presentation of hypothermia is described in the table below.

Condition	Core Body Temp.	Signs/Symptoms	Treatment
Mild Hypothermia	99 – 97 F 37 – 36 C	Normal, shivering may begin	Seek dry shelter; replace wet clothing, insulate whole body and head, avoid sweating, use external warmth (bath, fire) only if core above 95 degrees F, give warm sweet drinks and food.
	97 – 95 F 36 – 35 C	Cold sensation, goose bumps, unable to perform complex tasks with hands, shiver can be mild to severe, hands numb.	
Moderate Hypothermia	95 – 93 F 35 – 34 C	Intense shivering, muscle in-coordination becomes apparent, movements slow and labored, stumbling pace, mild confusion may appear alert.	Avoid exercise and external warmth, gently rest; give warm sweet drinks and calories, internal warming via warm moist air, monitor pulse and breathing.
	93 – 90 F 34 – 32 C	Violent shivering persist, difficulty speaking, sluggish thinking, amnesia starts to appear, gross muscle movements sluggish, unable to use hands, stumbles frequently, signs of depression, withdrawn.	
Severe Hypothermia	90 – 86 F 32 – 30 C	Shivering stops, exposed skin blue or puffy, muscle coordination very poor, inability to walk, confusion, incoherent/irrational behavior, but may be able to maintain posture and appearance of awareness.	Medical emergency, give nothing by mouth, wrap in an insulated blanket, avoid rapid rewarming, transfer to hospital immediately.
	86 – 82 F 30 – 28 C	Muscle rigidity, semiconscious, stupor, loss of awareness of others, pulse and respiration rate decrease, possible heart fibrillation.	
	82 – 78 F 28 – 25.5 C	Unconscious, heart beat and respiration erratic, pulse may not be palpable.	
	78 – 75 F 25.5 – 24 C	Pulmonary edema, cardiac and respiratory failure, death. Death may occur before this temperature is reached.	

1.2.3 Early warning signs of hypothermia:

- Feeling of being cold and tired;
- Heavier breathing and increased pulse rate;
- Tendency to keep moving (e.g., stamping feet, rubbing hands, continued walking/pacing);
- Goose bumps, holding arms tightly wrapped around the body, hunching of shoulders, and
- Shivering.

1.2.4 Hypothermia damages both the body's internal temperature mechanisms (hypothalamus) and the peripheral mechanisms to prevent heat loss (vasoconstriction and perspiration.) These effects may last up to three years after the initial hypothermia episode. Symptoms of hypothermia may include, but are not limited to:

- Pain in the extremities;
- Severe shivering and numbness;
- Low core body temperature;
- Drowsiness and muscular weakness;
- Apathy;
- Mental confusion;
- Loss of consciousness;
- Shock, and
- Decreasing pulse and breathing rate.

2.0 Recommended Treatment for Cold Stress-related Illnesses

2.1 Frostbite

2.1.1 Wrap the victim in woollen blanket and keep dry until he or she can be brought inside.

2.1.2 Remove the victim from the cold environment.

2.1.3 Do not rub, chafe, or manipulate frozen parts.

2.1.4 Place the victim in warm water (102ºF to 105ºF) and make sure the water remains warm. Test the water by pouring it on the inner surface of your forearm. Never thaw affected body parts if the victim has to go back out into the cold; refreezing can cause significant tissue damage.

2.1.5 Do not use hot water bottles or a heat lamp, and do not place the victim near a hot stove.

2.1.6 Do not allow the victim to walk if his or her feet are affected.

2.1.7 Have the victim gently exercise the affected parts once they are thawed.

2.1.8 Seek immediate medical attention for thawing of serious frostbite.

2.2 Hypothermia

2.2.1 Bring the victim into a warm room or shelter as quickly as possible.

2.2.2 Give artificial respiration and stop any bleeding, if necessary.

2.2.3 If the victim cannot be moved (spinal injury, etc.), carefully place newspapers, blankets, or some other insulation between the victim and the ground.

2.2.4 Remove all wet clothing.

2.2.5 Provide an external heat source, because the body cannot generate its own heat. Wrap the victim in prewarmed blankets, place him or her in the liner of a portable hypothermia treatment unit, put the torso (not the extremities) into a tub of warm water, or use body-to-body contact to rewarm the body core. These measures will slowly reopen the peripheral circulation, minimizing the possibility

of after-shock or after-drop (the flowing of cooled, stagnated blood from the limbs to the heart), which may cause ventricular fibrillation, cardiac arrest, or death.

2.2.6 Do not allow the victim to sleep.

2.2.7 Give warm, sweet drinks. Do not give alcohol or pain relievers.

2.2.8 Keep the victim still. Do not try to walk.

2.2.9 Do not rub numb skin.

2.2.10 Get medical attention as soon as possible.

Americas

Heat Stress

S3AM-113-PR1

1.0 Purpose and Scope

1.1 Establishes a Heat Illness Prevention Program to guide employees in preventing heat illness, recognition of the symptoms of heat stress-related illnesses and in taking the appropriate corrective action.

1.2 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 **Acclimated –** Employees who have developed physiological adaptation to hot environments characterized by increased sweating efficiency, circulation stability, and tolerance of high temperatures without stress. Acclimatization occurs after 7 to 10 consecutive days of exposure to heat and much of its benefit may be lost if exposure to hot environments is discontinued for a week.

2.2 **Chemical Protective Clothing (CPC)** – Apparel that is constructed of relatively impermeable materials intended to act as a barrier to physical contact of the Employee with potentially hazardous materials in the workplace. Such materials include Tyvek® coveralls (all types) and polyvinyl chloride coveralls and rain suits.

2.3 **Heat Cramps** – A form of heat stress brought on by profuse sweating and the resultant loss of salt from the body.

2.4 **Heat Exhaustion** – A form of heat stress brought about by the pooling of blood in the vessels of the skin and in the extremities.

2.5 **Heat Rash** – A heat-induced condition characterized by a red, bumpy rash with severe itching.

2.6 **Heat Stress** – The combination of environmental and physical work factors that constitute the total heat load imposed on the body.

2.7 **Heat Stroke** – The most serious form of heat stress, which involves a profound disturbance of the body's heat-regulating mechanism.

2.8 **Sunburn** – Caused by unprotected exposure to ultraviolet radiation present in sunlight that is damaging to the skin (Refer to *S3AM-121-PR1 Non-Ionizing Radiation*). The injury is characterized by red painful skin, blisters, and/or peeling.

2.9 **Unacclimated** – Employees who have not been exposed to hot work conditions for one week or more or who have become heat-intolerant due to illness or other reasons.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-004-PR1 Incident Reporting, Notifications & Investigation

3.3 S3AM-010-PR1 Emergency Response Planning

3.4 S3AM-121-PR1 Non-Ionizing Radiation

3.5 S3AM-208-PR1 Personal Protective Equipment

3.6 S3AM-209-PR1 Risk Assessment & Management

4.0 Procedures

4.1 Roles and Responsibilities

4.1.1 Managers

- Evaluate the need for heat illness prevention measures and incorporate as appropriate into the Safe Work Plan or Task Hazard Analysis.
- Allocate sufficient resources for the management of heat illness in the field including the provision of water, a shaded break area, and sufficient schedule to allow for breaks.

4.1.2 Safety, Health and Environment (SH&E) Manager

- Provide heat illness awareness training.
- Assist in developing appropriate work-rest schedules.
- Conduct/support incident investigations related to potential heat stress-related illnesses.

4.1.3 Supervisor

- Identify those tasks that may be most impacted by heat stress and communicate the hazard to the assigned Employees.
- Confirm that Employees have been trained on the recognition of heat illness.
- Confirm that this procedure, along with any applicable Safe Work Plan and/or Task Hazard Analysis (and heat exposure control plan that may be contained therein) are made available to affected Employees.
- Confirm that adequate supplies of appropriate fluids are readily available to Employees.
- Confirm that a proper rest area is available.
- Conduct heat illness monitoring, as applicable.
- Implement the work-rest schedule.
- Confirm that first aid measures are implemented once heat stress symptoms are identified.
- Confirm personnel are physically capable of performing the assigned tasks and are not in a physically compromised condition.
- Report all suspected heat illnesses.

4.1.4 Employee

- Observe each other for the early symptoms of heat illnesses.
- Maintain an adequate intake of available fluids.
- Be familiar with heat stress hazards, predisposing factors, and preventative measures.
- Report to work in a properly vested and hydrated condition.
- Report all suspected heat stress-related illnesses.

4.2 Restrictions

4.2.1 The Buddy System is required when working in high heat conditions; Employees shall not work alone.

4.2.2 Employees shall not be exposed to levels exceeding those specified for the given work level and work-rest regimen as listed in *S3AM-113-ATT1 Temperature Thresholds*.

4.2.3 Clothing corrections shall be applied in accordance with the tables provided in *S3AM-113-ATT1 Temperature Thresholds*.

4.3 Exposure Controls

4.3.1 It shall be determined whether Employees are or may be exposed to hazardous heat levels. The Supervisor shall:

- Conduct a heat stress assessment to determine the potential for hazardous exposure of Employees. Assessment shall include, but not limited to:
  - Ambient temperature.
  - Amount of sunshine (cloudy, clear). Refer to *S3AM-121-PR1 Non-Ionizing Radiation* additional direction concerning ultraviolet radiation exposures.
  - Other radiant heat sources (e.g. motor, fire, etc.).
  - Humidity.
  - Air flow.
  - Amount or type of physical labor being performed,
  - Physical condition of the Employees (e.g., acclimated/not)
  - Protective clothing in use.
  - Referral to *S3AM-113-ATT1 Temperature Thresholds* to assist in determining whether hazardous heat exposures may exist.
- If potential for hazardous exposure is identified, the Supervisor shall develop and implement a heat stress exposure control plan within the Safe Work Plan and/or Task Hazard Analysis. Refer to *S3AM-209-PR1 Risk Assessment & Management.*

4.3.2 If Employees are or may be exposed, the Supervisor shall implement engineering controls (e.g., shelters, cooling devises, etc.) to reduce the exposure of Employees to levels below those specified for the given work level and work-rest regimen as listed in *S3AM-113-ATT1 Temperature Thresholds*.

4.3.3 If engineering controls are not practicable, the Supervisor shall reduce the exposure of Employees to levels below those listed in *S3AM-113-ATT1 Temperature Thresholds* by providing administrative controls, including a work-rest cycle or personal protective equipment, if the equipment provides protection equally effective as administrative controls.

4.3.4 If Employees are or may be exposed, the Supervisor shall provide and maintain an adequate supply of cool, fresh, potable water close to the work area for the use of a heat exposed Employee. Water shall be provided (paid) by the project or program; if Employees purchase their own drinking water because water is not otherwise available on site, they shall be reimbursed.

4.3.5 If an Employee shows signs or reports symptoms of heat stress or strain, they shall be removed from the hot environment and treated by an appropriate first aid attendant on site, if available, or by a physician, refer to *S3AM-113-ATT2 Symptoms & Treatment* for more specifics.

4.4 Heat Stress Planning

4.4.1 Heat stress can be a significant site hazard, especially for Employees wearing CPC. To prepare for emergency response planning, refer to *S3AM-010-PR1 Emergency Response Planning* procedure.

4.4.2 The project and site specific risks need to be planned using the SH&E Plan and the Task Hazard Assessments (THA). Refer to the *S3AM-209-PR1 Risk Assessment & Management* procedure.

4.4.3 The heat a worker is exposed to may be a combination of air temperature, radiant heat, and humidity. The WBGT (wet-bulb globe thermometer) is a useful index of the environmental contribution to heat stress. Because WBGT is only an index of the environment, the contributions of

work demands, clothing, and state of acclimatization shall also be accounted for, as described in the following steps.

- Monitor ambient temperatures and conduct heat stress monitoring in accordance with the location specific SH&E Plan. Revise the heat stress monitoring and controls if there are any reports of discomfort due to heat stress.
- Monitor temperatures in each unique environment in which workers perform work (e.g., take WBGT measurements inside truck cabs for truck drivers, and take separate WBGT measurements in the outdoor area where field employees work, etc.). Follow manufacturer's instructions on proper use of the WBGT.
- Determine if individual workers are acclimatized or un-acclimatized. Full heat acclimatization requires up to 3 weeks of continued physical activity under heat-stress conditions similar to those anticipated for the work. Its loss begins when the activity under those heat-stress conditions is discontinued, or when there is a sustained increase in temperatures of 10 °F (5.6 °C) or more, and a noticeable loss occurs after 4 days. A worker can be considered acclimatized for the purpose of this procedure when they have been exposed to the site conditions (including level of activity) for 5 of the last 7 days.
- Determine the approximate workload of each worker or group of workers. The following examples (Table 1) can be used for comparison:

Table 1
Examples of Activities within Workload Categories

Categories	Example Activities
Resting	Sitting quietly
	Sitting with moderate arm movements
Light	Sitting with moderate arm and leg movements
	Standing with light work at machine or bench while using mostly arms
	Using a table saw
	Standing with light or moderate work at machine or bench and some walking about
Moderate	Scrubbing in a standing position
	Walking about with moderate lifting or pushing
	Walking on level at 3.5 miles/hr (6 km/hr) while carrying 6.6 lbs (3kg) weight load
Heavy	Carpenter sawing by hand
	Shoveling dry sand
	Heavy assembly work on a non-continuous basis
	Intermittent heavy lifting with pushing or pulling (e.g., pick-and-shovel work)
Very Heavy	Shoveling wet sand

- Determine the approximate proportion of work within an hour during a typical shift. Typically, the initial work schedule will be 60 minutes of work per hour (100 percent work) with a small break in the morning and afternoon, as appropriate, and a 30-minute lunch break mid-day.
- For workers wearing cloth coveralls (e.g., Nomex fire resistant clothing), add 3 to the measured WBGT. For impermeable clothing, such as Tyvek or Saranex, the WBGT procedures cannot be used. For these situations, workers should begin physiological monitoring as soon as the temperature in the work area exceeds 70ºF (21°C).
- Use the collected information to develop appropriate work to rest schedules as detailed in *S3AM-113-ATT1 Temperature Threshold*.

4.4.4 Given the work demands (light, moderate, heavy or very heavy), heat of the work environment, and such aspects as PPE in use, workload will be adjusted appropriately to allow for proper acclimation.

- This is the process by which the body "gets used to" hot work environments. This is achieved by slowly increasing workloads.
- New and returning Employees (absent one week or more) who have not had time to acclimatize may be more susceptible to heat related illnesses, even in seemingly low risk heat exposures.
- All Employees shall be allowed time to acclimatize in the event of a heat wave. All Employees assigned to a new process with additional heat exposures shall be allowed to acclimatize.
- Minimize workload and gradually increase as tolerance is built up. Allow for more frequent breaks.
- While acclimatization normally takes approximately 5 to 7 days, heightened monitoring of these Employees will be maintained for the first 14 days.

4.4.5 Employees shall be instructed in the recognition of heat stress symptoms, the first aid treatment procedures for severe heat stress, and the prevention of heat stress injuries. Employees shall be encouraged to immediately report any heat stress that they may experience or observe in fellow Employees. Supervisors shall use such information to adjust the work-rest schedule to accommodate such problems.

4.4.6 Wherever possible, a designated break area should be established in an air conditioned space, or in shaded areas where air conditioning is impractical. The break area should be equipped to allow Employees to loosen or remove protective clothing, and sufficient seating should be available for all Employees. During breaks, Employees shall be encouraged to drink plenty of water or other liquids, even if not thirsty, to replace lost fluids and to help cool off. Cool water should be available at all times in the break area, and in the work area itself unless hygiene/chemical exposure issues prevent it.

4.5 Symptoms and Treatment

4.5.1 Refer to *S3AM-113-ATT2 Symptoms & Treatment*.

4.5.2 Employees who exhibit ANY signs of significant heat stress (e.g., profuse sweating, confusion and irritability, pale, clammy skin) shall be relieved of all duties at once, made to rest in a cool location, and provided with large amounts of cool water.

4.5.3 Anyone exhibiting symptoms of heat stroke (red dry skin, or unconsciousness) shall be taken immediately to the nearest medical facility. Steps shall be taken to cool the person during transportation (clothing removal, wet the skin, air conditioning, etc.).

4.5.4 Severe heat stress (heat stroke) is a life-threatening condition that shall be treated by a competent medical authority.

4.6 Prevention

4.6.1 Requirements for working in extreme heat may be triggered by a regulatory established criteria (e.g. CAL/OSHA requires high heat procedures when temperature equals or exceeds 95°F) or as a result of a hazard analysis assessing various contributory factors (refer to *S3AM-113-ATT1 Temperature Thresholds*). Employees working in extreme heat or sun should understand and apply the following guidelines for preventing and detecting heat exhaustion and heat stroke.

- When possible, begin hydrating at least three days prior to working in high heat conditions.
- Review the heat stress exposure control plan within the Safe Work Plan and/or Task Hazard Analysis.
- If the supervisor is not immediately available confirm a reliable method of communication is in place to allow for contact with supervision. In the absence of cellular reception a satellite phone or similar device may be required.

- Take frequent short breaks in areas sheltered from direct sunlight; eat and drink small amounts frequently.
- Try to schedule work for the coolest part of the day, early morning and evening.
- Avoid strenuous physical activity outdoors during the hottest part of the day.
- Avoid sudden changes of temperature. Refer *to S3AM-113-ATT1 Temperature Thresholds*.
- Air out a hot vehicle before getting into it.
- Obtain medical direction if taking diuretics during hot weather (a lower dose may be necessary).
- When working in heat, drink 1 quart of water per hour of work.
- Avoid caffeine and alcohol as they increase dehydration.
- Monitor urine frequency and color to detect dehydration. Refer to the *S3AM-113-ATT3 Dehydration Chart.*
- The Buddy System is required when working in high heat conditions to enable effective communication and cross-observation for indications of heat stress.
- Initiate emergency response procedures when necessary, including contacting emergency medical services as appropriate and in accordance with the Emergency Response Plan.

4.6.2 Personal Protective Equipment

- Review the *S3AM-208-PR1 Personal Protective Equipment* procedure.
- Wear a hat and light-colored, loose-fitting clothing to reflect the sun.
- Apply sunscreen to exposed skin (SPF 30 or greater, follow directions on label).
- Wear sunglasses with UV protection.
- Pack extra water to avoid dehydration (try freezing water in bottles overnight to help keep the water cooler for longer during the day).

4.7 Work-Rest Schedule Practices

4.7.1 Intake of fluid will be increased beyond that which satisfies thirst, and it is important to avoid "fluid debt," which will not be made up as long as the individual is sweating.

- Two 8-ounce glasses of water should be taken prior to beginning work, then up to 32 ounces (1 quart) per hour during the work shift; fluid replacement at frequent intervals is most effective.
- The best fluid to drink is water; liquids like coffee or soda do not provide efficient hydration and may increase loss of water.
- If commercial electrolyte drinks (e.g., Gatorade) are used, the drink should be diluted with water, or 8 ounces of water should be taken with each 8 ounces of electrolyte beverage.

4.7.2 Additional salt is usually not needed and salt tablets should not be taken.

4.7.3 Replacement fluids should be cool and fresh, but not cold.

4.7.4 Breaks will be taken in a cool, shaded location, and any impermeable clothing should be opened or removed.

- A relatively cool, shaded area shall be provided for breaks when working in hot environments. For hazardous waste sites, the rest area should be located in the support zone adjacent to the contamination reduction zone, situated so that part of it is in the decontamination area so workers can take breaks without going through full decontamination.

- If shade is not available, shaded areas shall be constructed. This same type of canopy can be set up to shade personnel performing various types of work in hot weather.
- Cooling measures other than shade (e.g., misting, air conditioned break areas, air conditioned vehicles, etc.) can be used in lieu of shade provided it can be demonstrated that they are at least as effective in cooling employees.
- Employees should have access to these rest areas at break times and at any other time when suffering from heat illness or believing a preventive recovery period is needed.

4.7.5 Dry clothing or towels will be available to minimize chills when taking breaks.

4.7.6 Manual labor will not be performed during breaks, other than paperwork or similar light tasks.

4.7.7 Other controls that may be used include:

- Scheduling work at night or during the cooler parts of the day (6 am–10 am, 3 pm–7 pm).
- Erecting a cover or partition to shade the work area.
- Auxiliary cooling - wearing cooling devices beneath protective garments, but over any underclothing.
    - If cooling devices are worn, only physiological monitoring will be used to determine work activity.
    - These vests typically provide cooling via one of two methods: the use of ice or other frozen media, or the use of a vortex cooler. Each method has its advantages and disadvantages.
    - The frozen media vest requires a means for freezing the media, and the media (usually water or "blue ice") will melt, requiring replacement.
    - The vortex cooler tends to cool more uniformly. Instead of frozen media, this vest uses the expansion of compressed air to cool the wearer. The drawback is the compressed air requirement, but this is negated when the wearer is already using an airline respirator supplied by a compressor. A vortex cooler should not be supplied from air cylinders, as this will draw down the cylinders rapidly.
- Auxiliary cooling should be considered when the following conditions exist:
    - Ambient temperature over 80°F (26°C).
    - Workers are wearing impermeable garments (i.e., Tyvek, Saranex, Chemrel, etc.).
    - It is desirable to have long work shifts with minimum interruption.

4.8 Evaluating the Work-Rest Schedule's Effectiveness

4.8.1 Once a work-rest schedule is established, the Supervisor shall continually evaluate its effectiveness through observation of Employees for signs/symptoms of heat stress. Have workers assess themselves and their body's reaction to the heat and work conditions (self-assessment), and report any signs or symptoms of heat illness. These can include nausea or dizziness, heat cramps, extreme thirst, or very dark urine.

4.8.2 Measurement or physiological monitoring of each Employee's vitals (e.g., pulse, blood pressure, and temperature) can provide additional information in determining if the schedule is adequate. Refer to *S3AM-113-ATT1 Temperature Thresholds* for additional guidance on when physiological monitoring should be conducted.

4.8.3 Frequency of physiological monitoring is increased or decreased depending upon such factors as worker fitness, acclimatization, temperature of the work environment, type of PPE, etc.

Based on the results of the physiological monitoring and on the workers' self-assessments, the work period may be adjusted as follows:

- The work period may be increased (generally, by 5- to 10-minutes intervals, up to a maximum of 4 hours) if the results of the first 2 hours of the physiological monitoring and the workers' self-assessments indicate that workers are recovering adequately (see below), and on the judgment of the SH&E Manager.
- The work period shall be decreased if the results of the physiological monitoring and the workers' self-assessment indicate that workers are NOT recovering adequately (see below).

4.8.4 If physiological monitoring is conducted, the Employee and/or the SH&E Manager (or appropriate designate) shall measure and record body temperature and pulse rate as described below.

4.8.5 Monitor body temperature to determine if Employees are adequately dissipating heat build-up. Ear probe thermometers which are adjusted to oral temperature (aural temperature) are convenient and the preferred method of measurement. Determine work/rest regimen as follows:

- Measure oral body temperature at the end of the work period. Oral body temperatures are to be obtained prior to the employee drinking water or other fluids.
- If temperature exceeds 99.6°F (37.5°C), shorten the following work period by 1/3 without changing the rest period.
- If, at the next rest period, temperature still exceeds 99.6°F (37.5°C), the worker should not be allowed to continue work until repeated temperature measurements are in the acceptable range (i.e., less than 99.6°F). Do not leave the worker alone during the recovery time. Watch for signs of heat illness and be prepared to implement emergency response as necessary.
- Do not allow a worker to wear impermeable PPE when his/her oral temperature exceeds 100.6°F (38.1°C).

4.8.6 At the start of the workday each Employee's baseline pulse rate (in beats per minute [bpm]) is determined by taking a pulse count for 15 seconds and multiplying the result by four or by using an automated pulse count device. Pulse rates can then be measured at the beginning of each break period and two minutes thereafter to determine if the rest period allows for adequate recovery.

- Take the radial (wrist) pulse as early as possible in the rest period and determine the worker's heart rate in beats per minute. The heart rate is determined by counting the pulse for ten seconds and multiplying the number by 6 to get the beats per minute. Record this as P1.
- Wait 2 minutes and repeat the pulse measurement. Record this as P2.
- If P1 is greater than or equal to 110 beats per minute (bpm) and if (P1 – P2) is less than or equal to 10 bpm (indicating that workers are not recovering adequately), shorten the next work cycle by 1/3 without changing the rest period.
- At the next rest period, if P1 is still equal to or greater than 110 bpm, and if (P1 – P2) is still less than or equal to 10 bpm, shorten the following work cycle by 1/3 without changing the rest period.
- At the third rest period, if P1 is still equal to or greater than 110 bpm and (P1 – P2) is still less than or equal to 10 bpm, the worker should not be allowed to continue work until repeated pulse measurements are in the acceptable range (i.e., P1 is less than 110 bpm and (P1 – P2) is greater than 10 bpm). Do not leave the worker alone during the recovery time. Watch for signs of heat illness and be prepared to implement emergency response as necessary.

4.8.7 Use of an automated or similar blood pressure device will be used to assess each Employee's blood pressure at the beginning and end of each break period to determine if the rest period allows adequate cooling by applying the following criteria:

- If the blood pressure of an Employee is outside of 90/60 to 150/90, then the Employee will not be allowed to begin or resume work; extend the break period by at least five minutes, at the end of which blood pressure rates will be re-measured and the end-of-break criteria again applied.

4.8.8 All physiological monitoring of heat stress will be documented using *S3AM-113-FM1 Heat Stress Monitoring Log.*

4.9 Training

4.9.1 Employees and their Supervisors that may be exposed to the hazard will be trained and oriented to the hazard and the controls prior to work commencing.

4.9.2 Those Employees, including Supervisors, potentially exposed to heat stress will receive training, refer to the *S3AM-003-PR1 SH&E Training* procedure. Training will include, but is not limited to:

- Sources of heat stress (environmental and personal), influence of protective clothing, and importance of acclimatization;
- How the body handles heat and acclimatization;
- Recognition of heat-related illness symptoms;
- Preventative/corrective measures including, but not limited to;
  - Employees will be informed of the harmful effects of excessive alcohol consumption in the prevention of heat stress.
  - All Employees will be informed of the importance of adequate rest and proper diet in the prevention of heat stress.
- First aid procedures for heat stress-related illnesses; and
- Immediate reporting of any heat-related incident (injury, illness, near-miss), refer to the *S3AM-004-PR1 Incident Reporting, Notifications & Investigation* procedure.

5.0 Records

5.1 None

6.0 Attachments

6.1 S3AM-113-ATT1 Temperature Thresholds

6.2 S3AM-113-ATT2 Symptoms & Treatment

6.3 S3AM-113-ATT3 Dehydration Chart

6.4 S3AM-113-FM1 Heat Stress Monitoring Log

Americas

Heat Stress Monitoring Log

S3AM-113-FM1

The purpose of this form is to monitor employees for heat illness when applicable. It is the responsibility of the Foreman or Supervisor-in-Charge to ensure that each person completes the required information.

Project Name:			**Foreman/Supervisor:**								**Work/Rest Schedule1:** IN *(min)* OUT *(min)*					
Date:	**Water Provided[1]**		**Acclimated[2]**		**Initial Vitals[3]**	**Vital Signs and Time In/Out[3]**					**Celcius** ☐ / **Farenheit** ☐ (select one)					
Employee Name	Yes	No	Yes	No	**Vitals**	In (P_1)	Out (P_1)	**Vitals**	In (P_1)	Out (P_1)	**Vitals**	In (P_1)	Out (P_1)	**Vitals**	In (P_1)	Out (P_1)
					P			**P**			**P**			**P**		
					BP			**BP**			**BP**			**BP**		
					Temp			**Temp**			**Temp**			**Temp**		
					P			**P**			**P**			**P**		
					BP			**BP**			**BP**			**BP**		
					Temp			**Temp**			**Temp**			**Temp**		
					P			**P**			**P**			**P**		
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					BP			**BP**			**BP**			**BP**		
					Temp			**Temp**			**Temp**			**Temp**		

1. Each Employee should be provided a sufficient amount of water or sports drink before entering the hot zone. Drinks such as coffee and cola should be discouraged.
2. Am Employee is “acclimated” if he/she has worked in a hot environment for at least 5 - 7 consecutive days. If an Employee is acclimated, check “Yes.” If an Employee is not acclimated, check “No” and reduce the “Min In” by 50 percent for that Employee until the 5 – 7 -day period is reached.
3. “Vitals” refers to Employee vital signs (e.g., pulse [P], blood pressure [BP], body temperature [Temp], etc.). Initial vitals must be taken and recorded before the start of work and at each break period, or as specified in the Heat Stress Exposure Control Plan.

Heat-Related Illness Prevention

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Risk for a heat-related illness varies based upon work activities, personal protective equipment (PPE)/clothing selection, geographical locations, personal conditions and weather conditions. To reduce the potential of developing a heat-related illness, AECOM has developed a site-specific procedure incorporating:

- AECOM's SH&E Procedure for Heat Illness Preventions (S3AM-113_PR_Heat Stress),
- California Occupational Safety and Health Administration Heat Illness Prevention Standard (Title 8 of the California Code of Regulations, Section 3395), and

1. Planning

The Site Safety Officer (SSO) and Field Supervisor shall verify the risk of heat-related illnesses based on:

- Weather forecasts,
- Planned work activities,
- Planned PPE, and
- Personal risk factors.

The SSO and Project Manager shall also ensure the appropriate equipment and resources are available to employees at risk of a heat- related illness. Examples of necessary equipment may include (but are not limited to):

- Potable water with replenishment supply;
- Drinking cups, insulated water bottles or other small sealable container;
- Sun protection (hats, long sleeves, sunscreen, sunglasses);
- Communication method (cell phone or similar);
- Shade;
- Reliable thermometer (a simple thermometer, like those available at hardware stores, can be used to measure the outdoor "dry bulb" temperature); and
- Cooling devices such as cooling vests or misters.

2. Water

2.1 Provision of Water

- There is no potable water supply on-site. Each employee shall bring their own supply.

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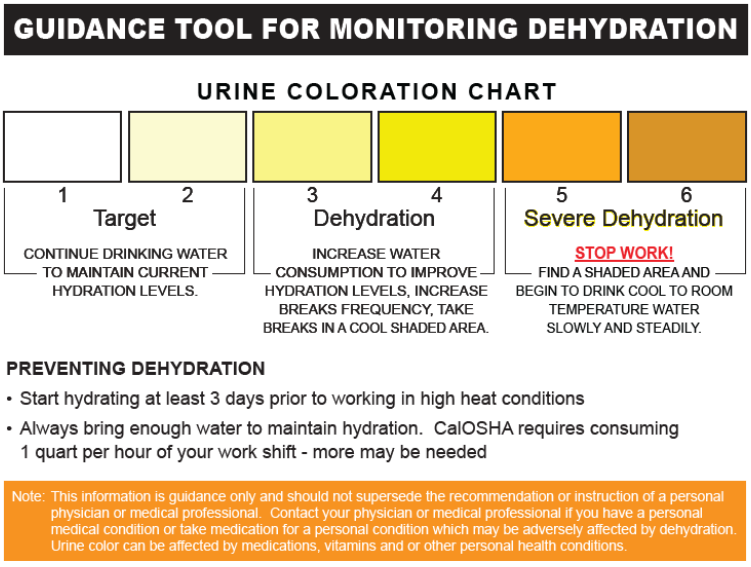
- All water shall be fresh, pure, potable, and cool (cooler than ambient temperature).
- Water will be located as close as possible to the work area.
- Water will be stored in an environment that will ensure a cool temperature and prevent contamination.
- Replenishment Procedures:

    - **Mobile/Remote Work**: Mobile and remote employees may carry water bottles or smaller sealed container of water with them while they are working, and refill containers at the primary source (cooler or other designated source) during breaks or as needed.

      Containers and refill frequency shall provide for a minimum of 1 quart of water to be consumed per hour while working Water bottles or smaller sealed container do not need to be empty prior to refilling; water should always be immediately available to employees.

2.2 Dehydration Prevention

The 2006 Cal/OSHA Heat Illness Case Study showed that, although 90% of the worksites had drinking water at the site, 96% of the employees suffering from heat illnesses were dehydrated.
Dehydration occurs when the body loses too much fluid. This can happen when an employee stops drinking water and can be accelerated by work in hot or dry conditions. Not drinking enough fluids can cause muscle cramps, fainting and shock, which is a life-threatening condition.
Drinking water should increase with activity level. Dehydration can affect the body's ability to recognize thirst, so employees shall drink water on a time schedule.
In hot conditions, it is important that employees drink enough water that urination is required at least every 2 hours. Water is the best hydration fluid. If sports drinks are used, they should be diluted at least 50 percent with water prior to drinking. **Do Not Drink Distilled Water.**
Dehydration can be prevented by monitoring urine color and adjusting water intake accordingly. The following guidance was developed to aid employees in monitoring hydration levels. This tool can be downloaded from: Hydration Chart.



3. Access to Shade

When temperatures **do not exceed 80 degrees Fahrenheit (°F) (26°Celsius [°C])**, access to shade for employee will be provided as needed, or as requested by employees. Timely access to shade will be provided upon an employee's request.

Shade is required when the temperature exceeds 80°F (26°C).

One or more shaded areas will be established at all times. Shade may require relocation to accommodate a moving work location.

The shaded area will either open to the air or be provided with ventilation or cooling (such as an air-conditioned vehicle). The amount of shade present shall be at least enough to accommodate the number of employees on a rest/recovery/meal/break period at any given time, so that they can sit in a normal posture fully in the shade without having to be in physical contact with each other.

The shaded area shall be located as close as practicable to the areas where employees are working, but no more than a 2.5-minute walk away. Access must be undeterred (free from obstacles or other barriers such as crossing traffic). The shaded area will be away from portable toilets, and in a clean, dry and otherwise hazard-free environment.

Examples of appropriate access to shade:

- Buildings, canopies, lean-tos, or other partial or temporary structures that are either ventilated or open to air movement.
- Trees and dense vines can provide shade that is superior to artificially provided shade and are accepted as compliant sources of shade as long as branches, thorns and the plant itself does not pose added harm to the employee.
- The interior of a vehicle may only be used to provide shade when the vehicle is air conditioned and the air conditioner is operating.

4. Work-Rest Cycles and Breaks

It is necessary to implement a work routine that incorporates adequate rest periods to allow employees to remove protective clothing, drink fluids (vital when extreme sweating is occurring), rest and recover.

The frequency and length of work breaks will be determined based on the following considerations:

- Employees are allowed and encouraged to take a preventative cool-down rest in the shade when they feel the need to do so to protect themselves from overheating. The breaks will last for a minimum of 5 minutes and as long as needed to resolve any signs/symptoms of heat illness that are observed.
- The SSO may determine the timing of work breaks based upon the ambient temperature, amount of sunshine, humidity, the amount of physical labor being performed, the physical condition of the employees, and protective clothing being used. The following guidelines shall be used to determine frequency and duration of rest breaks:

4.1 Adjusted Temperature Method

This method requires only that the ambient temperature (in °F [°C]) be known. Adjustment factors are applied to the ambient temperature to account for departures from ideal conditions (sunny conditions, light winds, moderate, humidity and a fully acclimated work force). The adjustments should be made by adding or subtracting the ambient temperature reading, or changes in table position, as indicated in Table 4-1. Adjustments are independent and cumulative; all applicable adjustments should be applied. The result is the *Adjusted Temperature*, which can be compared with the values in Table 4-2 for the applicable work rate (where light work corresponds to minimal physical activity besides standing/watching; very heavy work corresponds to significant, continuous physical labor) to determine the work-rest frequency.

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Table 4-1 Temperature Adjustment Factors

Time of Day	
Before daily temperature peak[1]	+2°F (+1.11°C)
10 a.m. – 2 p.m. (peak sunshine)	+2°F (+1.11°C)
Sunshine	
No clouds	+1°F (+0.56°C)
Partly Cloudy (3/8 – 5/8 cloud cover)	-3°F (-1.67°C)
Mostly Cloudy (5/8 – 7/8 cloud cover)	-5°F (-2.78°C)
Cloudy (>7/8 cloud cover)	-7°F (-3.89°C)
Indoor or nighttime work	-7°F (-3.89°C)
Wind	
Gusts greater than 5 miles per hour at least once per minute	-1°F (-0.56°C)
Gusts greater than 10 miles per hour at least once per minute	+2°F (+1.11°C)
Sustained greater than 5 miles per hour	-3°F (-1.67°C)
Sustained greater than 10 miles per hour	-5°F (-2.78°C)
Humidity	
Relative Humidity greater than 90%	+5°F (+2.78°C)
Relative humidity greater than 80%	+2°F (+1.11°C)
Relative Humidity less than 50%	-4°F (-2.23°C)
Chemical Protective Clothing (CPC)	
Modified Level D (coveralls, no respirator) [2]	+5°F (+1.11°C)
Miscellaneous	
Unacclimated work force	+5°F (+2.78°C)
Partially acclimated work force	+2°F (+1.11°C)
Working in shade	-3°F (-1.67°C)
Breaks taken in air conditioned space	-3°F (-1.67°C)

°F = degrees Fahrenheit; °C = degrees Celsius
[1] This adjustment accounts for temperature rise during the day. If the temperature has already reached its daytime peak, it can be ignored.
[2] Refer to S3AM-113-ATT1 for addition Chemical Protective Clothing (Type C – A)

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Table 4-2 Work-Rest Schedule Based on Adjusted Temperature

Work-Rest Frequency	Adjusted Temperature – ºF (ºC)			
	Light Work	**Moderate Work**	**Heavy Work**	**Very Heavy Work**
No Specified requirements	< 80ºF (26.67ºC)	< 75ºF (23.88ºC)	< 70ºF (21.11ºC)	< 65ºF (18.33ºC)
15-minute break every 90 minutes of work	80–90ºF (26.67–32.2ºC)	75–85ºF (23.88–29.44ºC)	70–80ºF (21.11–26.67ºC)	65–75ºF (18.33–23.88ºC)
15-minute break every 60 minutes of work	> 90–100ºF (32.22–37.77ºC)	> 85–95ºF (29.44–35ºC)	> 80–85ºF (26.67–29.44ºC)	> 75–80ºF (23.88–26.67ºC)
15-minute break every 45 minutes of work	> 100–110ºF (37.77–43.33ºC)	> 95–100ºF (35–37.77ºC)	> 85–90ºF (29.44–32.22ºC)	> 80–85ºF (26.67–29.44ºC)
15-minute break every 30 minutes of work	> 110–115ºF (43.33–46.11ºC)	> 100–105ºF (37.77–40.55ºC)	> 90–95ºF (32.22–35ºC)	> 85–90ºF (29.44–32.22ºC)
15-minute break every 15 minutes of work	> 115–120ºF (46.11–48.88ºC)	> 105–110ºF (40.55–43.33ºC)	> 95–100ºF (35–37.77ºC)	> 90–95ºF (32.2–35ºC)
STOP WORK	**> 120ºF** (48.88ºC)	**> 110ºF** (43.33ºC)	**> 100ºF** (37.77ºC)	**> 95ºF** (35ºC)

ºF = degrees Fahrenheit; ºC = degrees Centigrade

4.2 Procedures for Taking Breaks

- Breaks will be taken in a cool and/or shaded location, in an air-conditioned environment when possible. A shaded break area is required when temperatures are above 80 ºF (26ºC).
- Employees will be monitored by the supervisor or SSO and asked if he or she is experiencing symptoms of heat illness.
- Each employee should self-assess and assess their co-workers for sign/symptoms of a heat-related illness.
- Employees will be encouraged to remain in the shade.
- All breaks will last a minimum of 5 minutes in addition to the time needed to access the shade.
- Employees will not be ordered back to work until any signs or symptoms of heat illness have abated.
- Pulse rate information should be collected to verify the effectiveness of the break and work-rest cycle.
- Water will be available, and consumption encouraged in the break area.
- Manual labor will not be performed during breaks, other than paperwork or similar light tasks.

4.3 Evaluating the Work-Rest Schedule's Effectiveness

Once a work-rest schedule is established, the SSO must continually evaluate its effectiveness through observation of employees for signs/symptoms of heat stress. Measurement of each employee's pulse can provide additional information in determining if the schedule is adequate and is accomplished as follows:
Within the first minute of each rest period, each employee's heart rate (pulse) can be measured and compared to the following:

- Initial heart rate: 110 beats per minute (bpm) (28 beats every 15 seconds).

Each employee's heart rate must be measured again 3 minutes later and compared to the following:

- Recovery heart rate: 80 bpm (20 beats every 15 seconds).
- If both heart rate criteria are met, the subsequent work period may be increased by one-third, provided the temperature remains constant.
- If the initial heart rate is greater than 110 bpm, or the recovery rate is not less than 80 bpm, the subsequent work shift is decreased by one-third.

If cooling devices (e.g., cooling vest) are worn, only physiological monitoring will be used to determine work activity. Measurements for each employee can be recorded and tracked throughout the workday using the Heat Stress Monitoring Log provided in S3AM-113_PR_Heat Stress.

5. Emergency Services

A minimum of two workers trained in cardio-pulmonary resuscitation (CPR) and First Aid will be present on site for all activities that expose employees to temperatures greater than 80ºF (27ºC). This is ideal, but may need to be adjusted for specific working conditions.
Means of contacting Emergency Services shall be validated in areas where cell phone reception is limited, and alternate reliable means will be selected.
Emergency Services will be activated if severe heat illness (such as, but not limited to, decreased level of consciousness, staggering, vomiting, disorientation, irrational behavior or convulsions) is observed or suspected.
An employee that exhibits signs or symptoms of illness shall not be left alone without first aid or medical treatment to resolve symptoms.
Refer the Site-Specific Emergency Action Plan for specific emergency instructions in the Task Hazard Analysis (THAs), Safe Work Plan or Health and Safety Plan.

5.1 Acclimatization

All employees shall be closely observed by a supervisor or designee during a heat wave. For purposes of this section only, "heat wave" means any day in which the predicted high temperature for the day will be at least 80ºF (27ºC) and at least 10 ºF (5 ºC) higher than the average high daily temperature in the preceding 5 days.
An employee who has been newly assigned to a high heat area shall be closely observed by a supervisor or designee for the first 14 days of the employee's employment.

5.2 Training of Employees and Supervisors

All AECOM employees and supervisors shall receive training in the prevention of heat-related illnesses prior to starting work. Training will include:

- Environmental risk factors for heat illness, including added burden of heat load on the body caused by exertion, clothing and PPE;
- Personal Risk Factors for heat illness such as an individual's age, degree of acclimatization, health, water consumption, alcohol consumption, caffeine consumption, and use of prescription medications that affect the body's water retention or other physiological responses to heat;
- AECOM's S3AM-113_PR_Heat Stress and a review of the site-specific procedure in this Safe Work Plan, and associated THAs;
- Signs, symptoms and response measures for different types of heat-related illnesses;
- Procedure for stopping work and reporting signs and symptoms of a heat-related illness in themselves or other people on site;
- First aid measure for managing a case of heat illness;
- AECOM's procedure for responding to heat-related illnesses, including use of AECOM's Corporate Medical Provider (Work Care), and seeking emergency medical services (see the site-specific Emergency Action Plan);

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- Obtaining accurate weather forecast and ambient temperature data;
- Access to potable water, the minimum recommended consumption rate (1 quart per hour), procedure for drinking (small quantities regularly throughout the day, increase intake for higher heat, increased workload or increased sweating);
- Provision of shade required when temperatures are greater than 80ºF (27ºC);
- Acclimatization;
- How to establish a work-rest cycle per S3AM-113_PR_Heat Stress; and
- Specific high heat (95ºF [35ºC]) procedures.

6. High Heat Procedures (>95° F)

The following procedures shall be implemented when the temperature equals or exceeds 95ºF (35ºC). These procedures shall include the following to the extent practicable:

- Ensuring that effective communication by voice, observation, or electronic means is maintained so that employees at the work site can contact a supervisor when necessary. An electronic device, such as a cell phone or text messaging device, may be used for this purpose only if reception in the area is reliable.
- Conduct a pre-shift meeting to review high heat procedures, encourage water consumption, and review the work-rest cycle and supplemental breaks.
- Employees shall be monitored for signs and symptoms through an effective means of observation, which may include:
    - For teams less than 20, monitoring by a supervisor or supervisor designee (SSO).
    - For teams larger than 20, monitoring via the Buddy System.
    - Regular communication through cell phone or radio of a lone worker.

Note: for Lone Worker scenario an alternate means of monitoring the worker must be devised.

- Reminders to drink plenty of water throughout the work shift shall be provided by the SSO or Site Supervisor or from peer to peer.
- Designate an employee that is authorized to call Emergency Services in the event of an emergency

7. Identifying and Responding to Sign and Symptoms

Heat stress can be a significant field site hazard, particularly for non-acclimated personnel working in the desert. Site personnel must be instructed in the identification of heat-stress symptoms of heat-related illnesses. Employees are required to immediately report any signs of symptoms that they may experience or observe in fellow employees. The guidance below in Table 7-1 will be used in identifying and responding to heat-related illness. Any employee exhibiting a sign or symptom of a heat-related illness shall receive appropriate first aid or medical care through the AECOM supervisor, and AECOM's Incident Reporting process.

Table 7-1 Identification and Treatment of Heat-Related Illness

Type of Heat-Related Illness	Description	First Aid
Dehydration	*96% of the employees suffering from heat illnesses were dehydrated.* Dehydration results from in taking less water than your body is using (sweating). Dehydration results in reduced urine output, dark-colored urine, shriveled skin that doesn't "bounce back" when pinched, extreme thirst (not always), sleepiness, lack of sweat, dry skin, headache, constipation.	• Stop work and move employee to shaded rest/break area. • Drink water, slowly and steadily. • Report to SSO, contact Safety Professional/Work Care for guidance on fluid intake and returning to work.
Heat Rash	A heat rash occurs when sweat ducts become clogged and the sweat can't get to the surface of the skin. Instead, it becomes trapped beneath the skin's surface causing a mild inflammation or rash.	Avoid working in hot, humid weather, wear loose clothing made of breathable fabrics like cotton, use air conditioning, and keep the skin clean with frequent baths or showers to prevent sweat glands from becoming clogged. Change clothing that is wet or soiled. Heat rash can be treated by cleaning and cooling the area with cool water and applying an over-the-counter hydrocortisone cream. There is risk of infection from heat rash if sweat glands become infected. The signs of infection include pain, increased swelling, and redness that does not resolve. Pustules may form at the site of the rash. This infection occurs because bacteria have invaded the blocked sweat gland. Antibiotic treatment may be required. Chronic and recurrent heat rash may need to be treated by a health care practitioner or dermatologist (skin specialist).
Mild Heat Strain	The mildest form of heat-related illness. Victims exhibit irritability, lethargy, and significant sweating. The victim may complain of headache or nausea. This is the initial stage of overheating, and prompt action at this point may prevent more severe heat-related illness from occurring.	• Provide the victim with a work break during which he/she may relax, remove any excess protective clothing, and drink cool fluids. • An air-conditioned spot is an ideal break location. • Once the victim shows improvement, he/she may resume working; however, the work pace should be moderated to prevent recurrence of the symptoms.
Heat Exhaustion	Usually begins with muscular weakness and cramping, dizziness, staggering gait, and nausea. The victim will have pale, clammy moist skin and may perspire profusely. The pulse is weak and fast and the victim may faint unless they lie down. The bowels may move involuntarily.	• Immediately remove the victim from the work area to a shady or cool area with good air circulation (*avoid drafts or sudden chilling*). • Remove all protective outerwear. • Call a physician. • Treat the victim for shock. (*Make the victim lie down, raise his or her feet 6–12 inches, and keep him/her cool by loosening all clothing.*) • If the victim is conscious, it may be helpful to give him/her sips of water. • Transport victim to a medical facility as soon as possible.

Type of Heat-Related Illness	Description	First Aid
Heat Stroke	The most serious of heat illness, heat stroke represents the collapse of the body's cooling mechanisms. As a result, body temperature may rise to 104 degrees Fahrenheit or higher. As the victim progresses toward heat stroke, symptoms such as headache, dizziness, and nausea can be noted, and the skin is observed to be dry, red, and hot. Sudden collapse and loss of consciousness follows quickly, and death is imminent if exposure continues. Heat stroke can occur suddenly.	• Immediately evacuate the victim to a cool/shady area. • Remove all protective outerwear and as much personal clothing as decency permits. • Lay the victim on his/her back with the feet slightly elevated. • Apply cold wet towels or ice bags to the head, armpits, and thighs. • Sponge off the bare skin with cool water. • The main objective is to cool without chilling the victim. • Give no stimulants or hot drinks. • Since heat stroke is a severe medical condition requiring professional medical attention, emergency medical help should be summoned immediately to provide on-site treatment of the victim and proper transport to a medical facility.

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Americas

Heat Stress – Temperature Thresholds

S3AM-113-ATT1

1.0 Work-Rest Schedule

The prevention of heat stress is best performed through Supervisor observation of Employees and routine heat stress awareness training activities. However, it is also necessary to implement a work routine that incorporates adequate rest periods to allow Employees to remove protective clothing, drink fluids (vital when extreme sweating is occurring), rest and recover. The frequency and length of work breaks shall be determined by the Supervisor based upon the ambient temperature, amount of sunshine, humidity, the amount of physical labor being performed, the physical condition of the Employees (e.g., acclimated/not), and protective clothing being used.

1.1 Establishing a Work-Rest Schedule:

1.1.1 AECOM permits the use of either of two techniques to initially determine an appropriate daily work-rest schedule. These methods are:

- Wet Bulb Globe Thermometer (WBGT) Method: This method is preferred if a WBGT meter is available.
- Adjusted Temperature Method: This method should be used only if WBGT data is not available.

1.1.2 Either procedure will provide the Supervisor with a recommended routine; however, adjustments to this routine may be required to accommodate the specific daily conditions at the work site.

1.2 WBGT Work-Rest Schedule Guidelines:

1.2.1 If the measured WBGT is less than the action limit value, there is little risk of excessive exposure to heat stress, and work can continue.

- Continue to monitor ambient conditions with the WBGT. However, if there are reports of the symptoms of heat-related disorders, then the analysis of little risk should be reconsidered.
- If the measured WBGT is greater than the values in the following two tables, institute heat stress controls, including the associated work-rest cycle, and perform physiological monitoring as described in *S3AM-113-PR1 Heat Stress*.
- Because of the physiological strain associated with very heavy work among less fit workers regardless of WBGT, values are not provided in Table 1 or 2 for continuous work or 75% work – 25% rest regimen. Physiological monitoring should always be implemented under these conditions.

1.2.2 Table 1, the Non-CPC Activities WBGT Chart, is intended for use where personnel are not utilizing Chemical Protective Clothing (CPC). Where workers are required to utilize CPC, Table 2, the CPC Activities WBGT Chart, will be used.

1.2.3 WBGT readings are compared directly with the values of the applicable WBGT Chart for the applicable work rate (where light work corresponds to minimal physical activity besides standing/watching; very heavy work corresponds to significant, continuous physical labor) to determine the work-rest frequency.

Table 1. Non-CPC Activities WBGT Chart

Work-Rest Regimen	WBGT			
	Light Work	Moderate Work	Heavy Work	Very Heavy Work
Continuous Work	85°F (29.4°C)	81°F (27.2°C)	78°F (25.6°C)	
75% Work – 25% Rest	86°F (30°C)	83°F (28.3°C)	81°F (27.2°C)	
50% Work – 50% Rest	88°F (31.1°C)	85°F (29.4°C)	83°F (28.3°C)	81°F (27.2°C)
25% Work – 75% Rest	90°F (32.2°C)	87°F (30.6°C)	86°F (30°C)	85°F (29.4°C)

Modified from ACGIH's 2014 *Threshold Limit Values for Chemical Substances and Physical Agents*, for acclimatized workers.

Table 2. CPC Activities WBGT Chart

Work-Rest Regimen	WBGT			
	Light Work	Moderate Work	Heavy Work	Very Heavy Work
Continuous Work	74°F (23.3°C)	70°F (21.1°C)	67°F (19.4°C)	
75% Work – 25% Rest	75°F (23.9°C)	72°F (22.2°C)	70°F (21.1°C)	
50% Work – 50% Rest	77°F (25°C)	74°F (23.3°C)	72°F (22.2°C)	70°F (21.1°C)
25% Work – 75% Rest	79°F (26.1°C)	76°F (24.4°C)	75°F (23.9°C)	74°F (23.3°C)

Modified from ACGIH's 2014 *Threshold Limit Values for Chemical Substances and Physical Agents*, for acclimatized workers.

1.3 Humidex Based Work-Rest Schedule Guidelines

1.3.1 The Humidex method is a simplified way of protecting workers from heat stress. It is an equivalent scale intended to express the combined effects of warm temperatures and humidity. Humidex is used as a measure of perceived heat that results from the combined effect of excessive humidity and high temperature.

1.3.2 This method requires only a local air temperature and relative humidity value. Monitoring shall continue throughout the day for changing conditions. Identify a representative location where measurements can be taken. Measurements should be recorded at least hourly when ambient temperatures and 90°F (32°C) for personnel wearing normal permeable work clothes.

- Step 1: On the Humidex table below, look up the temperature on the left (Celsius is located below RH>) and the relative humidity (RH) on the top. Determine the Humidex value.

F	RH>	100%	95%	90%	85%	80%	75%	70%	65%	60%	55%	50%	45%	40%	35%	30%	25%	20%
108	42													55	52	50	48	46
106	41												55	53	51	48	46	44
104	40											55	53	51	49	47	45	43
102	39										55	53	51	49	47	45	43	41
100	38		Step 1 - Determine HUMIDEX VALUE							54	53	51	49	47	45	43	42	40
99	37								54	52	51	49	47	45	44	42	40	38
97	36					57	55	53	52	50	49	47	45	44	42	40	39	37
95	35				56	54	53	51	50	48	47	45	43	42	40	39	37	36
93	34		56	55	53	52	51	49	48	46	45	43	42	40	39	37	36	34
91	33	55	54	53	51	50	48	47	46	44	43	41	40	39	37	36	34	33
90	32	53	51	50	49	48	46	45	44	42	41	40	38	37	36	34	33	32
88	31	50	49	48	47	45	44	43	42	40	39	38	37	35	34	33	32	30
86	30	48	47	46	44	43	42	41	40	39	37	36	35	34	33	31	30	29
84	29	46	45	43	42	41	40	39	38	37	36	35	33	32	31	30	29	28
82	28	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27
81	27	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25
79	26	39	38	37	36	35	34	33	33	32	31	30	29	28	27	26	25	24
77	25	37	36	35	34	33	33	32	31	30	29	28	27	26	26	25	24	23

- Step 2: Place the Humidex value into the Heat Index Adjustment Table below. Determine the applicable adjustments based on the given work or task.

Heat Index Adjustment Table

	Step 2 - Risk Factor Adjustment	
Write in value	What is the HUMIDEX value from the table in Step 1?	
	Radiant Heat	**Adjustment**
	Working in full-sun	Add 2
	Working in ½ or partial sun or weak radiant heat source	Add 1
	Working near very hot equipment surfaces or processes	Add 2
	Clothing: Pick One Only	
	Short/long sleeve shirt and pants – no overalls	None
	Overalls (e.g., Nomex suit)	Add 3
	Double layer overalls	Add 5
Stop	Impermeable clothing	Perform Physiological Monitoring
	Acclimatization	
	Have been working at least 5 of last 7 days in heat stress conditions.	Subtract 4
	Work Load & Miscellaneous Factors	
	Light Work (Standing, slow walking)	Subtract 2
	Medium Work (Walking about with moderate lifting or pushing)	None
	Heavy Work (Shoveling dry sand, carrying 50 lbs)	Add 2
	Very Heavy Work (Shoveling wet sand)	Add 3
	TOTAL – Compare to Heat Index Response Plan	

- Step 3: Compare adjusted Heat Index Total to the Heat Index Response Plan table to obtain guidance for work/rest.

Heat Index Response Plan*

TOTAL NUMBER	Final Step 3 - HEAT INDEX Response
30-33	alert & information & water
34-37	warning & increase water
38-39	75% work - 25% rest & monitor for signs of heat stress
40-41	50% work - 50% rest & monitor for signs of heat stress
42-44	25% work - 75% rest & monitor for signs of heat stress
45+	Perform Physiological Monitoring

*** Percent work and rest/recovery are on a per hour basis. Adjustments and subsequent work/rest cycle recommendations are rough guidelines only. No heat stress prediction scheme can replace monitoring of symptoms or a health care practitioners advice in the case of individuals with special medical conditions or predisposing circumstances for heat related illness. Always pay attention to the way workers are feeling. Recuperate if fatigued, nauseated, dizzy or thirsty,**

1.4 Adjusted Temperature Work-Rest Schedule Guidelines:

This method can be utilized where WBGT data is not available, and requires only that the ambient temperature be known. Adjustment factors are applied to the ambient temperature to account for departures from ideal conditions (sunny conditions, light winds, moderate humidity and a fully acclimated work force). The adjustments will be made by addition or subtraction to the ambient temperature reading, or changes in table position, as indicated in Table 3. Adjustments are independent and cumulative, all applicable adjustments should be applied. The result is the Adjusted Temperature, which can be compared with the values in Table 4 for the applicable work rate (where light work corresponds to minimal physical activity besides standing/watching; very heavy work corresponds to significant, continuous physical labor) to determine the work-rest schedule.

Table 3. Temperature Adjustment Factors

Time of Day	
Before daily temperature peak[1]	+2°F (+1.11°C)
10 am – 2 pm (peak sunshine)	+2°F (+1.11°C)
Sunshine	
No clouds	+1°F (+0.56°C)
Partly Cloudy (3/8 – 5/8 cloud cover)	-3°F (-1.67°C)
Mostly Cloudy (5/8 – 7/8 cloud cover)	-5°F (-2.78°C)
Cloudy (>7/8 cloud cover)	-7°F (-3.89°C)
Indoor or nighttime work	-7°F (-3.89°C)
Wind (*ignore if indoors or wearing CPC*)	
Gusts greater than 5 miles per hour at least once per minute	-1°F (-0.56°C)
Gusts greater than 10 miles per hour at least once per minute	+2°F (+1.11°C)
Sustained greater than 5 miles per hour	-3°F (-1.67°C)
Sustained greater than 10 miles per hour	-5°F (-2.78°C)
Humidity (*ignore if wearing CPC*)	
Relative Humidity greater than 90%	+5°F (+2.78°C)
Relative Humidity greater than 80%	+2°F (+1.11°C)
Relative Humidity less than 50%	-4°F (-2.23°C)
Chemical Protective Clothing (CPC)	
Modified Level D (coveralls, no respirator)	+5°F (+2.78°C)
Level C (coveralls w/o hood, full-face respirator)	+8°F (+4.45°C)
Level C (coveralls with hood, full-face respirator)	+10°F (+5°C)
Level B with airline system (hooded chemical resistant clothing)	+9°F (+5.56°C)
Level B with SCBA (hooded chemical resistant clothing)	+9°F (+5.56°C) and right one column[2]
Level A (totally encapsulating chemical protective suit)	+14°F (+7.78°C) and right one column
Other	Specified in the HASP
Miscellaneous	
Unacclimated work force	+5°F (+2.78°C)
Partially acclimated work force	+2°F (+1.11°C)
Working in shade	-3°F (-1.67°C)
Breaks taken in air conditioned space	-3°F (-1.67°C)

For complete descriptions of Level A through D Protective Clothing refer to Unites States 29 CFR 1910.120 Appendix B

[1] This adjustment accounts for temperature rise during the day. If the temperature has already reached its daytime peak it can be ignored.

[2] Locate the proper column based on work rate, then move one column to the right (next higher work rate) before locating the corresponding adjusted temperature.

Table 4. Work-Rest Schedule Based on Adjusted Temperature

Work-Rest Regimen	Adjusted Temperature			
	Light Work	**Moderate Work**	**Heavy Work**	**Very Heavy Work**
No specified requirements	< 80°F (26.67°C)	< 75 (23.88°C)	< 70 (21.11°C)	< 65 (18.33°C)
15 minute break every 90 minutes of work	80°F – 90°F (26.67°C) - (32.22°C)	75 – 85 (23.88°C) - (29.44°C)	70 – 80 (21.11°C) - (26.67°C)	65 – 75 (18.33°C) - (23.88°C)
15 minute break every 60 minutes of work	>90 – 100 (32.22°C) - (37.77°C)	> 85 – 95 (29.44°C) - (35°C)	>80 – 85 (26.67°C) - (29.44°C)	>75 – 80 (23.88°C) - (26.67°C)
15 minute break every 45 minutes of work	>100 – 110 (37.77°C) - (43.33°C)	>95 – 100 (35°C) - (37.77°C)	>85 – 90 (29.44°C) - (32.22°C)	>80 – 85 (26.67°C) - (29.44°C)
15 minute break every 30 minutes of work	>110 – 115 (43.33°C) - (46.11°C)	>100 – 105 (37.77°C) – (40.55°C)	>90 – 95 (32.22°C) - (35°C)	>85 – 90 (29.44°C) - (32.22°C)
15 minute break every 15 minutes of work	>115 – 120 (46.11°C) - (48.88°C)	>105 – 110 (40.55°C) - (43.33°C)	>95 -100 (35°C) - (37.77°C)	>90 – 95 (32.22°C) - (35°C)
Stop Work	**>120** (48.88°C)	**>110** (43.33°C)	**>100** (37.77°C)	**>95** (35°C)

Note: Time spent performing decontamination or donning/doffing CPC should not be included in calculating work or break time lengths.

Work-rest schedules and water provisioning may be documented using logs such *as S3AM-113-FM2 Daily Heat Illness Prevention Log*.

Americas

Heat Stress – Symptoms & Treatment

S3AM-113-ATT2

1.0 Heat Illness Symptoms

1.1 The following are four stages of heat-related illness:

1.1.1 Heat Rash

Heat rash (prickly heat) may result from continuous exposure to heat or humid air. It appears as red papules (elevated skin lesion), usually in areas where the clothing is restrictive, and gives rise to a prickly sensation, particularly as sweating increases. It occurs in skin that is persistently wetted by un-evaporated sweat. The papules may become infected unless treated.

1.1.2 Heat Cramps

Heat cramps are painful muscle cramps caused by heavy sweating and inadequate electrolyte replacement due to over-exertion in extreme heat. Symtpoms include:

- Muscle spasms; and
- Pain in the hands, feet, and abdomen.

1.1.3 Heat Exhaustion

Heat exhaustion is the next stage. Heat exhaustion occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Symptoms include:

- Cool, moist, pale, flushed or red skin;
- Heavy sweating;
- Headache;
- Nausea or vomiting;
- Dizziness;
- Exhaustion;
- Mood changes (irritable, or confused/can't think straight), and
- Fainting

The key here is that the victim is still sweating, so the cooling system is still working; it's just under severe stress. The body core temperature may be elevated, but not higher than 104ºF (40ºC). It is important to recognize and treat these symptoms as soon as possible, as the transition from heat exhaustion to the very hazardous heat stroke can be quite rapid.

1.1.4 Heat Stroke

Heat exhaustion can sometimes lead to heat stroke, the most serious form of heat stress, which can be fatal and requires emergency treatment. Heat stroke happens when body temperature regulation fails and body temperature continues to rise to critical levels, often to 105 degrees Fahrenheit (°F) (40.5 degrees Celsius [° C]) or higher. Immediate action must be taken to cool the body before serious injury and death occurs. Competent medical help must be obtained. Symptoms of heat stroke:

- Vomiting;
- Decreased alertness level or complete loss of consciousness;
- Slurred speech;
- High body temperature (sometimes as high as 105°F [40.5°C]);
- Red, hot, usually dry skin;
- Lack of or reduced perspiration;
- Skin may still be moist or the victim may stop sweating and the skin may be red, hot, and dry;

- Rapid, weak pulse or rapid, strong pulse;
- Rapid, shallow breathing;
- Nausea;
- Dizziness and confusion; and
- Coma.

2.0 Recommended Treatment for Heat Stress-related Illnesses

2.1 Heat Rash

2.1.1 Treatment for heat rash includes:

- Shower after work, dry off thoroughly, and put on clean, dry underwear and clothes;
- Try to stay in a cool place after work;
- If, in spite of this, you develop heat rash, contact WorkCare.

2.2 Heat Cramps

2.2.1 Treatment for heat cramps includes:

- Gently stretch the cramped muscle and hold the stretch for about 20 seconds, then gently massage the muscle. Repeat these steps if necessary;
- Take more frequent breaks and drink more water;
- Move victim to a cool place;
- Administer drinks of cool water;
- Apply manual pressure to cramped muscles;
- Once spasms disappear, you may return to work;
- Seek medical attention if symptoms are not alleviated or if more serious problems are indicated.

2.3 Heat Exhaustion

2.3.1 Treatment of heat exhaustion includes:

- Get out of the sun to a cool location and drink cool water, a little at a time;
- Remove or loosen tight clothing and elevate the feet;
- If you are nauseated or dizzy, lie down;
- Move the victim to a cool place, administer drinks of cool water and fan to cool;
- Seek medical attention immediately.

2.4 Heat Stroke

2.4.1 Treatment of heat stroke, or if a person's temperature exceeds 102°F (38.9 °C) includes:

- Call for immediate medical help and then try to lower the temperature as quickly as possible:
  - Apply cool (not cold) water the person's whole body, then fan the person;
  - Wrap in wet sheet;
  - If available, use cold packs under arms, neck, and ankles;
  - Body temperature is measured frequently, often constantly. To avoid overcooling, cooling is stopped when the body temperature is reduced to about 102°F (38ºC);
- Do not give aspirin or acetaminophen to reduce the temperature;
- Treat as a true medical emergency. Seek medical help immediately;
- Protect from injury during convulsion;
- Ensure that the person's airway is open;
- Transfer to a medical facility immediately.

Americas

Dehydration Chart

S3AM-113-ATT3

GUIDANCE TOOL FOR MONITORING DEHYDRATION

URINE COLORATION CHART



1 2	3 4	5 6
Target	Dehydration	Severe Dehydration
CONTINUE DRINKING WATER TO MAINTAIN CURRENT HYDRATION LEVELS.	INCREASE WATER CONSUMPTION TO IMPROVE HYDRATION LEVELS, INCREASE BREAKS FREQUENCY, TAKE BREAKS IN A COOL SHADED AREA.	STOP WORK! FIND A SHADED AREA AND BEGIN TO DRINK COOL TO ROOM TEMPERATURE WATER SLOWLY AND STEADILY.

PREVENTING DEHYDRATION

- Start hydrating at least 3 days prior to working in high heat conditions
- Always bring enough water to maintain hydration. CalOSHA requires consuming 1 quart per hour of your work shift - more may be needed

Note: This information is guidance only and should not supersede the recommendation or instruction of a personal physician or medical professional. Contact your physician or medical professional if you have a personal medical condition or take medication for a personal condition which may be adversely affected by dehydration. Urine color can be affected by medications, vitamins and or other personal health conditions.

Americas

Compressed Gases

S3AM-114-PR1

1.0 Purpose and Scope

1.1 This procedure provides the requirements for using, handling, storing, transporting, disposition and/or decommissioning compressed gas cylinders.

1.2 This procedure applies to all AECOM Americas based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 **Compressed Air (Non-Breathable)** – Air that is at a pressure greater than that of the atmosphere. Compressed air shall not be used for cleaning purposes except where reduced to less than 30 psi and then only with effective chip guarding and personal protective equipment. Utilized for tools, equipment, and mechanical machinery and cleaning purposes as described in this procedure.

2.2 **Compressed Gas** – Any material or mixture in a pressure vessel having:

- An absolute pressure exceeding 40 pounds per square inch (PSI) at 70°F (25 pounds per square inch gauge); or
- An absolute pressure exceeding 104 Psia at 130°F, regardless of the pressure at 70°F.

2.3 **Cylinder –** Pressure vessel designed for pressures higher than 40 Psia and having a circular cross section.

2.4 **Decommission** – The removal of a compressed gas cylinder from service by rendering it permanently unusable.

2.5 **Disposition** – Recycling, treatment, or disposal of a compressed gas cylinder and/or its contents.

2.6 **Pneumatics –** The use of pressurized air to affect mechanical motion for machinery, equipment and tools.

2.7 **Psi** – Pounds per square inch.

2.8 **Psia –** Pounds per square inch absolute (i.e., pressure in a container that would appear on an ordinary gauge plus the local atmospheric pressure [14.696 psi at sea level]), psig- pounds per square inch gauge.

2.9 **Psig** – Pounds per square inch gauge. The pressure in a vessel or container as registered on a gauge attached to the container. This reading does not include the pressure of the atmosphere outside the container.

2.10 **Pressure Relief Valve** – A device installed on most cylinders to prevent the rupture of a normally pressurized cylinder when it is inadvertently exposed to fire or high temperatures.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-116-PR1 Hazardous Materials Shipping

3.3 S3AM-127-PR1 Exposure Monitoring

3.4 S3AM-208-PR1 Personal Protective Equipment

3.5 S3AM-209-PR1 Risk Assessment & Management

3.6 S3AM-332-PR1 Hot Work

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager**

- Ensuring the safety of employees on their project sites.
- Implement these procedures during all activities involving compressed gases.
- Seek consultation with the SH&E Manager when unknown compressed gas cylinders are encountered.
- Confirm employees have received the appropriate training as it relates to compressed gases/compressed gas cylinders.
- Confirm a hazard assessment/evaluation of the activities involving compressed gases has been completed.
- Contact the SH&E Manager prior to any compressed gas cylinder operation.
- Immediately report any leaking/suspected leaking compressed gas cylinder(s) to the SH&E Manager and implement the appropriate emergency action(s).
- Immediately report the discovery of any unknown compressed gas cylinder(s) to the SH&E Manager and cordon off the area in all directions a minimum of 50 feet (15.24 meters).
- Confirm that all compressed gas cylinders are properly inspected, stored, and, secured.
- Confirm that all compressed gas cylinders are handled in a safe manner, protecting both the person and cylinder.
- Confirm that all compressed gas cylinder manifolds and connections are properly made and inspected.
- Confirm an appropriate emergency response plan is established prior to the start of any compressed gas cylinder operation.

4.1.2 **SH&E Manager**

- Review and authorize all compressed gas cylinder operations.
- Conduct/support compressed gas hazard assessments/evaluations.
- Provide awareness training to project teams regarding hazards of encountered compressed gases.
- Support the identification/disposition of unknown compressed gas cylinders.
- Support the development of a site-specific cylinder plan.

4.1.3 **Employee**

- Immediately report any leaking/suspected leaking compressed gas cylinder(s) to a Manager.
- Immediately report the discovery of any unknown compressed gas cylinders to Project Manager.
- Properly handle all compressed gas cylinders.
- Shall be supervised by employees experienced in the operation of compressed gas tools and equipment.

4.2 Training

4.2.1 On-site orientation to the hazards of the equipment and the proper use, handling, and storage shall be completed for all employees handling or coming into contact with compressed air tools and equipment or compressed gas cylinders. Refer to *S3AM-003-PR1 SH&E Training* and *S3AM-114-ATT1 Compressor Safety*.

4.2.2 Employees shall be instructed on the PPE requirements for the applicable tasks. Refer to *S3AM-208-PR1 Personal Protective Equipment*.

4.3 General Use of Compressed Air or Gas

4.3.1 Compressed air or other compressed gases are not to be used to blow dirt, chips, or dust from clothing while it is being worn. Compressed air used for other types of cleaning (other than clothing/persons) is to be limited to 30 psig.

4.3.2 The use of blown compressed air is to be controlled, and proper personal protective equipment or safeguards utilized, to protect against the possibility of eye injury to the operator or other persons.

4.3.3 Compressed air or gases are not to be used to empty containers of liquids.

4.3.4 Compressed gases are not to be used to elevate or otherwise transfer any hazardous substance from one container to another unless the containers are designed to withstand the operating gas pressure with a safety factor of at least four.

4.3.5 Compressed cylinders of unknown content will not be opened, but will be returned to the supplier, manufacturer or equivalent.

4.4 Air Compressor Operations

4.4.1 Air compressor equipment should be operated only by authorized and trained employees.

4.4.2 The air intake should be from a clean, outside, fresh air source. Screens or filters can be used to clean the air.

4.4.3 Air compressors should never be operated at speeds faster than the manufacturer's recommendation.

4.4.4 Equipment should not become overheated.

4.4.5 Moving parts, such as compressor flywheels, pulleys, and belts that could be hazardous should be effectively guarded.

4.4.6 Keep the air supplied tools clean and dry. Dust, moisture, and corrosive fumes can damage tools.

4.4.7 Keep tools clean, lubricated, and maintained according to manufacturer's instructions.

4.4.8 Only use attachments and accessories recommended by the manufacturer.

4.4.9 Review the manufacturer's instruction before using a tool.

4.4.10 Post warning signs where pneumatic tools are used.

4.4.11 Set up screens or shields in areas where nearby workers may be exposed to flying fragments, chips, dust, and excessive noise.

4.4.12 Be aware of proper handling and ergonomics while using the tool.

4.4.13 Reduce physical fatigue by supporting heavy tools with a counter-balance wherever possible

4.4.14 Refer to *S3AM-114-ATT1 Compressor Safety* for additional information.

4.5 Air Hoses

4.5.1 Use the proper hose and fittings of the correct diameter.

4.5.2 Use hoses specifically designed to resist abrasion, cutting, crushing and failure from continuous flexing.

4.5.3 Choose air-supply hoses that have a minimum working pressure rating of 1035 kPa (150 psig) or 150% of the maximum pressure produced in the system, whichever is higher.

4.5.4 Check hoses regularly for cuts, bulges and abrasions. Tag and replace, if defective.

4.5.5 Blow out the air line before connecting a tool. Hold hose firmly and blow away from yourself and others.

4.5.6 Make sure that hose connections fit properly and are equipped with a mechanical means of securing the connection (e.g., chain, wire, or positive locking device).

4.5.7 Install quick disconnects of a pressure-release type rather than a disengagement type. Attach the male end of the connector to the tool, NOT the hose.

4.5.8 Do not operate the tool at a pressure above the manufacturer's rating.

4.5.9 Turn off the air pressure to hose when not in use or when changing power tools.

4.5.10 Do not carry a pneumatic tool by its hose.

4.5.11 Do not use compressed air to blow debris or to clean dirt from clothes.

4.5.12 All pipes, hoses, and fittings shall have a rating of the maximum pressure of the compressor. Compressed air pipelines should be identified (psi) as to maximum working pressure.

4.5.13 Air supply shutoff valves should be located (as near as possible) at the point-of-operation.

4.5.14 Air hoses should be kept free of grease and oil to reduce the possibility of deterioration.

4.5.15 Avoid trip hazards. Hoses should not be strung across floors or aisles where they are liable to cause employees to trip and fall. When possible, air supply hoses should be suspended overhead, or otherwise located to afford efficient access and protection against damage.

4.5.16 Hose ends shall be secured to prevent whipping if an accidental cut or break occurs.

4.5.17 Pneumatic impact tools, such as riveting guns, should never be pointed at a person.

4.5.18 Before a pneumatic tool is disconnected (unless it has quick disconnect plugs), the air supply shall be turned off at the control valve and the tool bled.

4.5.19 Shop air used for cleaning should be regulated to15 psi unless equipped with diffuser nozzles to provide lesser pressure.

4.5.20 Goggles, face shields or other eye protection shall be worn by employees using compressed air for cleaning equipment.

4.5.21 Static electricity can be generated through the use of pneumatic tools. This type of equipment shall be grounded or bonded if it is used where fuel, flammable vapors or explosive atmospheres are present.

4.5.22 The following are hazards associated with the use of compressed air tools and equipment:

- Poorly designed tool (wrist strain);
- Vibration (vibration-induced white finger);
- Noise (hearing loss); and
- Dust (respiratory problems).

4.5.23 The following hazards have the potential to cause serious bodily injury when working with compressed air:

- Incorrect tool selection;
- Use of damaged tool;
- Improper, inadequate, or no guards;
- Rotating shaft (entanglement);
- Wheel breakage (grinder);
- Flying chips;
- Whipping of the hose;
- Accidental start up;

- Air embolism (compressed air injected into the body);
- Dropped tool; and
- Tripping over hose.

4.6 Compressed Air Equipment Maintenance

4.6.1 Only authorized and trained employees should service and maintain air compressor equipment.

4.6.2 Exposed, non-current-carrying, metal parts of compressor should be effectively grounded.

4.6.3 Low Flash Point lubricants should not be used on compressors because of its high operating temperatures that could cause a fire or explosion.

4.6.4 Equipment should not be over lubricated.

4.6.5 Gasoline or diesel fuel powered compressors shall not be used indoors.

4.6.6 Equipment placed outside but near buildings should have the exhausts directed away from doors, windows and fresh air intakes.

4.6.7 Soapy water of lye solutions can be used to clean compressor parts of carbon deposits, but kerosene or other flammable substances should not be used. Frequent cleaning is necessary to keep compressors in good working condition.

4.6.8 The air systems should be completely purged after each cleaning.

4.6.9 During maintenance work, the switches of electrically operated compressors should be locked open and tagged to prevent accidental starting.

4.6.10 Portable electric compressors should be disconnected from the power supply before performing maintenance.

4.7 Compressed Gas Cylinder Requirements

4.7.1 Cylinders are not to be used unless they bear Department of Transportation (DOT) or Transportation of Dangerous Goods (TDG) markings showing that they have been tested as required by DOT or TDG regulations.

4.7.2 Cylinders shall never be dropped, struck, or permitted to strike each other violently. Cylinders may be moved by tilting and rolling them on their bottom edges.

4.7.3 Valve protection caps shall always be kept on cylinders when they are being moved or stored, and until ready for use. Caution should be exercised as insects such as spiders, wasps, and bees may be encountered in cylinder caps.

4.7.4 Do not lift cylinders by the valve protection cap.

4.7.5 Cylinder valves are to be kept closed except when gas is being used or when connected to a permanent manifold. Valves of empty cylinders shall be closed.

4.7.6 Cylinders shall never be used as rollers or supports, or for any purpose other than carrying gas.

4.7.7 Valves and regulators shall be inspected for foreign materials such as oil or dirt and deficiencies such as damaged threads or broken gauges. Deficient valves or regulators shall be removed from service and replaced.

4.7.8 Threads on regulator connections or other auxiliary equipment shall be the same as those on the cylinder valve outlet.

4.7.9 Regulators shall be specific to the gas being used and no adapters may be used to connect regulators to cylinders.

4.7.10 When withdrawing cylinder content, open the cylinder valve slowly using the appropriate tool (e.g., manufacturer supplied, non-sparking, etc.). Point the valve opening away from yourself and other persons.

4.7.11 Before a regulator is removed from a cylinder, close the cylinder valve and release all pressure from the regulator. This procedure also serves as a check to confirm that the main cylinder valve is completely closed.

4.7.12 Never hammer the valve wheel in attempting to open or close the valve.

4.7.13 No person, except the owner of the cylinder or person authorized by the owner, shall refill a cylinder (Exceptions to this includes the filling of self-contained breathing apparatus cylinders with Grade D breathing air, or the filling of the [Foxboro] Organic Vapor Analyzer (OVA) hydrogen cylinders). Disposable cylinders shall not be refilled with any material after use of the original contents.

4.7.14 Cylinders of compressed gas shall be stored in areas where they are protected from external heat sources such as flame impingement, intense radiant heat, electric arc, or high-temperature steam lines.

4.7.15 Cylinders are to be stored in an assigned, well-ventilated area, with full and empty cylinders stored separately. Empty cylinders shall be marked ‘empty’.

4.7.16 Stored fuel gases and oxygen cylinders are to be separated by at least 20 feet, or by a fire wall at least 5 feet high that has a fire-resistance rating of at least ½ hour.

4.7.17 Oxygen, nitrogen, helium, or freon cylinders shall only be stored or transported in an upright or horizontal position. Acetylene cylinders shall always be kept in an upright position. All horizontally-placed cylinders are to be secured by chocks or ties to prevent rolling.

4.7.18 Cylinders are to be secured to a fixed object by chain or equivalent fastening device whenever they are placed in an upright position. The protective cap is not to be removed or the cylinder valve opened until the cylinder is secured.

4.7.19 Repair of leaks shall never be attempted on a pressurized system. System pressure should be reduced to atmospheric pressure as rapidly as possible, and the Manager notified immediately.

4.7.20 Compressed gas cylinders shall be legibly marked for the purpose of identifying the gas content with either the chemical or the trade name of the gas. Such marking is to be done by means of stenciling, stamping or labelling, and shall not be readily removable. Whenever practical, the marking is to be located on the shoulder of the cylinder. Positive identification of the gas in any cylinder is required before connecting cylinders for use.

4.7.21 Gas cylinders moved by hoist shall be handled in suitable cradles or job-made “skip” (materials) boxes. Any slings used for this purpose shall be specifically designed for that cylinder handling.

4.7.22 Cylinders shall not be placed where they might form part of an electrical circuit.

4.7.23 Transfer of compressed gases (including acetylene) from one cylinder to another, or mixing of gases in a cylinder, is prohibited.

4.7.24 Oxygen cylinders are never to be stored near:

- Highly combustible materials, especially oil and grease;
- Reserve stocks of acetylene or other fuel gas cylinders; and
- Any other substance likely to cause or accelerate fire.

4.7.25 Compressed oxygen is never to be used:

- As breathing air;
- To purge pipelines, tanks, or any confined area;
- To supply a head-pressure tank;
- In pneumatic tools;
- In oil preheating burners;

- To start internal combustion engines;
- For ventilation;
- For cleaning clothing; and
- In any other way as a substitute for compressed air.

4.7.26 Use of a cylinder's contents for purposes other than those intended by the supplier is prohibited.

4.7.27 Cylinders of compressed natural gas or propane equipped with a pressure relief device shall always be positioned in a manner that this device remains above the liquid level (e.g., if stored or installed horizontally on a forklift, relief device is positioned at the top).

4.7.28 Storage of liquefied petroleum gas (LPG) within buildings is prohibited, and outdoor storage or LPG shall meet applicable building and fire codes.

4.8 Special Precautions for Compressed Gas Cylinders Containing Hydrogen

4.8.1 Inside buildings, cylinders of hydrogen should be separated from oxygen cylinders by a minimum distance of 20 feet (6.1 meters) or by a barrier of non-combustible material at least 5 feet (1.5 meters) high having a fire resistance rating of at least one half hour.

4.8.2 Conspicuous signs should be posted in hydrogen storage areas forbidding smoking, open flames or the use of lights or lighting not approved for use in flammable areas.

4.8.3 Hydrogen storage areas shall be labeled, "Hydrogen-Flammable Gas-No Smoking-No Open Flame" or equivalent.

4.9 Inspection of Compressed Gas Cylinders

4.9.1 Prior to formally accepting any delivered compressed gas cylinders, a visual inspection of each cylinder will be documented as specified below. In addition, all compressed gas cylinders stored at an AECOM facility will be inspected monthly.

- Visually inspect cylinders, refer to *S3AM-114-FM1 Compressed Gas Cylinder Inspection.*
- Verify that all the required markings are on the cylinders.
- If required, determine when the cylinder was last hydrostatically-tested.
- Inspect the safety relief devices, if required.
- If any defects are noted during the inspection, the cylinder should be refused on delivery and a new delivery requested (notify the Manager).

4.9.2 Where compressed gas cylinders are stored at an AECOM facility, a qualified person will be designated to confirm cylinder activities comply with the requirements in this procedure. Inspection entails the evaluation of the integrity of the cylinder as well as the serviceability of any attached manifold and valve fittings. Inspection activities of cylinders beyond visual inspection are recommended to be conducted in isolation or a remote location for worker and public safety. The inspection of any cylinder will be conducted by a qualified person, refer to *S3AM-114-FM1 Compressed Gas Cylinder Inspection*.

4.10 Cylinder Inspection Procedures

4.10.1 All cylinder inspection procedures will adhere to the applicable regulatory requirement. At a minimum, the inspection process will include the following procedures:

- Observe the cylinder from a safe distance to identify any visual markings or other information.
- Inspect the cylinder size, shape, and general condition (if visible, include the valve system/stem in the inspection process).
- If the cylinder or valve system appears to be in poor condition or has lost structural integrity, do not approach the cylinder. Observations indicating a cylinder is in poor condition may include:

- Leaking,
- Hissing sound,
- Odor in vicinity of the cylinder,
- Rusty components,
- Bulging side wall or end, and/or
- Corroded valve system.

4.10.2 If the cylinder is determined to be in poor condition, cordon the area off and limit access to necessary employees only.

4.10.3 Wear applicable PPE and approach the cylinder with the appropriate direct reading air monitoring instrument (do not approach from the ends of the cylinder), then determine the airborne contaminant concentrations in the immediate area.

4.10.4 Document cylinder information (e.g., visible markings, labels, placards, etc.).

4.10.5 Cylinders presenting potential deficiencies (e.g., dent, missing labels, valve protection cap cannot be removed by hand, corrosion, etc.) shall be tagged 'Do Not Use', removed from use, and returned to the supplier.

4.11 Ground Transport of Compressed Gas Cylinders

4.11.1 AECOM will transport (drive/haul) quantities of compressed gases which do not exceed Materials of Trade (MOT) quantities, whereas the transport of placardable quantities is prohibited without the proper DOT / TDG licenses/credentials and consultation with the SH&E Manager.

4.11.2 Compressed gas cylinders in portable service are to be conveyed by suitable trucks, to which they are securely fastened. All gas cylinders in service shall be securely held in substantial racks or secured to other rigid structures so that they will not fall or be knocked over.

4.12 Air/Common Carrier Transport

4.12.1 All shipping of compressed gases via air/common carrier including instrument gases, regardless of quantity, shall be conducted by a qualified and trained HazMat Shipper (Level 1-2 Shipper) or jurisdictional equivalent, and shall conducted under the oversight of a designated DOT/International Air Transport Association (IATA) shipping specialist, or jurisdictional equivalent. Refer to *S3AM-116-PR1 Hazardous Materials Shipping.*

4.12.2 No compressed gas cylinder, regardless of contents or quantity, will be shipped via an external carrier vendor (i.e., UPS, FedEx, etc.) without the authorization of:

- SH&E Manager, and
- DOT/IATA shipping specialist.

4.12.3

4.13 Cylinder Color Coding Determination

4.13.1 The color coding of compressed gas cylinders is established by the Compressed Gas Association, which has assigned specific colors to categories or classes of chemicals/substances. It is important to note there is currently not requirement to adhere to this color coding scheme.

4.13.2 While recently manufactured cylinders reflect the color coding guidance established by the CGA, older cylinders may not reflect this nomenclature. It is also possible for cylinders to have been repainted a different color from their original.

4.13.3 Cylinder contents should <u>never</u> be determined by the color of the cylinder alone. Colors are not uniform throughout the compressed gas industry.

4.13.4 Cylinder contents shall be identified by a decal, label, tag, or stenciling. If an identifying label is lacking or not legible, return the container to the supplier, unused.

4.14 Air Monitoring Requirements

4.14.1 Air monitoring requirements are dependent upon the specific substances contained within the cylinders and will be specified within the site-specific safety plan prepared prior to commencement of field activities. Air monitoring parameters, refer to *S3AM-127-PR1 Exposure Monitoring*, may include, but are not limited to:

- Explosivity (i.e., lower explosive limit [LEL]), and
- Chemical-specific substance (e.g., chlorine, ammonia, arsine, etc.).

4.14.2 Action levels will be identified in the site-specific safety plan.

4.15 Cylinder Staging

4.15.1 Staging involves the organization, and sometimes consolidation, of cylinders that have similar contents or characteristics.

4.15.2 The staging of cylinders will occur in a remote location at the site in order to minimize the potential injury or property damage from an accidental release or emergency decompression (if the integrity of the cylinder is in question, it should not be moved).

4.15.3 Safe distances will be based on the evacuation distances provided in DOT's Emergency Response Guidebook (most current edition).

4.15.4 When multiple cylinders containing different substances are present, the distance should be based on the greatest evacuation distance required by the substances present.

4.16 Cylinder Disposition & Decommissioning Activities

4.16.1 Disposition refers to the recycling, treatment, or disposal of a compressed gas cylinder and/or its contents.

4.16.2 Recovery and recycling of materials are preferred over any other method of disposition. Cylinder disposition activities shall be approved by the SH&E Manager.

4.16.3 An effort should be made to recover and recycle the contents of a cylinder; however, if recovering or recycling the contents is not possible, then other options include:

- Venting to the Atmosphere,
- Flaring,
- Neutralization, and
- Detonation.

4.16.4 Under no circumstances will poisonous, toxic, or ozone-depleting substances be vented to the atmosphere. Only cylinders containing flammable gases should be detonated, as the flammable contents will be consumed in the subsequent explosion.

4.16.5 If the cylinder valve has been determined to be inoperable, then the available options for disposition are limited to having an outside vendor perform the remote opening and sampling of the cylinder, or detonation of the cylinder where the cylinder contents are consumed in the subsequent explosion (flammable gases only).

4.16.6 All cylinders shall be inventoried, staged, and inspected.

4.16.7 Prior to the commencement of cylinder disposition and decommissioning activities, local emergency response agencies (i.e., Fire Department, Medical, and Emergency Response, if separate) shall be confirmed and, as applicable, activities coordinated with the local agencies.

4.16.8 Air monitoring is mandatory during cylinder disposition and decommissioning operations.

4.16.9 A SH&E Manager shall be contacted during the planning stages of a cylinder disposition and decommissioning effort in order to determine whether a site-specific cylinder plan is required.

4.17 Venting to the Atmosphere

4.17.1 Cylinders that contain non-flammable, non-toxic materials can be vented to the atmosphere. All venting activities will be performed in accordance with the following procedures:

- Atmospheric venting will be accomplished at a remote location and in compliance with all applicable environmental air regulatory requirements.
- Atmospheric venting activities will be completed in a Level B Ensemble (unless otherwise specified in the site-specific safety plan and cylinder plan).
- Venting activities will be dependent upon a wind direction that does not carry the outgas plume in the direction of an adjacent public structure.
- The cylinder will be properly grounded to confirm a static charge is not generated, potentially resulting in ignition of a flammable gas.
- All tools used on the cylinder will be non-sparking.
- Low-pressure discharging will not exceed 15 pounds per square inch gauge (psig).
- Once discharging has started, all workers will retreat to the exclusion zone (minimum 100 feet) around the remote location until the discharging process is complete.

4.18 Flaring

4.18.1 Flaring activities involve the combustion of the cylinder contents through the discharge of a low-intensity flame. Flaring activities will be performed in accordance with the following procedures:

- Flaring will be accomplished at a remote location and in compliance with all applicable environmental air regulatory requirements.
- All personnel involved with flaring activities shall be appropriately trained and wear PPE appropriate to the hazards (e.g. Nomex fire-retardant forearm-length gloves, other fire-retardant clothing, self-contained breathing apparatus, etc.).
- Flaring activities will be dependent upon a wind direction that does not carry the combustion plume in the direction of any offsite structure or activity, or into uncontrolled (public access) areas.
- The cylinder will be properly grounded to confirm a static charge is not generated, potentially resulting in ignition of a flammable gas.
- All tools used on the cylinder will be non-sparking.
- Low-pressure discharging will not exceed 15 pounds per square inch gauge (psig).
- A hot work permit shall be completed prior to the start of flaring activities, refer to *S3AM-332-PR1 Hot Work*.
- No other cylinders will be within 50 feet (15.24 meters) of the cylinder being flared.
- Flaring activities will use a low-pressure discharge and maintain a small, low-intensity flame.
- A firewatch will be established, with a worker stationed outside the exclusion zone with a fire extinguisher (20A:100B:C) during flaring activities (i.e., fire watch). During the work the worker assigned to the firewatch will have no other duties.
- The flare will be positioned so that it is not pointing toward any flammable materials, persons, or equipment in the immediate area.

4.19 Neutralization

4.19.1 Neutralization refers to the on-site neutralization of the cylinder contents through a controlled chemical reaction process. Specialized equipment may be necessary based on the chemical involved, as well as reaction by-products, catalysts, or physical conditions (i.e., temperature, acidic, basic, etc.). Neutralization activities will be performed in accordance with the following procedures:

- Neutralization is the required disposition method for cylinders containing acid gases, as well as many alkaline gases.
- The neutralization process shall be approved by a professional engineer (e.g., chemical) or based on a published chemical-specific neutralization methodology.
- Liquid levels in the reaction vessels will be maintained at least 12 inches (30.5 centimeters) below the top of the vessel.
- Based on the specific chemical reaction, the temperature of the reaction vessel and its contents will be monitored continuously and controlled accordingly.
- Pressure levels will be maintained within acceptable limits to prevent the reaction from accelerating, unwanted by-product formation, or the break-through of the chemical intended to be neutralized.
- Employees involved in neutralization activities shall be appropriately trained and wear the PPE identified within the site-specific safety plan and cylinder plan.

4.20 Detonation

4.20.1 Detonation refers to the use of explosives to open and subsequently consume the contents of the cylinder by the heat generated during the explosion. Detonation activities will be performed in accordance with the following procedures:

- All personnel involved with detonation activities shall be appropriately trained and wear PPE appropriate to the hazards (e.g. Nomex fire-retardant forearm-length gloves, other fire-retardant clothing, self-contained breathing apparatus, etc.).
- A detonation plan shall be submitted to and approved by the SH&E Manager prior to the commencement of cylinder detonation activities.
- The detonation of compressed gas cylinders will be completed under the guidance of experienced ordnance and explosives (OE) professional who is licensed in the use of explosives.
- A sufficient amount of explosives will be used to consume the entire contents of the cylinder (flammable gases only).
- A blast pit will be excavated where all detonations will take place.
- The OE professional will determine the blast hazard zone/potential debris impact zone, and this area will be evacuated prior to the detonation.
- The OE professional will sound a warning signal (e.g., horn or equivalent) three times to indicate that a detonation is imminent and confirm all persons have evacuated the blast hazard zone prior to detonation.
- Employees will be on standby outside the blast hazard zone with fire extinguishers (minimum rating of 20A:100B:C).

4.21 Cylinder Decommissioning Operations

4.21.1 Decommissioning refers to the removal of a compressed gas cylinder from service by rendering it permanently unusable.

4.21.2 Prior to decommissioning, cylinder contents will be verified, removed from the cylinder, and the cylinder purged with an inert gas (e.g., nitrogen, carbon dioxide, etc.).

4.21.3 All identifying marks or decals will be removed from the cylinder.

4.21.4 The SH&E Manager shall be contacted prior to the decommissioning of compressed gas cylinders that contain or previously contained:

- Ethylene oxide,

- Arsine,
- Diborane,
- Hydrogen selenide,
- Cyanogen chloride,
- Amines,
- Hydrogen sulfide,
- Acetylene, or
- Methyl mercaptan.

4.21.5 Additional safety precautions may be necessary due to highly reactive residues left behind by these substances.

4.21.6 The recommended methods of decommissioning include:

- Burning/torch-cutting an elongated hole into the side of the cylinder, refer to *S3AM-332-PR1 Hot Work;*
- Torch-cutting the cylinder in half; and
- Crushing the cylinder.

5.0 Records

5.1 None

6.0 Attachments

6.1 S3AM-114-ATT1 Compressor Safety

6.2 S3AM-114-FM1 Compressed Gas Cylinder Inspection

Americas

Compressed Gas Cylinder Inspection

S3AM-114-FM1

Location Inspected: _____ **Job No.:** _____

Date Inspected: _____ **Name of Inspector:** _____

1.	DOT / TDG container specification number present on cylinders.	☐ Yes	☐ No	☐ NA
2.	Proper DOT / TDG shipping name, ID # and hazard class on cylinders.	☐ Yes	☐ No	☐ NA
3.	Manufacturer's name and appropriate hazard warnings present.	☐ Yes	☐ No	☐ NA
4.	Serial number of cylinders and inspectors official mark present.	☐ Yes	☐ No	☐ NA
5.	Most recent hydrostatic test date marked and within 5 years.	☐ Yes	☐ No	☐ NA
6.	Cylinder valve and neck ring free of oil, grease or other foreign matter.	☐ Yes	☐ No	☐ NA
7.	Valve threads clean and in good condition.	☐ Yes	☐ No	☐ NA
8.	Pressure rating of cylinder not exceeded.	☐ Yes	☐ No	☐ NA
9.	Cylinder surface is free of cracks, and dents, gouges, weld defects, etc.	☐ Yes	☐ No	☐ NA
10.	Cylinder surface is free of arc burns and fire burns.	☐ Yes	☐ No	☐ NA
11.	Cylinder cap is present and threaded in place.	☐ Yes	☐ No	☐ NA
12.	Cylinder surface, particularly bottom, is free of excessive corrosion, and pitting.	☐ Yes	☐ No	☐ NA
13.	Cylinders must be capped when regulators are removed.	☐ Yes	☐ No	☐ NA
14.	Oxygen and fuel cylinders are stowed in designated well-ventilated areas.	☐ Yes	☐ No	☐ NA
15.	Storage areas have temperatures less than 125º F (52º C).	☐ Yes	☐ No	☐ NA
16.	Cylinders are stored upright and secured from falling over.	☐ Yes	☐ No	☐ NA
17.	Cylinders are in segregated groups by gas type and not intermingled with other cylinders.	☐ Yes	☐ No	☐ NA
18.	Oxygen cylinders are stored at least 20 feet (6.1 meters) away from flammables. (A fire-resistive partition of at least 1-hour fire-resistance rating of at least 5-foot (1.52 meters) height may be used in lieu of 20 foot [6.1 meter] separation.)	☐ Yes	☐ No	☐ NA
19.	Flammable or combustible materials are kept at least 20 feet (6.1 meters) away from stored cylinders.	☐ Yes	☐ No	☐ NA
20.	Gas cylinder valves are protected from snow and ice during winter months.	☐ Yes	☐ No	☐ NA
21.	Oxygen cylinders are kept free from oil and grease.	☐ Yes	☐ No	☐ NA
22.	Welding cylinders are securely fastened to ready-use racks.	☐ Yes	☐ No	☐ NA
23.	Smoking or open flames are not permitted in areas where cylinders are stored.	☐ Yes	☐ No	☐ NA
24.	Cylinder storage areas are posted with the following sign: “DANGER – NO SMOKING OR OPEN FLAME”.	☐ Yes	☐ No	☐ NA
25.	Cylinders are labeled with gas contents and warning statement.	☐ Yes	☐ No	☐ NA
26.	Empty cylinders are segregated from full cylinders.	☐ Yes	☐ No	☐ NA

Americas

Compressor Safety

S3AM-114-ATT1

1.0 Objective / Overview

1.1 Compressors should be used with extreme caution in order to prevent personal injury.

1.2 When using a compressor it's important to follow the manufacturer's instructions to avoid injuring someone or damaging your compressor.

1.3 Allow only trained, authorized personnel to operate the compressor. Along with training, other safety measures include: proper maintenance of equipment and personal protective equipment.

2.0 Safe Operating Guidelines

2.1 Follow manufactures recommended operating instructions, every compressor is not the same. Maintain adequate ventilation.

2.2 Gas and diesel powered generators emit carbon monoxide (CO). Never operate a fuel-powered compressor in an enclosed building without proper ventilation.

2.3 Turn the compressor off to refuel. Gasoline and its vapors may ignite if they come into contact with hot components or an electrical spark, store fuel in a properly designed container in a secure location.

2.4 Operators shall perform a pre-operational check of all air hoses, couplings, and connections to determine if leakage or other damage exists. Tag unsafe equipment and take out of service immediately.

2.5 Decompress air from the compressor prior to removing any caps or air equipment attachments such as jackhammers, drills, etc.

2.6 Keep oil and flammable material clear of air fittings and joints.

2.7 Make sure connections are secure to avoid a hose coming loose during use.

2.8 To avoid a shock, make sure that your hands are dry and you're standing in a dry place whenever you operate an electrically powered compressor.

2.9 Use only UL-listed, three-prong extension cords. Be sure the extension cord is the proper size (wire-gauge) to handle the electric load that will be plugged into it.

2.10 Have a Class A:B:C fire extinguisher readily available at all times.

3.0 Potential Hazards

3.1 Burns from contact with the hot muffler or engine

3.2 Shocks/electrocution

3.3 Noise exposure

3.4 Inhaling exhaust gases, CO

3.5 Contact with pressurized air

4.0 Training Requirements

4.1 Review of applicable procedures.

4.2 Demonstrated knowledge on the use of the compressor.

4.3 Review of manufacturers operating guidelines.

5.0 Personal Protective Equipment

5.1 Leather Gloves

5.2 Hearing Protection

5.3 Long Sleeve Shirt (e.g., to shield from burns, etc.)

5.4 Refer to *S3AM-208-PR1 Personal Protective Equipment*

Americas

Hazardous Materials Communication

S3AM-115-PR1

1.0 Purpose and Scope

1.1 Provides a Hazard Communication Program so that AECOM employees are informed of the hazards of the chemicals to which they may be exposed in the course of their work by way of container labeling and other forms of warning, safety data sheets (SDS), and employee training.

1.2 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

1.3 The program applies to the use of any hazardous substances which are known to be present in the workplace in such a manner that employees may be exposed under normal conditions of use or in a foreseeable emergency.

1.4 The program does not apply to general consumer products, for example, cleaners, printer toner, white out, etc.

2.0 Terms and Definitions

2.1 **Acute Effect** – An adverse effect on the human body with immediate onset of symptoms.

2.2 **Article** – A manufactured item: (1) which is formed to a specific shape or design during manufacture; (2) which has end use function(s) dependent in whole or in part upon its shape or design during end use; and, (3) which does not release or otherwise result in exposure to, a hazardous chemical, under normal conditions of use.

2.3 **Carcinogen –** Those chemicals appearing in any of the following reference sources are established as carcinogens for hazard communication purposes:

- National Toxicology Program (NTP) Annual Report on Carcinogens.
- International Agency for Research on Cancer (IARC) Monographs, Volumes 1-34. Note: The Registry of Toxic Effects of Chemical Substances published by NIOSH indicates whether a substance has been found by NTP or IARC to be a potential carcinogen.

2.4 **Chemical Name –** The scientific designation of a substance in accordance with the nomenclature system developed by the International Union of Pure and Applied Chemistry or the system developed by the Chemical Abstracts Service.

2.5 **Chronic Effect –** An adverse effect on the human body with symptoms which develop slowly over a long period of time or which frequently recur.

2.6 **Combustible Liquid –** Any liquid having a flash point at or above 100°F (37.8°C) but below 200°F (93.3°C), except any mixture having components with flash points of 200°F (93.3°C), or higher, the total volume of which makes up 99% or more of the total volume of the mixture.

2.7 **Common Name –** Any designation or identification such as code name, code number, trade name or brand name used to identify a substance other than by its chemical name.

2.8 **Container –** Any bag, barrel, bottle, box, can, cylinder, drum, reaction vessel, storage tank or the like that contains a hazardous chemical. For purposes of this procedure, pipes or piping systems, and engines, fuel tanks, or other operating systems in a vehicle are not considered to be containers.

2.9 **Location –** Any separate and distinct AECOM office, laboratory or other company facility.

2.10 **Exposure –** Any situation arising from work operations where an employee may ingest, inhale, absorb through the skin or eyes or otherwise come into contact with a hazardous substance.

2.11 **Flammable –** A substance that falls into one of the following categories:

2.11.1 **Flammable Aerosol** – An aerosol that when tested by the method described in 16 CFR 1500.45, yields a flame projection exceeding 18 inches at full valve opening or flashback (a flame extending back to the valve) at any degree of valve opening.

2.11.2 **Flammable Gas** – A gas that at ambient temperature and pressure:

- Forms a flammable mixture with air at a concentration of 13% of volume or less; or
- Forms a range of flammable mixtures with air wider than 12% by volume, regardless of the lower limit.

2.11.3 **Flammable Liquid** – Any liquid having a flash point below 100°F (37.8°C), except any mixture having components with flash points of 100°F (37.8°C) or higher, the total of which make up 99% or more of the total volume of the mixture**.**

2.11.4 **Flammable Solid** – A solid, including a powdered, granular or pasty mixture of a substance that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change or retained heat from manufacturing or processing or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard**.**

Flammable Solids do not include blasting agents or explosives as defined in 8 CCR 5237(a).

2.12 **Flash Point –** Minimum temperature of a liquid at which it gives off sufficient vapors to form an ignitable mixture with the air near the surface of the liquid or within the container used.

2.13 **GHS** – The Globally Harmonized System of Classification and Labelling of Chemicals developed by the United Nations with the goal of an international system to define and classify the hazards of chemical products, and communicate health and safety information on labels and safety data sheets.

2.14 **Hazardous Chemical –** Those chemicals appearing in any of the following reference sources are established as hazardous chemicals for hazard communication purposes.

- 29 CFR Part 1910, Subpart Z, Toxic and Hazardous Substances, OSHA.
- Hazardous Products Act, R.C.S. 1985, c. H-3, section 2, Canada.
- For operations within the state of California, the list of hazardous substances prepared by the California Director of Industrial Relations pursuant to Labor Code Section 6382. The concentrations and footnotes, which are applicable to the list, shall be understood to modify the same substance on all other source lists or hazard determinations set forth in § 8 CCR 5194(d)(3)(B) and (d)(5)(D).

2.15 **Hazardous Substance –**A hazardous chemical or carcinogen, or a product or mixture containing a hazardous chemical or carcinogen provided that:

2.15.1 The hazardous chemical is 1% or more of the mixture or product or 2% if the hazardous chemical exists as an impurity in the mixture; or

2.15.2 The carcinogen is 0.1% or more of the mixture or product;

2.15.3 Manufacturers, importers and distributors will be relied upon to perform the appropriate hazard determination for the substances they produce or sell.

2.15.4 The following materials are not covered by the Hazard Communication Standard:

- Any hazardous waste as defined by the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, as amended (42 USC 6901 et seq.) when subject to regulations issued under that act by the Environmental Protection Agency.
- Tobacco or tobacco products;
- Wood or wood products. Note: Wood dust is not exempt since the hazards of wood dust are not “self-evident” as are the hazards of wood or wood products;
- Consumer products (including pens, pencils, adhesive tape) used in the work place under typical consumer usage;
- Articles (i.e. plastic chairs);

- Foods, drugs, or cosmetics intended for personal consumption by employees while in the work place;
- Foods, drugs, cosmetics in retail store packaged for retail sale; and
- Any drug in solid form used for direct administration to the patient (i.e., tablets or pills).

Hazardous substance shall be considered the equivalent term to 'controlled substance'.

2.16 **Hazardous Substance Inventory (HSI) / WHMIS Log –** A listing of all chemicals stored or used at an office or project site. Note that the list may be imbedded in a project Health and Safety Plan.

2.17 **Immediate Use –** Means that the hazardous chemical will be under the control of and used only by the person who transfers it from a labeled container and only within the work shift in which it is transferred.

2.18 **National Fire Protection Association (NFPA)** – The NFPA is a trade association that issues standards and codes concerning risks associated with fire. A system of categories has been established by NFPA standard 704; colors and numbers, to provide basic hazard information concerning hazardous materials. It enables firefighters and other emergency personnel to easily decide whether or not to evacuate an area or proceed with emergency control operations. The three principal categories of identification are Health, Flammability and Instability. A numerical range of "0 to 4" indicates the severity of the hazard. A "4" indicates the most severe and a "0" indicates a minimal hazard. Refer to *S3AM-115-ATT1 Pictograms &Sample Labels* for an example.

2.19 **Mixture –** Any solution or intimate admixture of two or more substances which do not react chemically with each other.

2.20 **Reactivity** – A measure of the tendency of a substance to undergo chemical reaction with the release of energy.

2.21 **SDS –** A Safety Data Sheet prepared pursuant to state and federal regulations, OSHA Form 174 and Canada regulations (Hazardous Products Act & Regulation).

2.22 **SDS Administrator –** The individual or group designated by the Office Manager (Operations) or Project Manager to maintain the location-specific inventory list or log and the SDS binder required if that location uses or stores hazardous substances.

2.23 **Solubility –** The ability of substance to blend and mix uniformly with another.

2.24 **Specific Gravity (density) –** Ratio of the weight of a substance to the weight of the same volume of another substance. As used in this directive, specific gravity or density refers to the weight of substance as compared to the weight of an equal volume of water.

2.25 **Vapor Density –** The weight of a vapor-air mixture resulting from the vaporization of a volatile liquid at equilibrium temperature and pressure conditions, as compared with the weight of an equal volume of air under the same conditions.

2.26 **WHMIS –** The Workplace Hazardous Materials Information System (WHMIS) is Canada's national hazard communication standard. The key elements of the system are cautionary labeling of containers of WHMIS "controlled products", the provision of safety data sheets (SDSs) and worker education and training programs.

3.0 References

3.1 Additional definitions can be found in the Globally Harmonized System of Classification and Labelling of Chemicals (GHS), Hazardous Material Regulations (HMR), the Transportation of Dangerous Goods (TDG) Regulations, and the International Air Transport Association (IATA) Dangerous Goods Regulation (DGR).

3.2 S3AM-003-PR1 SH&E Training

3.3 S3AM-117-PR1 Hazardous Waste Operations

3.4 S3AM-208-PR1 Personal Protective Equipment

3.5 S3AM-209-PR1 Risk Assessment & Management

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **SH&E Manager / SH&E Department**

- Audit their regional offices to confirm that they maintain a location-specific Hazardous Substance Inventory (HSI).
- Audit their regional offices to confirm that if a location-specific HSI is required, that current SDSs are available for each substance listed on the HSI.
- Provide interpretation of SDSs and hazard information for GHS labels/WHMIS labels/NFPA labels and other information to assist in training employees.
- Provide hazard communication training to AECOM employees and file documentation related to this training (e.g. trainer name, date trained, brief description of training, etc.).
- Review SDS for adequacy of completion to meet the OSHA and Canadian standard and returning them to supplier, if necessary.

4.1.2 **Manager / Site Safety Officer (SSO) / Supervisor**

- Have an operations-specific, written hazard communication program which at least describes how the requirements of this Procedure and the US OSHA and Canadian Hazard Communication requirements for labels and other forms of warning, safety data sheets, and employee information and training will be met.
- Appoint an SDS administrator for their location if they store or use hazardous substances.
- Confirm, if required, that the SDS Administrator maintains an HSI for their location.
- Confirm that a copy of this Procedure and the site-specific SDS are available to all employees (and/or their designated representative). Employees shall be instructed in the location of this Procedure and the SDSs.
- Confirm that all employees (including new employees) under their supervision have received the appropriate training required by this procedure prior to assigning employees to tasks involving the use of, or potential exposure to, hazardous substances.
- Notify employees of hazardous substances covered by this procedure that are used in their work area.
- Determine the potential fire, toxic, or reactivity hazards which are likely to be encountered in the handling or utilization of a hazardous substance and will communicate this information to their affected employees, before any are permitted to work with it.
- Confirm that a current SDS (is replaced as new versions are issued) is available for each hazardous substance used, or potentially encountered, in the work areas or on the projects that are under their supervision.
- Confirm hazardous substances are properly labelled.
- Notify subcontractors (working for AECOM) of any hazardous substances that are used or stored by AECOM to which the subcontractor’s employees may be exposed.
- Notify clients or property owner/operators of chemicals brought onto their property by AECOM or AECOM’s subcontractors.
- Request SDSs from all subcontractor organization for the relevant chemicals they bring onto an AECOM controlled site.
- Access or obtain, and maintain copies of SDS from:

- The product manufacturer or supplier;
- All AECOM subcontractors bringing chemicals onto the project site; and
- The client, for all of the client's chemicals to which AECOM or AECOM subcontract employees are potentially exposed.

4.1.3 **Employee**

- Confirm that they have received appropriate hazard communication training prior to working with materials that fall under the procedure.
- Only work with materials for which they have been instructed on how to find an SDS and how to work with that material safely.
- Utilize the appropriate Personal Protective Equipment (PPE) and spill containment materials as per the SDS.
- Provide a copy of all SDSs received to the SDS Administrator at their facility.
- Verify that an SDS is available in their work area for each hazardous substance that they use.

4.2 General Procedure

4.2.1 Confirm that containers of hazardous substances that they use are properly labelled. All employees have a right to, and should, know the properties and potential hazards of substances to which they may be exposed.

4.2.2 Should AECOM assign employees that do not read and speak English to tasks with chemical exposures, communications will be provided in the language understood by that employee.

4.3 Employee Information and Training

4.3.1 Training of employees on hazardous substances in their work area shall be conducted:

- At the time of their initial assignment;
- Whenever a new hazardous substance is introduced into their work area; and
- According to jurisdictional requirements (e.g., GHS, WHMIS, etc.).

4.3.2 As a minimum, the training requirements apply to employees in the following job categories:

- All employees who perform field work that involves the use of, shipping / receiving of, or potential exposure to, hazardous substances covered under the OSHA Hazard Communication Standard and WHMIS; and
- Laboratory Employees.

4.3.3 The Initial Training will provide instruction in the following:

- Methods and observations that may be used to detect the presence or release of a hazardous substance in the work area (such as personal monitoring, visual appearance or odor of hazardous substances being released, etc.);
- The physical and health hazards of substances in the work area and measures and procedures AECOM has implemented to protect employees; and
- The details of this hazard communication program, including an explanation of the labelling system and the SDS, and how he/she can obtain and use appropriate hazard information;
- Any operations in their work area in which hazardous substances are present;
- Location and availability of this written hazard communications program (this procedure);
- Their right to personally receive information regarding hazardous substances to which they may be exposed;

- Their right to have their physician receive information regarding hazardous substances to which they may be exposed; and
- Any relevant jurisdictional regulation, such as an employee's right against discharge or other discrimination (in California) due to the employee's exercise of rights afforded pursuant to provisions of the California Hazardous Substances Information and Training Act.

4.3.4 Periodic Training and Training for Non-Routine Tasks

Additional training will be provided to employees who have received initial training whenever:

- A new hazardous substance is introduced into their work area;
- A new or significantly increased risk has been identified related to an existing hazardous substance (e.g. as identified in an updated SDS); and
- Non-routine tasks are performed, which will potentially result in exposure to hazardous substances, or exposure under circumstances, which were not addressed during initial training.

Supervisors, in coordination with their SH&E Manager, shall provide such training through an explanation of the information on the contents of the SDS for that substance.

When training their employees, supervisors shall explain:

- Any health hazards associated with use of the substance or mixture;
- Proper precautions for handling;
- Necessary personal protective equipment or other safety precautions to prevent or minimize exposure; and
- Emergency procedures for spills, fire, disposal, and first aid.

For most projects involving field work, this periodic training requirement will be facilitated through the implementation of the site specific SH&E Plan that has been developed for the project.

4.3.5 Documentation of Initial and Periodic Training

- All training required shall be documented at the time it is performed by having the employee sign a copy of a training attendance sheet.

4.4 Hazardous Waste Exemption

4.4.1 In the U.S., hazardous wastes are excluded from the state and federal Hazard Communication standards. AECOM employees who handle or are otherwise exposed to hazardous wastes are covered by the requirements of the Resource Conservation and Recovery Act (RCRA) and other local waste related laws and regulations and the OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) standard at 29 CFR 1910.120 and *S3AM-117-PR1 Hazardous Waste Operations.*

4.5 Hazardous Substance Inventory and Chemical Usage

Establishment of a Specific Hazardous Substance Inventory (HSI) or WHMIS Log, as referenced or contained within the safe to work plan, refer *S3AM-209-PR1 Risk Assessment & Management*, shall include:

4.5.1 If an AECOM location uses or stores additional hazardous substances, a location-specific HSI or WHMIS Log shall be maintained at that location.

4.5.2 If it is determined that an office-specific HSI is needed, the Manager shall confirm that one is developed and maintained by someone appointed as the location's SDS Administrator.

4.5.3 The HSI or WHMIS Log may be hard copy or managed through an electronic SDS management system.

4.5.4 The content of the HSI or WHMIS Log shall be updated as new hazardous substances are procured for, or removed from the location, and shall be verified by the SH&E Manager through regular inspections of the location.

4.5.5 In order to meet the 30-years-after-employment-termination record retention requirement, the office or project specific HSIs shall be managed as a permanent record.

Prior to using any chemical, a Task Hazard Analysis (THA) shall be completed by the employees assigned to use the chemical. The analysis will identify the hazards associated with the chemical (e.g. review the SDS to identify carcinogens or extremely hazardous chemicals), the tasks to be performed, and prescribe the Personal Protective Equipment (PPE) to be used, refer to *S3AM-208-PR1 Personal Protective Equipment.*

4.6 Safety Data Sheets (SDS)

4.6.1 Location-Specific SDS Inventory

- If it is determined that an AECOM location is required to maintain a location-specific inventory SDSs for the specific hazardous substances shall be maintained on file at that location.
- The SH&E Manager shall audit the local office or project for SDS request and maintenance and report deficiencies to the appropriate management level, as necessary, to confirm compliance with this procedure.

4.6.2 Field Project Sites and Client Facilities

- The Project Manager and/or the Site Safety Officer shall access or obtain, and maintain copies of SDS from:
  - The product manufacturer or supplier;
  - All AECOM subcontractors bringing chemicals onto the project site; and
  - The client, for all of the client's chemicals to which AECOM or AECOM subcontract employees are potentially exposed.

4.6.3 Employee Access to SDSs

SDSs should be maintained at the local location that uses that hazardous substance. Copies of this program and the SDS should be made available to the employee upon request to the office's SDS Administrator.

4.6.4 Field Access to SDSs

When hazardous substances are brought into the field, the user shall confirm that a copy of the SDS for that substance accompanies it and is available at the field location where it is to be used.

4.6.5 SDSs for AECOM Products

It is unlikely that AECOM activities would create a chemical for which a new SDS were needed. If such a chemical were created, the SH&E Department shall work with the appropriate operations groups to draft, review, and publish the new SDS.

4.6.6 Content of the SDS:

- Safety Data Sheets, previously referred to as Material Safety Data Sheets, will now require a 16-section format that is essentially the same as the ANSI standard for Hazardous Workplace Chemicals-Hazard Evaluation and Safety Data Sheets and Precautionary Labeling Preparation (ANSI Z400.1 & Z129.1 – 2010).
- Section 1, Identification includes product identifier; manufacturer or distributor name, address, phone number; emergency phone number; recommended use; restrictions on use.
- Section 2, Hazard(s) identification includes all information regarding the hazards of the chemical and the appropriate warning information associated with the hazards including classification, signal word, hazard statement, pictograms, and precautionary statement.

- Section 3, Composition/information on ingredients includes information on chemical ingredients; trade secret claims.
- Section 4, First-aid measures includes important symptoms/ effects, acute, delayed; required treatment.
- Section 5, Fire-fighting measures lists suitable extinguishing techniques, equipment; chemical hazards from fire.
- Section 6, Accidental release measures lists emergency procedures; protective equipment; proper methods of containment and cleanup.
- Section 7, Handling and storage lists precautions for safe handling and storage, including incompatibilities.
- Section 8, Exposure controls/personal protection lists OSHA's Permissible Exposure Limits (PELs); Threshold Limit Values (TLVs); appropriate engineering controls; personal protective equipment (PPE).
- Section 9, lists the physical and chemical properties of the hazardous substance.
- Section 10, Stability and reactivity lists chemical stability and possibility of hazardous reactions.
- Section 11, Toxicological information includes routes of exposure; related symptoms, acute and chronic effects; numerical measures of toxicity.
- Section 12, Ecological information
- Section 13, Disposal considerations
- Section 14, Transport information
- Section 15, Regulatory information
- Section 16, Other information, includes the date of preparation or last revision.

SDSs that do not contain this information shall be returned to the distributor or manufacturer to be updated.

4.6.7 Trade Secrets

Some hazardous substance suppliers may claim the information requested on SDSs is proprietary and not provide the information to AECOM.

When SDSs supplied to the SH&E Manager indicate that proprietary information has been withheld, the SH&E Manager will either obtain the necessary information to make a hazard assessment or reject the material for use within AECOM.

4.6.8 For Canadian operations, all relevant SDS shall be current (no more than 3 years old) and readily available (in French and English) for all hazardous materials.

4.7 Labeling

4.7.1 Containers of hazardous substances used or stored in each AECOM location shall be labeled, tagged or marked with the following information:

- Product name or Identifier;
- Hazard Pictogram;
- Signal Word;
- Physical, Health, Environmental Statements;
- Supplemental Information;
- Precautionary Measures and Pictograms;

- First Aid Statements;
- Name and Address of Company; and
- Telephone Number.

4.7.2 Refer to *S3AM-115-ATT1 Pictograms & Sample Labels*.

4.7.3 Labels on containers shall not be removed or defaced. Labels or other forms of warning shall be legible, in English and French (Canada), and prominently displayed on the container.

4.7.4 Formal and informal inspections shall include observing that hazardous materials are properly labeled.

4.7.5 Immediately replace lost or illegible labels provided the product can be conclusively identified. Any failure to have the appropriate labeling information on a container at any time, or illegible or missing labels will be cause to suspend use of the product until the product is conclusively identified and is properly labeled.

4.7.6 Carcinogen Labeling

Chemicals which have been indicated as positive or suspect carcinogens by either OSHA, ACGIH, the International Agency for Research on Cancer (IARC) (World Health Organization), or the National Toxicology Program (NTP) will be considered to be carcinogenic for purpose of the HCS.

4.7.7 Stationary Process Containers

If there is stationary process equipment within a work area (e.g., vessels, piping systems, etc.), signs, placards, pictograms, process sheets, batch tickets, operating procedures, or other such written materials may be used in lieu of fixed labels on the containers, as long as the alternative method conveys the appropriate hazard information. The written materials shall be readily accessible to the employees in the work area.

4.7.8 Portable Containers

Portable containers of hazardous substances need not be labelled when the substance is transferred from labelled containers and will be used immediately by the employee who performs the transfer, however the container shall still contain the product identifier (name). Immediate use means the container will remain in the employee's immediate possession and direct oversight until the container is fully emptied or contents are returned to a labelled container.

Containers of hazardous substances transferred from labelled containers and not intended for the immediate use of the employee performing the transfer shall be labelled with the chemical name and a hazard warning label meeting workplace label requirements in accordance with the OSHA Hazard Communication Standard or WHMIS (as applicable to the given jurisdiction).

4.8 Chemical Storage

4.8.1 Hazardous chemicals are to be stored in labeled containers with the lids securely closed using appropriate undamaged caps or lids. Confirm liners are in place if used.

4.8.2 Flammable and combustible materials shall be stored in fire impervious cabinets in designated stockroom areas. Chemicals shall be stored in compliance with instructions provided on their labels, SDS, or the manufacturer's specifications (e.g. compatibility with other substances, environmental conditions, etc.).

NOTE: Flammable gases or other compressed gases should not be stored in flammable material cabinets as these cabinets are not designed for containment of pressurized gases.

4.8.3 All hazardous chemicals shall be stored in a manner that prevents spillage and leakage from exposing people or the environment to the chemical.

4.8.4 Hazardous chemicals shall not be stored with foods or beverages. Food and beverages shall not be consumed in areas where hazardous chemicals are used or stored.

4.9 Chemical Use in Offices

4.9.1 In general, hazardous substances should not be taken into office areas, conference rooms, or break areas, contact the SH&E Manager for guidance if this general requirement is infeasible.

4.9.2 General exceptions to this rule are the following:

- Liquid paper;
- Toner;
- Cleaners;
- Isobutylene calibration gas; and
- pH calibration solutions for instruments.

4.9.3 Each office or location using or storing hazardous materials will develop a written office/ location-specific Hazard Communication/WHMIS Program.

4.9.4 If the local office decides to implement the requirements of the standard in any way that differs from this procedure, they shall verify the changes with the SH&E Manager, document the changes, and communicate the differences to all affected employees.

4.10 Canada-specific

4.10.1 Consumer products are exempt from supplier labels and SDS requirements. Some cleaning solvents may be packaged as consumer products and these shall be labeled in accordance with the Consumer Product Act requirements.

4.10.2 In addition to the labelling of storage containers in the workplace, the contents of process piping (including valves), process vessels and reaction vessels are required to be identified through the use of colour coding, labels, placards or other modes of identifications that shall be communicated to workers through training programs. It is important for employees to be aware of and understand Client labelling requirements for these types of process systems.

5.0 Records

5.1 HSI or WHMIS Logs shall be retained in project or office files for a minimum of 30 years or according to jurisdictional requirements.

5.2 Training documentation shall be retained in accordance with *S3AM-003-PR SH&E Training*.

6.0 Attachments

6.1 S3AM-115-ATT1 Pictograms & Sample Labels

Americas

Hazardous Materials Shipping

S3AM-116-PR1

1.0 Purpose and Scope

1.1 This procedure prescribes the minimum requirements for shipping samples, hazardous materials (HzM) and dangerous goods. These minimum requirements are intended to prevent shipping-related incidents and prevent injuries to employees, members of the public, and emergency response personnel. This procedure is also designed to provide a framework for compliance with the requirements of:

- The U.S. Department of Transportation (DOT) Hazardous Materials Regulations (HMR) published under 49 CFR;
- Transport Canada Transportation of Dangerous Goods Regulations (TDG Regulations) for shipment of hazardous materials/dangerous goods by land;
- The International Air Transportation Association (IATA) Dangerous Goods Regulations (DGR) for shipping dangerous goods by air; and
- Other related regulations applicable to the Americas.

1.2 This document is not a replacement for the regulatory requirements, but is intended to provide information surrounding the shipment of HzM and/or Dangerous Goods.

1.3 Examples of hazardous materials / dangerous goods regulated by the DOT and IATA that may be encountered or used during AECOM business may include, but are not limited to, certain field environmental samples, compressed gases (fire extinguishers, calibration gases, compressed air, and welding and cutting gases), ionizing radiation sources used to calibrate detection equipment or analytical equipment, nuclear-density meters, laboratory reagents, hazardous wastes, materials used for bench-scale and pilot plant operations, oils, greases, lubricating fluids, cleaning solvents, degreasing solvents, paints, spray paints, paint removers and/or strippers, diesel fuel, gasoline, pesticides, inks, glues and other adhesives, battery fluids, ammonia cleaning solutions, and peroxide solutions.

1.4 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

A complete list of definitions can be found in their entirety in the HMR, the TDG Regulations, and the IATA DGR. The terms and definitions below are representative of those most likely applicable to AECOM operations.

2.1 **Agency Letter** – A letter approved by both AECOM's Legal Department and the client and that authorizes AECOM to act as its agent for the purpose of arranging for the transport and/or disposal of waste, and indemnifies AECOM's liability when acting "As an Agent of [client's name]".

2.2 **Carrier** – Also called the transporter. A person engaged in the transportation of passengers or property by land, water, or air either as a common, contract, private carrier, or civil aircraft.

2.3 **Consignor** – Also referred to as **Offeror**. The person who, prior to offering goods for transport, performs functions including selecting packaging, classifying hazardous materials, physical transfer (not to be confused with transport) of hazardous materials, preparing shipping papers, signing hazardous material certifications on shipping papers (as agent for), marking or placarding vehicles or packagings, or providing placards to carriers. See also **Generator**.

2.4 **Consignee** – Also called the receiver. The person or place shown on a shipping document, package marking, or other media as the location to which a carrier is directed to transport a hazardous material.

2.5 **Dangerous Goods** – Products, substances, or organisms which are capable of posing a risk to health, safety, property, or the environment and which are shown in the list of dangerous goods in the TDG Regulations and/or IATA DGR or which are classified according to the TDG Regulations and/or IATA DGR, generally synonymous with hazardous materials.

2.6 **Delegation of Authority (DoA)** – The framework of authority within which AECOM (Americas) carries out its day-to-day operations.

2.7 **Generator** – Any person, by site, whose act or process created the hazardous waste; hazardous waste generators are divided into categories based on the amount of waste they produce each month. A generator may also be a referred to as a **Consignor** when offering the hazardous waste for transport.

2.8 **Hazardous Materials (HzM)** – A substance or material which has been determined by the U.S. Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and includes hazardous substances, hazardous wastes, marine pollutants, and elevated temperature materials. Hazardous materials may include, but are not limited to: batteries, adhesives, paints, compressed gases, nuclear density meters, laboratory reagents, field samples, soil and sand siftings, hazardous wastes, and materials used for bench scale and pilot plant operations. While most environmental samples (both water and soil) do not meet the definition of hazardous material, extreme care must be taken to properly classify materials. HzM Classifications:

- Class 1 Explosives
- Class 2 Gases
- Class 3 Flammable Liquid and Combustible Liquid
- Class 4 Flammable Solid, Spontaneously Combustible, and Dangerous When Wet
- Class 5 Oxidizer, Organic Peroxide
- Class 6 Poison (Toxic), Poison Inhalation Hazard, Infectious Substance
- Class 7 Radioactive
- Class 8 Corrosive
- Class 9 Miscellaneous Hazardous Material.

2.9 **Hazardous Waste (HzW)** – A “solid waste” which because of its quantity, concentration, or physical, chemical, or infectious characteristics may

(1) pose a substantial hazard or potential hazard to human health or the environment when improperly treated, stored or disposed of, or otherwise mismanaged; or

(2) cause or contribute to an increase in mortality, or an increase in irreversible or incapacitating illness.

Four types of hazardous waste exist:

- Listed Waste: Wastes that USEPA has determined are hazardous. The lists include the F-list (waste from common manufacturing and industrial processes), K-list (wastes from specific industries), and P- and U-lists (wastes from commercial chemical products);
- Characterized Wastes: Wastes that do not meet any of the listings above but that exhibit ignitability, corrosivity, reactivity, or toxicity;
- Universal Wastes: Batteries, pesticides, mercury-containing equipment and lamps;
- Mixed Wastes: Waste that contains both radioactive and hazardous waste components.

2.10 **Hazardous Waste Manifest System** – A set of forms, reports, and procedures designed to track hazardous waste from the time it leaves the generator facility where it was produced, until it reaches the off-site waste management facility that will store, treat, or dispose of the hazardous waste.

2.11 **HzM Employee** – A person who is employed by a HzM employer, who in the course of employment directly affects dangerous goods/hazardous materials transportation safety. This term includes employees who prepare hazardous materials for transportation, or are responsible for safety of transporting hazardous materials.

2.12 **HzM Employer** – A person who uses one or more of its employees in connection with transporting dangerous goods/hazardous materials in commerce, causing hazardous materials to be transported or shipping in commerce.

2.13 **HMR** – Hazardous Material Regulation.

2.14 **IATA** – International Air Transport Association.

2.15 **ICAO** – International Civil Aviation Organization.

2.16 **Hazardous Waste Manifest** – A paper document that contains information on the type and quantity of the waste being transported, instructions for handling the waste, and signature lines for all parties involved in the disposal process, which must be signed by each party that handles the waste.

2.17 **Materials of Trade (MOT)** – A hazardous material, other than a hazardous waste, that is carried on a motor vehicle:

- For the purpose of protecting the health and safety of the motor vehicle operator or passengers;
- For the purpose of supporting the operation or maintenance of a motor vehicle (including its auxiliary equipment); or
- By a private motor carrier in direct support of a principal business that is other than transportation by motor vehicle.
- Refer to *S3AM-116-ATT1 Materials of Trade Limits.*

2.18 **NAPL** – Non-aqueous phase liquid

2.19 **Offeror** – Refer to **Consignor**.

2.20 **Reportable Quantity (RQ)** – The spill-related or incident-related quantity of a material listed in the applicable Federal, State, or Provincial regulations requiring a formal report.

2.21 **TDG** – Transportation of Dangerous Good – Canadian Act and Regulation.

2.22 **Transporter** – Refer to **Carrier.**

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-004-PR1 Incident Reporting, Notification & Investigation

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager / Supervisor**

- Verifying the potential to ship HzM via a carrier during the planned scope of services and if confirmed, identify the appropriately trained individuals are available to support the HzM shipment;
- Prior to authorizing an AECOM employee to sign a client's Hazardous Waste Manifest, the Manager will:
    - Verify with the Office of Risk Management that the necessary Delegations of Authority (DoA), Americas approvals are in-place.

- Obtain an Agency Letter approved by both the client and AECOM Counsel.

- Prior to assignment, confirm that employees are properly trained to perform their job-specific assignments.
- Filing copies of all HzM shipping documents in the associated program or project files.
- As applicable, providing for the appropriate storage of the HzM in the office or other necessary location.
- Verifying that the HzM to be shipped is prepared / packaged by the designated AECOM DOT Level 1 or 2 Shipper (United States), appropriately TDG trained personnel (Canada), or personnel trained to the requirements of the applicable jurisdiction, type of HzM and method of transport.
- Immediately reporting any incident, spill, release, mishandling, mislabeling, etc. related to an HzM shipment to AECOM's Incident Reporting Line, refer to *S3AM-004-PR1 Incident Reporting, Notifications & Investigations*.

4.1.2 **SH&E Department**

- Contracting a 24-hour emergency response service with a telephone number that will be answered by a person either with information on the hazards of the shipment or with immediate access to such a person.
- Maintaining the annual renewal of AECOM's U.S. DOT Hazardous Materials Registration and applicable renewals of Canadian TDG Permits.
- Posting AECOM's Hazardous Materials Registration and Permits on the AECOM intranet.
- Defining the training to be required of employees involved in HzM shipping and facilitating the delivery of that training.

4.1.3 **SH&E Manager**

- Providing resources to employees involved in shipping hazardous materials.
- Approving the designation of a AECOM DOT Level 2 Shipper (United States).
- Supporting the delivery of HzM shipping and Hazardous Waste Manifest training.

4.1.4 **Counsel**

- Reviewing and approving the Agency Letter authorizing AECOM to sign a client's Hazardous Waste Manifest "As an Agent of [client's name]".
- Updating the template Agency Letter to address additional liabilities, as necessary.
- Providing the template Agency Letter to Managers, as requested.

4.1.5 **Office of Risk Management**

- Supporting Managers in understanding the applicable *Sub-Delegations of Authority, Americas* requirements as it pertains to signing a client's Hazardous Waste Manifest "As an Agent of [client's name]".

4.1.6 **Employee**

- Completing training appropriate to role(s) in hazardous materials shipping.
- Shipping or transporting HzM as authorized and in compliance with training.
- Signing a client's Hazardous Waste Manifest as authorized.
- Immediately reporting any incident, spill, release, mishandling, mislabeling, etc. related to a HzM shipment to the Manager or Supervisor and in accordance with *S3AM-004-PR1 Incident Reporting, Notifications & Investigations*.

- As required and applicable, initiating emergency response procedures.

4.1.7 **AECOM DOT Level 1 Shipper (United States)**

- Identifying, with the support of an AECOM DOT Level 2 Shipper, the appropriate HzM shipping requirements (e.g., mode of transportation, packaging, labelling, regulated status, and shipping documents, etc.).
- Preparing the HzM for shipment (e.g., packaging, labelling, etc.).
- Preparing the necessary HzM shipping documents.
- Contacting a AECOM DOT Level 2 Shipper if uncertain of the shipping requirements.
- Maintaining the appropriate training as required by the HMR, TDG, and IATA.

4.1.8 **AECOM DOT Level 2 Shipper (United States)**

- Serving as the HzM shipping Subject Matter Expert for the Geography, Business Group, or business unit, as appropriate.
- Supporting information requests from AECOM DOT Level I Shippers.

4.2 General Requirements

4.2.1 Do not offer packages for shipment without knowing the contents and classifying the packages in accordance with the DOT or TDG requirements, and, if applicable, IATA regulations.

4.2.2 Select the best way to ship the hazardous material based on the quantity, hazard(s), and mode of transportation (e.g., air, land, water). When possible, only use ground carriers for transportation of hazardous material, since more restrictive requirements apply to air shipments.

- The air shipment of environmental samples represents a significant percentage of hazardous materials/dangerous goods shipped by AECOM.
- Although most environmental samples (both water and soil) do not meet the definition of hazardous, extreme care must be taken to properly classify materials.
- AECOM employees must follow the IATA Dangerous Goods Regulations for any air transportation of hazardous materials.

4.2.3 Employees trained and designated as AECOM HzM DOT Level 1 or 2 Shippers (United States), appropriately TDG trained personnel (Canada), or personnel trained to the requirements of the applicable jurisdiction, are the only individuals authorized to physically transport or prepare documents to ship HzM via a carrier.

- Employees shall confirm training documentation is valid and readily available when handling or transporting dangerous goods.

4.2.4 Shipments of HzM must be placed in appropriate containers to prevent any leaks or releases of the HzM. Containers of dangerous materials, no matter what shape or size, shall be labeled;

- Specific packaging and shipping instructions apply to all hazardous material shipments. These instructions vary by chemical/product and are different for passenger aircraft and cargo aircraft.
    - Carrier-specific requirements can be obtained from the Internet or by calling the carrier's customer service line.
- Carrier (transporter) shall confirm cargo is securely loaded, properly segregated and free of leaks prior to departure.
- Carrier (transporter) shall refuse consignments of hazardous materials that are offered for transport that do not meet the requirements of the applicable regulations.

- Vehicles that transport dangerous materials as per regulations shall appropriately display the applicable placards (e.g. correct placard(s), clean and in appropriate locations) and any other required information (e.g. motor vehicle carrier number, etc.).
- Carrier (transporter) shall replace any marks that are damaged or lost while in transport.

4.2.5 Proper shipping documents or the appropriate exemption Permit, must accompany every shipment of dangerous materials.

4.2.6 Specific technical names must be used on shipping documents (i.e., Shipper's Declaration for Dangerous Goods); never use an acronym (i.e., LNAPL) as the technical name.

4.2.7 AECOM has selected INFOTRAC® (http://www.infotrac.net/) to provide 24-hour emergency response support service in the United States and Canada. All HzM shipping papers which list INFOTRAC® for 24-hour emergency response must list AECOM's account number 74984.

- All HzM shipments via a carrier must be reported to INFOTRAC.

4.2.8 If AECOM is the consignor (shipper or generator), registration with CANUTEC (Canada) to provide 24-hour emergency contact is permitted and shall be confirmed prior to shipment. If AECOM is listed on the shipping document (Canada) as carrier (transporter) only, registration with CANUTEC does not apply, and an alternate 24-hour emergency number shall be in place (e.g. INFOTRAC).

- Emergency response procedures applicable to the dangerous materials transported shall be developed and followed in the event of an incident.
- Employees shall be appropriately trained to these procedures, AECOM incident reporting requirements (refer to *S3AM-004-PR1 Incident Reporting, Notification & Investigation*) and any applicable external reporting requirements.
- A copy of applicable emergency response information should be supplied with the shipping papers for responders to use in emergency situations (e.g. Canada – Emergency Response Assistance Plan [ERAP, appropriate pages from the DOT Emergency Response Guidebook [ERG], and/or Safety Data Sheets [SDS]).
- The external reporting requirements and to which agency or body, as specified in regulation, vary according to jurisdiction and the class of the goods spilled, released, lost, stolen or misplaced (e.g. local authorities or police, National Response Center, Center for Disease Control, etc.).
    - External reporting requirements for spills, releases, loss, theft or misplacement of hazardous materials are dependent upon the quantities or levels of the hazardous materials involved in the incident.
- AECOM shall submit a written report of all incidents involving the transportation of hazardous materials as required to all appropriate entities, that could include:
    - The U.S. Department of Transportation;
    - U.S. National Response Center
    - Transport Canada within 30 days of a reportable occurrence (Dangerous Occurrence Report); or
    - Any other agency as required by regulation.
- Report in any other manner as specified by the applicable jurisdiction.

4.2.9 Employees are not authorized to physically transport HzM quantities, in a motor vehicle, in excess of the MOT limits. Refer to *S3AM-116-ATT1 Materials of Trade Limits*.

4.2.10 Carrier (transporter) shall inspect for transportation of dangerous materials compliance as a part of vehicle inspections.

4.2.11 AECOM will never be identified as the GENERATOR on a client's Hazardous Waste Manifest.

- Employees are only authorized to sign a client's Hazardous Waste Manifest if:

- The necessary approvals have been obtained per the *Sub-Delegations of Authority, Americas*;
- The client could not logistically sign the manifest given they were not on the site;
- An Agency Letter was signed by the client and approved by AECOM Counsel; and
- Employees completed the required training.

- Never sign a client's Hazardous Waste Manifest as AECOM; sign "As an Agent of [client name]".

4.2.12 Carrier (transporter) shall transport materials using identified "Dangerous Goods Routes" as applicable.

4.2.13 Carrier (transporter) shall verify that trans-national movement of waste meets requirements of the Basel Convention, as well as appropriate internationally recognized standards for the mode (e.g., International Maritime Dangerous Goods [IMDG] Code, International Air Transport Association [IATA] Dangerous Goods Regulations [DGR], etc.).

4.3 Security

4.3.1 AECOM sites that transport or offer the following types or quantities of materials for transportation in the United States must have a Hazardous Material Transportation Security Plan on site and must ensure that all applicable employees are trained in the plan:

- Any quantity of a Division 1.1, 1.2, or 1.3 material.
- A quantity of a Division 1.4, 1.5, or 1.6 material requiring placarding in accordance with subpart F.
- A large bulk quantity of Division 2.1 material.
- A large bulk quantity of Division 2.2 material with a subsidiary hazard of 5.1.
- Any quantity of a material poisonous by inhalation, as defined in 49 CFR 171.8.
- A large bulk quantity of a Class 3 material meeting the criteria for Packing Group I or II.
- A quantity of desensitized explosives meeting the definition of Division 4.1 or Class 3 material requiring placarding in accordance with subpart F.
- A large bulk quantity of a Division 4.2 material meeting the criteria for Packing Group I or II.
- A quantity of a Division 4.3 material requiring placarding in accordance with subpart F.
- A large bulk quantity of a Division 5.1 material in Packing Groups I and II; perchlorates; or ammonium nitrate, ammonium nitrate fertilizers, or ammonium nitrate emulsions, suspensions, or gels.
- Any quantity of organic peroxide, Type B, liquid or solid, temperature controlled.
- A large bulk quantity of Division 6.1 material (for a material poisonous by inhalation see paragraph (e) above).
- A select agent or toxin regulated by the Centers for Disease Control and Prevention under 42 CFR 73 or the United States Department of Agriculture under 9 CFR 121.
- A quantity of uranium hexafluoride requiring placarding under 49 CFR 172.505(b).
- International Atomic Energy Agency (IAEA) Code of Conduct Category 1 and 2 materials including Highway Route Controlled quantities as defined in 49 CFR 173.403 or known radionuclides in forms listed as RAM-QC by the Nuclear Regulatory Commission.
- A large bulk quantity of Class 8 material meeting the criteria for Packing Group I.

4.3.2 The specific HzM security plan shall be reviewed annually and updated if required.

4.4 Training

4.4.1 Employees involved in shipping hazardous materials/dangerous goods (e.g., packaging, preparing paperwork, loading and/or unloading, and transporting hazardous materials) are required to have documented training prior to shipping activities, refer to *S3AM-003-PR SH&E Training*. Training requirements are based on the type of materials shipped (e.g., calibration/compressed gases, laboratory reagents, field samples, hazardous wastes, etc.) and employee responsibility.

- AECOM (US) DOT Level 1 Shipper Performance Training: The specific content of this training (typically 4 hours) is focused on proper procedures for packaging, labeling and shipping HzM/HzW over land and sea. This training has a three year renewal requirement.
- AECOM (US) DOT Level 2 Shipper Performance Training: A comprehensive 2-day HzM shipping training course typically completed in an in-person seminar.
- IATA Performance Training: This training supplements (US) DOT Level 1 training and provides additional information for the proper shipment of HzM/HzW via air transportation. This training has a two year renewal requirement.
- Resource Conservation and Recovery Act (RCRA) Part B Awareness Training (US Project Sites): Applicable to employees shipping HzW, including listed wastes, from US project sites. General RCRA Awareness training can be completed through online vendors. Additional project-specific training regarding HzW generation, project site roles and responsibilities, HzW management and shipment will need to be coordinated between the Manager and Client. Training may also include procedures for signing waste documents, i.e. profiles and characterization forms, where permitted by client contracts. Training will be provided in accordance with Permits, Consent Orders or other Regulatory Agency-issued agreements regarding project site HzW generation. This training has an annual renewal requirement.
- TDG Training: Training is focused on proper procedures for labeling, placarding, documenting and shipping of HzM/HzW. This training has a three year renewal requirement.

4.5 Documentation

4.5.1 Permits

- The carrier (transporter) shall obtain any required permits prior to transporting hazardous materials.

4.5.2 Bills of Lading

- Bills of Lading documents include those generated when shipping non-hazardous materials and hazardous materials and include Oilfield Waste Manifests and Hazardous Waste Manifests. Bills of Lading are to be completed as follows:
  - Consignor (shipper or generator) shall input or provide the appropriate information, including the consignor's information (e.g. name, address, etc.) and the appropriate identifiers for the materials to be transported.
    - If the item is a dangerous material, it must be clearly identified as a dangerous good (e.g. marked with an "X" in the DG column), and the primary class and subsidiary class must be entered along with the UN number, name, packing group (if applicable) and quantity.
  - The carrier (transporter) shall enter in full the Carrier information, such as:
    - Company name, address, date, truck unit number, and telephone number.
    - The applicable emergency response information, including the 24-hour emergency number.
    - Carrier's employee shall confirm the bill of lading has been properly completed, print his/her name and sign the form prior to transport.
  - The carrier (transporter) driver shall maintain the bill of lading within immediate reach when restrained by a seatbelt and visible to a person entering the vehicle, or in a holder mounted on the inside of the driver's door.

    - Once the waste is transported to the destination, the consignee (receiver) completes their appropriate sections.
- Copies are maintained by the consignor, carrier and consignee.

5.0 Records

5.1 Bill of Lading and Shipper's Declaration for Dangerous Goods shall be retained in the project files for a minimum of 2 years.

5.2 Agency Letters and hazardous waste manifests shall be retained in the project files for at least 3 years after the initial carrier accepted the material.

6.0 Attachments

6.1 S3AM-116-ATT1 Materials of Trade Limits

Americas

Materials of Trade Limits

S3AM-116-ATT1

1.0 United States

1.1 The Department of Transportation (DOT) "Materials of Trade" or "MOTs" exception applies to hazardous materials, other than hazardous waste, that are carried on a motor vehicle for one of the following purposes:

1.1.1 To protect the health and safety of the motor vehicle operator or passengers, such as insect repellant or a fire extinguisher;

1.1.2 To support the operation or maintenance of a motor vehicle (including its auxiliary equipment), such as a spare battery or gasoline; or

1.1.3 To directly support a principal business of a private motor carrier (including vehicles operated by a rail carrier) that is other than transportation by motor vehicle – for example, landscaping, pest control, painting, plumbing, or welding services.

1.2 Some AECOM activities (e.g., environmental sampling and other field services), may be able to use this exception. The exception is found in the Code of Federal Regulations at 49 CFR 173.6. A HzM-trained employee should make the determination as to whether this exception will apply to the shipment.

1.3 The MOTs exception allows AECOM employees to transport certain amounts of chemicals aboard their vehicles without preparing shipping papers, emergency response information, placarding, or formal training.

1.4 MOTs must be packaged in the manufacturer's original packaging, or a packaging of equal or greater strength or integrity. Gases must be in DOT specification cylinders. If the inner container (such as the bottle) is secured against movement inside the vehicle (if it is kept in a cabinet or tool box), then no outer packaging (such as a cardboard box) is required. The MOT must be marked with a common name or the technical name.

1.5 No HzM training is required, except that the driver must have general knowledge of the MOT regulations, quantity limitations, packaging requirements, and marking and labeling requirements. The driver is not allowed to exceed total aggregate weight of 440 pounds of MOTs aboard the vehicle.

1.6 The HzM classes and quantities of HzM items typically transported by AECOM can be transported as MOTs:

1.7 The inner container of a Packing Group II and III material in Class 3, 8, 9, Division 4.1, 5.1, 5.2, 6.1, or ORM-D cannot exceed 66 pounds (30 kilograms) or 8 gallons each.

1.8 A Division 2.1 or 2.2 cylinder cannot exceed 220 pounds (100 kilgrams).

1.9 The inner container of a Packing Group II or II material in Division 4.3 cannot exceed 1 ounce (28 grams).

2.0 Canada

2.1 Canada's TDG Regulations apply to everyone. They even apply when an individual transports dangerous goods such as gasoline, oxygen and propane for personal use. However certain exemptions exist for small quantities or for specific situations.

2.1.1 Most of these exemptions, which are called "special cases", are found in Part 1 of the TDG Regulations, under section 1.15 to 1.48. This document contains a basic overview of a few of these "special cases."

2.1.2 These "special cases" may exempt the parties involved from documentation requirements, or placarding and training requirements of the TDG Regulations.

2.1.3 Please refer to the TDG Regulations for further guidance before applying exemptions.

2.2 150 kilogram gross mass exemption

2.2.1 The total gross mass of all dangerous goods (i.e. oxygen, propane, gasoline, etc.) must not be greater than 330 pounds (150 kilograms). "Gross mass" includes the weight of the container and all of its contents.

2.2.2 The dangerous goods must be packed in containers that weigh 66 pounds (30 kilograms) or less (except for gases).

2.2.3 The dangerous goods must be available to the general public and transported by the user/purchaser or by a retailer to or from a user/purchaser.

2.2.4 The containers must be designed not to leak under normal conditions of transport.

2.2.5 When using the "150 kilogram Gross Mass Exemption" for class 2 gases, remember:

- If transporting a gas such as propane or oxygen, the cylinder must be certified for use in Canada and marked with the letters TC or DOT/TC;
- Flammable gases, such as propane or acetylene, are limited to a cylinder size of 46L.

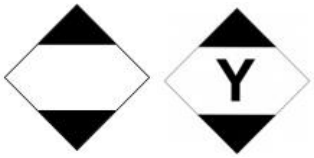
2.3 Limited Quantity

2.3.1 A limited quantity is a small quantity of dangerous goods to which the general public normally has access, such as aerosol sprays and small cans of paint.

2.3.2 Since dangerous goods cannot all be shipped as limited quantities, consult Column 6(a) of Schedule 1 of the TDG Act and Regulation.

2.3.3 Do not ship dangerous goods as a "limited quantity" when a “0” is in Column 6(a) of Schedule 1.

2.3.4 Each means of containment (i.e. box, etc.) must have a gross mass of 66 pounds (30 kilograms) or less and display one of the following international marks:



2.4 Gases in Small Means of Containment

2.4.1 This exemption allows for the transport up to 1102 pounds (500 kilograms) of the gases listed below. When using this exemption, the maximum amount of cylinders is limited to five. The cylinders must be visible from outside the vehicle.

- UN1001, ACETYLENE, DISSOLVED;
- UN1002, AIR, COMPRESSED;
- UN1006, ARGON, COMPRESSED;
- UN1013, CARBON DIOXIDE;
- UN1060, METHYLACETYLENE AND PROPADIENE MIXTURE, STABILIZED;
- UN1066, NITROGEN, COMPRESSED;
- UN1072, OXYGEN, COMPRESSED; or
- UN1978, PROPANE.

Americas

Hazardous Waste Operations

S3AM-117-PR1

1.0 Purpose and Scope

1.1 Provides requirements for AECOM operations pertaining to hazardous waste and emergency response (HAZWOPER) services. In Canada and South America, there is no direct counterpart to HAZWOPER; however, as due diligence and in compliance with applicable duty of care/general duty clauses, staff working in Canada and South America will comply with this procedure as far as it aligns with the location's respective legislation.

1.2 Provides a procedure intended to address small incidental spills from work related equipment and supplies. For operations with bulk quantities of fuels, chemicals, oils, and for operations where AECOM is providing emergency response services for spills, the SH&E Manager or designee shall specify spill prevention and preparedness criteria including training, equipment, and proficiency.

1.3 To define appropriate procedures to decontaminate both equipment and personnel when exposure to hazardous chemicals or physical agents has occurred.

1.4 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 **Contamination Reduction Zone (CRZ)** – The transition area between the contaminated area and the clean area where decontamination activities occur.

2.2 **Decontamination** – The process of removing or neutralizing contaminants that have accumulated on personnel or equipment.

2.3 **Emergency Response** – A response effort by employees from outside the immediate release area or by other designated responders (e.g.., mutual-aid groups, local fire departments, etc.) to an occurrence that results, or is likely to result, in an uncontrollable release of a hazardous substance or whenever a release requires that a federal, state, territorial or provincial agency be notified, such as:

- A release at or above a reportable quantity (RQ) of a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) hazardous substance (40 CFR 302.8) is required to be reported to the National Response Center (NRC).
- A release at or above provincial reporting thresholds, if any, or alternatively those specified under the Canadian Transportation of Dangerous Goods Act are reportable under the Canadian Environmental Protection to the respective provincial or territorial Environmental Regulatory Agency .
- A hazardous chemical release at or above an RQ under the Emergency Planning and Community Right-to-Know Act (EPCRA) (Title III under the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 350-372) is required to be reported to state and local officials.
- A release in violation of a facilities Spill Prevention, Control, and Countermeasure (SPCC) Plan (40 CFR 112).

Responses to incidental release of hazardous substances where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area or by maintenance personnel are not considered to be emergency responses within the scope of the HAZWOPER standard. Responses to releases of hazardous substances where there is no potential safety or health hazard are not considered to be emergency responses.

2.4 **Exclusion Zone (EZ)** – The area where contamination does or could occur.

2.5 **First Responder** – First responders are individuals who are likely to witness or discover a hazardous substance release, injury, fire, or other incident and who have been trained to initiate an emergency response sequence by notifying the proper authorities of the release. They would take no further action beyond first aid, initial control of the incident, and notifying the authorities and others of the incident.

2.6 **Hazardous Materials** – A hazardous material is any item or agent (biological, chemical, physical) that has the potential to cause harm to humans, animals, or the environment, either by itself or through interaction with other factors. Additionally a hazardous material may be defined as any substance or chemical which is a "health hazard" or "physical hazard," including chemicals that are carcinogens, toxic agents, irritants, corrosives, sensitizers; agents that act on the hematopoietic system; agents that damage the lungs, skin, eyes, or mucous membranes; chemicals that are combustible, explosive, flammable, oxidizers, pyrophoric, unstable-reactive, or water-reactive; and chemicals that in the course of normal handling, use, or storage may produce or release dusts, gases, fumes, vapor, mists, or smoke that may have any of the previously mentioned characteristics. This may be caused when released by spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, disposing into the environment, by being transported or moved, and items or chemicals that are "special nuclear source" or by-product materials or radioactive substances.

2.7 **Hazardous Materials Specialist** – Hazardous materials specialists are individuals who respond with and provide support to hazardous materials technicians. Their duties parallel those of the hazardous materials technician; however, those duties require a more directed or specific knowledge of the various substances they may be called upon to contain. The hazardous materials specialist would also act as the site liaison with federal, state, local, and other government authorities in regards to site activities.

2.8 **Hazardous Materials Technician** – Hazardous materials technicians are individuals who respond to releases or potential releases for the purpose of stopping the release. They assume a more aggressive role than a first responder in that they will approach the point of release in order to plug, patch, or otherwise stop the release of a hazardous substance.

2.9 **Hazardous Waste** – Hazardous waste is waste that is dangerous or potentially harmful to our health or the environment. Hazardous wastes can be liquids, solids, gases, or sludge. They can be discarded commercial products, like cleaning fluids or pesticides, or the by-products of manufacturing processes. Hazardous waste are divided into:

- Listed wastes (http://www.epa.gov/osw/hazard/wastetypes/listed.htm);
- Characteristic wastes (http://www.epa.gov/osw/hazard/wastetypes/characteristic.htm);
- Universal wastes (http://www.epa.gov/osw/hazard/wastetypes/universal/index.htmwastes); and
- Mixed wastes;
- Specific procedures determine how waste is identified (http://www.epa.gov/osw/hazard/wastetypes/wasteid/index.htm), classified, listed, and delisted.

2.10 **Health and Safety Plan (SH&E PLAN)** – A document prepared for each project that contains site-specific information including the Emergency Response Plan for the project.

2.11 **Incidental Releases** - A response to a spill or release of a hazardous substance (in quantities below its RQ) where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area using equipment and materials available to them at the time or the spill or release. Any spill or release that cannot be managed with the personnel, materials, and equipment at the site shall be considered an Emergency Response.

- Responses to releases of hazardous substances where there is no potential safety or health hazard (i.e., fire, explosion, or chemical exposure) are not considered to be emergency responses. Handling of incidental releases shall be in accordance with applicable standard operating procedures.

2.12 **Incident Command System (ICS)** – ICS is a standardized on-scene incident management concept designed specifically to allow responders to adopt an integrated organizational structure equal to the complexity and demands of any single incident or multiple incidents without being hindered by jurisdictional boundaries. In the ICS the first person responding to an incident becomes the Incident Commander and turns that title and duties over to more qualified responders as they arrive on scene.

2.13 **Incident Commander** – The Incident Commander (IC) is responsible for all aspects of the response, including developing incident objectives and managing all incident operations. The title and responsibilities are typically assumed by a qualified IC from the client or public sector.

2.14 **Support Zone (SZ)** – An uncontaminated zone where administrative and other support functions (e.g. first aid, equipment supply, emergency information, etc.) are located.

3.0 References

3.1 SR1-003-WI2 Disruptive Event Response Instruction

3.2 S3AM-003-PR1 SH&E Training

3.3 S3AM-004-PR1 Incident Reporting, Notifications & Investigation

3.4 S3AM-010-PR1 Emergency Response Planning

3.5 S3AM-012-PR1 First Aid

3.6 S3AM-017-PR1 Injury & Illness Recordkeeping

3.7 S3AM-127-PR1 Exposure Monitoring

3.8 S3AM-128-PR1 Medical Screening & Surveillance

3.9 S3AM-208-PR1 Personal Protective Equipment

3.10 S3AM-209-PR1 Risk Assessment & Management

3.11 S3AM-213-PR1 Subcontractor Management

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager**

- Enforces and supports the implementation of SH&E Plans, Location Specific Emergency Response Plans, and Spill Response Plans;
- Prepare or request a SH&E Plan for every AECOM project with Hazardous Waste Operations and Emergency Response Activities, refer to *S3AM-209-PR1 Risk Assessment & Management*;
- Verify that all personnel working on the project are qualified to perform the activities they are assigned (see HAZWOPER and Emergency Spill Response Training requirements below);
- Request client's emergency response procedures;
- Appoint a Site Safety Officer (SSO) with appropriate qualifications for the specific hazardous waste project;
- Confirm that the SSO for complex projects, such as those with complicated remediation activities, has no duties other than site safety and health of the field team;
- Confirm the communication of the location-specific emergency response plan details to all employees assigned to a field project;
- Authorize the procurement of the necessary decontamination supplies;

- Verify that the applicable decontamination steps are clearly defined in the approved SH&E Plan;
- Verify staff are appropriately trained to execute the defined decontamination procedures;
- Verify that adequate staffing is available to safely conduct the applicable decontamination steps;
- Confirm that the necessary communications equipment for the project is available;
- Confirm that incident investigations are performed as required and a report is filed. Refer to *S3AM-004-PR1 Incident Reporting, Notifications & Investigation*;
- During spill response, all AECOM emergency responders and their communications shall be coordinated and controlled through the Manager. The individual in charge shall implement the and shall be responsible for the following tasks:
    - Become the individual in charge at the incident until relieved by more qualified personnel;
    - Notify the appropriate agency, the AECOM incident Reporting line, and operations. Refer to *S3AM-117-ATT1 Spill Notification Numbers North America* for US and Canadian required notifications;
    - Designate a safety supervisor who is knowledgeable about the operations being implemented at the emergency response site and who will have specific responsibility to identify and evaluate hazards and to provide direction on the safety of operations for the emergency at hand. If the safety supervisor judges activities to be an Immediately Dangerous to Life or Health (IDLH) and/or to involve an imminent danger condition, the safety supervisor shall have the authority to alter, suspend, or terminate those activities. The safety official shall immediately inform the individual in charge of the ICS of any actions needed to be taken to correct these hazards at the emergency scene;
    - Identify all hazardous substances or conditions present and address as appropriate site analysis, use of engineering controls, maximum exposure limits, hazardous substance, and handling procedures;
    - Implement appropriate emergency operations. Refer to *S3AM-010-Emergency Response Planning*;
    - Limit the number of emergency response personnel at the emergency site;
    - Implement the buddy system in groups of two or more;
    - Confirm that the PPE worn is appropriate for the hazards to be encountered;
    - Implement appropriate decontamination procedures after emergency operations have terminated.
- Responsibility for the emergency response shall be transferred upon arrival of a more qualified AECOM Incident Commander or a Public Service Incident Commander.
- Confirm appropriate communications concerning an emergency event are initiated as per *S3AM-010-PR1 Emergency Response Planning* and *SR1-003-WI2 Disruptive Event Response Instruction*.

4.1.2 **SH&E Manager or designee**

- Provide technical guidance for:
    - The development and implementation of SH&E Plans and Emergency Response Plans;
    - The Incident Commander regarding the correct way to respond to the spill;
    - Project-specific Spill Response Plans when required;

- Prepare emergency action plans as part of project SH&E Plans and emergency reference sheets;
- Interface with the local emergency responders when necessary;
- Interface with clients regarding facility emergency response procedures;
- Decide whether AECOM or an outside emergency response company will clean up the spill;
- Report spills, as necessary, to state/provincial environmental agencies;
- Review the incident report and facilitate the post-response discussion;
- Review and revise this procedure as necessary based on recommendations from post-response discussions;
- Advise Managers and Supervisors on the necessary decontamination procedures for the known or reasonably anticipated chemical hazards and physical agents associated with the planned scope of work;
- Support the project team to verify that adequate protective measures are in-place (e.g. Engineering Controls, Administrative Controls, Personal Protective Equipment, etc.).

4.1.3 **Site Safety Officer (SSO)**

- Verify that a SH&E PLAN is available for the project and is reviewed prior to the commencement of site activities;
- Conduct pre-entry briefing and daily tailgate meetings and review facility, site-specific emergency procedures, and site specific decontamination procedures;
- Communicate the site-specific emergency response details to all employees assigned to a field project;
- Establish the designated site work zones (e.g., EZ, CRZ, SZ, etc.);
- Enforce the applicable decontamination steps as defined in the approved SH&E Plan;
- Initiate Stop Work and emergency response procedures as required;
- Account for all AECOM and subcontractor employees after site evacuation;
- Brief on-site and off-site responders in the event of an emergency;
- Conduct site-specific training on the applicable decontamination steps/procedures;
- Procure the necessary decontamination supplies and establishing the decontamination line;

4.1.4 **Employees**

- Maintain HAZWOPER training, or equivalent training as it relates to the given jurisdiction;
- Follow the SH&E Plan and emergency procedures prepared for the project;
- Initiate Stop Work if necessary;
- Initiate emergency response via verbal communications or the alarm system if first to encounter an emergency;
- Follow the defined decontamination steps as stated in the approved SH&E Plan;
- Follow precautions and safe handling practices to avoid spills;
- Alert Manager to any deteriorating hazardous materials containers within the office or project area;
- Report all spills and leaks to the Manager immediately;
- Secure the spill area as quickly as possible and prevent the migration of exterior spilled materials or substances to drains or other openings; and

4.1.5 **All personnel** (e.g., AECOM employees, general laborers, equipment operators, chemists, supervisors, etc.) performing activities at hazardous waste sites that expose or potentially expose them to hazardous wastes and health hazards are considered HAZWOPER site workers and shall meet the training and medical surveillance requirements specified in 29 CFR 1910.120(e) and (f), respectively. Additional training may be required based on site activities including related exposures and risks (e.g., confined space entry, excavations, fall protection, other materials [lead], etc.). These additional training requirements are to be outlined in the project- or site-specific SH&E Plan.

4.2 Project SH&E Documentation—SH&E Plan

4.2.1 The project SH&E documentation prepared for HAZWOPER activities is referred to as a site-specific SH&E Plan, and shall meet the requirements presented in 29 CFR 1910.120(b)(4).

4.2.2 A safety and health risk or hazard analysis for each on-site task that will be performed.

4.2.3 The required SH&E Plan elements include:

- A description of the work location, the site history, and a summary of any information available concerning site hazards (including both physical hazards and contamination conditions);
- A summary of the work activities to be performed under AECOM's scope of activities;
- Identified risks shall include both chemical and physical hazards to which personnel may be exposed during the conduct of the work task;
- Protective measures for each work task to prevent or mitigate the potential hazards identified in the hazard analyses;
- Personal protective equipment (PPE) requirements for each work task**.** Refer to *S3AM-208-PR1 Personal Protective Equipment*;
- Frequency and types of air monitoring, personal monitoring, and environmental sampling techniques and instrumentation to be used;
- Site control measures;
- Decontamination procedures;
- An emergency response plan, *S3AM-010-PR1 Emergency Response Planning*, addressing actions to be taken in the event of each type of credible incident that might result during the performance of planned work activities, including minor and major injuries, and chemical release and fire. Response plans shall address the means for coordinating the evacuation of all on-site personnel in the event of a catastrophic incident.

4.2.4 Responsibility for development of each AECOM SH&E Plan will be coordinated between the Manager and the SH&E Manager or SH&E Department designee as part of project initiation. Regardless of where the SH&E Plan is developed, it will be reviewed and approved by the SH&E Manager prior to submission to any agency outside of AECOM.

4.2.5 Contractors and Subcontractors

- The health and safety of the employees of any contractor or subcontractor who does not have a contract directly with AECOM, and for whom AECOM does not have contractual safety oversight, is the responsibility of that contractor or subcontractor. The contractor or subcontractor shall evaluate the hazards and potential hazards to their own employees and shall adhere to their own Health and Safety Plan;
- Subcontractors who maintain a contract directly with AECOM shall comply with AECOM SH&E program requirements. Refer to *S3AM-213-PR1 Subcontractor Management*;
- In addition, all AECOM subcontractors' Health and Safety Plans shall, at a minimum conform to the requirements of the AECOM SH&E Plan. The AECOM SH&E Plan does not, nor is it intended to, address procedures of contractors or subcontractors during their site activities.

4.3 Personnel Qualifications— Training and Medical Surveillance

4.3.1 HAZWOPER-qualified employees shall participate in the following medical surveillance and training requirements. Medical surveillance and SH&E training requirements are further described in *S3AM-128-PR1 Medical Screening & Surveillance* and *S3AM-003-PR1 SH&E Training* respectively.

4.3.2 Employees receiving initial and refresher responder training shall be issued a certificate indicating training competency. Copies of all training records shall be maintained in accordance with the *S3AM-003-PR1 SH&E Training*.

4.3.3 Medical Surveillance

- Specific HAZWOPER medical examination protocols have been developed by AECOM's Corporate Medical Provider (CMP) to meet the requirements of 29 CFR 1910.120(f). To be medically qualified to perform HAZWOPER work, employees receive the following medical examinations:
    - Initial (Baseline) Examination — The initial examination is part of pre-employment requirements and shall be completed (with results received) prior to the employee's start of work date;
    - Annual Examination — HAZWOPER-qualified employees will complete a medical examination once each year. Medical qualification expires on the anniversary date of the last examination completed. There will be no "grace period" exemptions beyond this date without the express approval of the Region SH&E Manager. At the recommendation of the SH&E Department, the CMP may approve an alternate examination frequency at periods of up to two years (biennial) in cases in which the worker's exposures to environmental contaminants are infrequent and typically well below any occupational exposure limits (e.g., senior management personnel);
    - Termination Examination — When reassigned to non-HAZWOPER duties or at the conclusion of employment at AECOM, HAZWOPER-qualified personnel will be provided with the opportunity to receive a termination medical examination;
    - Special Examinations — The SH&E Department and the CMP will jointly determine the need for special examinations because of:
        - Unusual exposure conditions; and
        - In response to possible overexposures.
- The CMP will determine the medical protocol elements for each of these examinations based on exposure information provided by the SH&E Department. The CMP will evaluate the results of each Employee's examination and will provide a written statement of medical clearance clearly stating medical compliance with the HAZWOPER regulatory standard (29 CFR 1910.120(f)) and approval of the Employee to perform unrestricted HAZWOPER activities. For initial and annual examinations, the CMP will also evaluate the Employee for the use of air purifying and supplied air respiratory protection. The written evaluation from these examinations will indicate the CMP's approval/limitations on the Employee's use of respiratory protection;
- If an Employee does not wish to participate in part or in the complete medical surveillance program, and is permitted by the given jurisdiction, the employee shall provide a written statement of refusal. Refer to *S3AM-128-PR1 Medical Screening & Surveillance*;

4.3.4 Training - HAZWOPER

All personnel assigned to work at a hazardous waste site, sampling at Treatment, Storage and/or Disposal Facilities (TSDFs), or are performing Remediation and Investigation Activities, shall participate in training meeting the requirements of 29 CFR 1910.120(e), or equivalent training as it relates to the given jurisdiction. All personnel shall have the following training:

- 40-hour initial Training — Before being assigned to a HAZWOPER site, AECOM Employees shall complete 40 hours of off-site training meeting the requirements of 29 CFR 1910.120(e)(3)(i). At the conclusion of training, personnel will receive a written certification of course completion, signed by the instructor, that indicates the course of instruction (40-hour HAZWOPER) and training dates. A copy of this certification shall be provided to the employee's SH&E Manager. Employees are responsible for maintaining their own copy of this certificate and for presenting it to the SSO when working on any HAZWOPER site;
- 3 days of on-the-job training — The Employee shall receive 3 days of actual supervision by a trained experienced supervisor;
- Refresher 8-Hour Training — To remain qualified to perform on-site HAZWOPER work activities, each AECOM Employee will complete 8 hours of HAZWOPER refresher training meeting the requirements of 29 CFR 1910.120(e)(8) at yearly intervals following completion of Initial 40-hour training. At the conclusion of training, personnel will receive a written certification of course completion, signed by the instructor, that indicates the course of instruction (8-hour HAZWOPER Refresher) and the training date. A copy of this certification shall be provided to the employee's SH&E Manager. Employees are responsible for maintaining their own copy of this certificate and for presenting it to the SSO when working on any HAZWOPER site;
- 8-hour Supervisor 8-Hour Training - any AECOM Employee acting in a management capacity for HAZWOPER activities (e.g., project manager, site safety officers, etc.), including oversight of subcontractor HAZWOPER activities, shall complete an additional 8 hours of HAZWOPER Supervisor training meeting the requirements of 29 CFR 1910.120(e)(4). Although this training is required only once, supervisors shall maintain their overall HAZWOPER qualification through annual completion of refresher training. At the conclusion of Supervisor 8-Hour Training personnel will receive a written certification of course completion, signed by the instructor that indicates the course of instruction and the training date. A copy of this certification shall be provided to the SH&E Manager. Employees are responsible for maintaining their own copy of this certificate and for presenting it to the SSO when working on any HAZWOPER site;
- 24-Hour HAZWOPER Training — Site support contractors and site visitors may qualify to substitute 24-hour HAZWOPER training in place of 40-hour training, as specified in 29 CFR 1910.120(e)(3)(ii). Personnel potentially qualifying for this alternative training include:
    - Site support personnel who will not work in any Exclusion Zone areas;
    - Subcontractors and site visitors whose duties will not entail significant exposure to site contaminants defined as not working in any areas where airborne contaminant concentrations exceed one-half of any applicable occupational exposure limit, and no contact or exposure to materials with site contaminant concentrations exceeding natural background levels. The SH&E Manager shall approve the substitution of 24-hour training for initial 40-hour training. Persons qualifying for 24-hour training shall provide written certification of course completion prior to beginning work on site. Persons completing 24-hour training shall complete 8 hours of annual refresher training at the required interval to maintain eligibility for on-site work and shall provide proof of this training (as necessary to demonstrate retraining) prior to beginning work on site.

Available Training Sources:

- On-site training provided by the SH&E Department;
- Outsourced training providers approved by the SH&E Department;

4.3.5 Training – Emergency Response

On an as-needed basis, if a project requires AECOM to provide a HAZMAT emergency response team, the following training requirements shall be met:

- Operations Level – a minimum of 8 hours of initial and refresher training for those responsible for acting defensively in the case of a release, attempting to contain the release from a safe distance;
- HAZMAT Technician – at least 24 hours of initial training and 8 hours of refresher training. They will participate in operations-level training and know how to implement the emergency response plan for the facility/site/project location;
- HAZMAT Specialist – at least 24 hours of initial training and 8 hours of refresher training. They will be trained in the same content as the HAZMAT Technician, as well as in how to develop a site safety and control plan;
- Incident Commander – will have at least 40 hours of training covering the Operations Level training and techniques for implementing the emergency response plan and directing the incident. They will be knowledgeable in relevant regulations. The Incident Commander will become the individual in charge of a site-specific incident command system and will coordinate and control communications with external agencies;

4.3.6 Subcontractor Personnel Training Records

Any subcontractor organization whose employees will support AECOM operations at a HAZWOPER site will:

- Provide the Manager with a copy of their written HAZWOPER medical surveillance and training program requirements. The elements of the program(s) shall be similar to those for AECOM's own program, as detailed above. Refer to *S3AM-213-PR1 Subcontractor Management*;
- Provide the Manager with written certification of a physician's approved medical clearance for each employee who will work on the site. Certification can be demonstrated by:
    - A copy of the physician's signed medical clearance for each employee (preferred); or
    - A letter identifying the medical status and clearance expiration date of every employee, signed by the company's safety director or an officer of the company.
    - A copy of the each employee's training certifications, which will include:
        - The initial 40-hour training certificate (24-hour training may be substituted with SH&E Manager approval);
        - The most current Refresher training certificate (shall be current within the previous one-year period);
        - A copy of the Supervisor training certificate for each person serving in a site supervisory capacity (e.g., project manager, site safety officers, etc.).

4.4 HAZWOPER and Spill Response Equipment

4.4.1 Specific HAZWOPER activity and spill response equipment shall be identified in the site specific SH&E PLAN. All AECOM offices and project sites that store chemicals at their location shall have the appropriate spill response equipment. Such equipment may include the following:

- Over-pack containers of varying capacities;
- Absorbent material such as vermiculite or commercially prepared, absorbent containing pillows, rolls, sheets, or booms;
- Acid and base neutralizing agents;
- Chemically resistant gloves for solvents, alcohols, and acids;
- Poly-coated Tyvek coveralls;
- Safety goggles;
- Respiratory protection;

4.4.2 Spill response equipment shall be placed adjacent to areas where chemicals are routinely handled, stored, and/or where shipments are received. Similar types of spill response equipment shall also be available in any AECOM vehicle or rented vehicle in which chemicals are being transported. Location of spill response equipment shall be selected to permit access outside of likely spill locations.

4.4.3 Spill Response Equipment for Field Programs

- The amount of chemicals being used during a field program will dictate the types and quantity of spill response equipment that is brought to the site;
- If several squirt bottles of decontamination solution are all that is being brought to a site, a few spill pillows and a one-gallon bucket (3.8 liters) may be sufficient to respond to a spill of these materials;
- If gallons of chemicals are being delivered to the site in drums or bulk tanks, a greater variety of spill response equipment will be needed. As indicated previously, during these types of field programs, a separate spill plan will be incorporated into the project or site specific SH&E Plan, and will provide a greater level of detail regarding the specific spill response effort for that field program. Refer to *S3AM-209-PR1 Risk Assessment & Management*;

4.5 Personal Protective Equipment (PPE) Ensembles

4.5.1 Defined HAZWOPER PPE ensembles are specified for general use on all AECOM HAZWOPER operations. The project SH&E Plan may specify modifications to these requirements to meet site-specific conditions. Refer also to *S3AM-208-PR1 Personal Protective Equipment* for additional information concerning PPE requirements.

4.5.2 Level D Ensemble

The Level D ensemble provides a minimal level of skin protection (primarily against physical rather than chemical hazards) and no respiratory protection. Level D PPE is the minimum work uniform to be used on HAZWOPER sites. Its use is appropriate when there is no significant potential for encountering hazardous substances or health hazards while working in controlled work areas.

Level D Equipment List:

- Hard hat;
- Eye protection;
- Safety-toe work boots;
- Shirts with sleeves and long pants (shorts are unacceptable for use); and
- Hearing protection (as required).

4.5.3 Modified Level D Ensemble

The Modified Level D ensemble provides moderate skin protection against contact with hazardous substances, but no respiratory protection. Its use is appropriate where there is a moderate-to-low potential for skin contact with known hazardous substances and health hazards, but no significant inhalation hazard is anticipated. The Modified Level D ensemble will consist of the Level D ensemble, supplemented by the addition of one or more of the following items:

Modified Level D Equipment List:

- Full faceshield;
- Plain (uncoated) disposable coveralls;
- Chemical-resistant disposable outer coveralls;

- Chemical-resistant outer gloves taped to outer coveralls;[1]
- Chemical-resistant inner gloves; and[1]
- Chemical-resistant safety-toe boots (taped to outer coveralls).

4.5.4 Level C Ensemble

The Level C ensemble provides moderate skin protection against contact with hazardous substances and moderate respiratory protection. Its use is appropriate where there is the potential for skin contact with known hazardous substances and health hazards, together with a limited and well-defined potential for exposure via inhalation.

Level C Equipment List:

- Full-face air-purifying respirator (APR) equipped with cartridge types as designated in the project SH&E PLAN;[2]
- Plaind (uncoated) disposable coveralls;
- Chemical-resistant disposable outer coveralls;
- Chemical-resistant outer gloves taped to outer coveralls;[3]
- Chemical-resistant inner gloves;
- Hard hat;
- Safety-toe boots taped to coveralls; the use of boot covers (e.g., booties) or chemical-resistant boots may be specified; and
- Hearing protection (as required).

4.5.5 Level B Ensemble

The Level B ensemble provides both the highest level of inhalation exposure protection and considerable skin contact protection. Its use is appropriate where there are significant known or suspected hazardous substances and health hazards, involving both skin and inhalation exposure (up to and including Immediately Dangerous to Life or Health [IDLH] conditions) or where adverse atmospheric conditions cannot be mitigated by use of air purifying respirators (e.g. oxygen deficient atmospheres or chemicals with poor warning properties). The use of Level B PPE requires prior approval by the SH&E Manager.

Level B Equipment List:

- Supplied air respirator (SCBA or airline system with Grade D or better breathing air);
- Chemical-resistant disposable outer coveralls;
- Chemical-resistant outer glove taped to outer coveralls;[3]
- Chemical-resistant inner gloves;[3]
- Hard hat;
- Chemical resistant safety-toe boots taped to coveralls; and
- Hearing protection (as required).

1 Selection of specific glove types/materials will be provided in the project SH&E Plan based on consideration of the contaminants and the physical conditions of the work.

2 Selection of specific cartridges will be made by the SH&E Department (or Competent Person – Respiratory Protection as designated by the SH&E manager) based on contaminants present. A cartridge change-out frequency will also be specified in the SH&E based on the manufacturer's cartridge performance data.

3 Selection of specific glove types/materials will be provided in the project SH&E based on consideration of the contaminants and the physical conditions of the work.

4.5.6 Level A Ensemble

The Level A ensemble provides the highest level of both respiratory and skin protection, up to and including protection against skin contact with vapor-phase contaminants. The use of Level A PPE requires prior approval by the Americas SH&E Director.

Specific Level A ensemble components will be determined on a case-by-case basis by the SH&E Department.

4.6 Emergency Response Plans

4.6.1 A Location Specific Emergency Response Plan shall be developed and implemented to handle anticipated emergencies prior to performing emergency response operations. The plan shall be in writing and available for inspection and copying by employees, their representatives, and OSHA personnel. The plan shall be reviewed and approved by the SH&E Manager prior to issue.

4.6.2 AECOM'S *S3AM-010-PR1 Emergency Response Planning* shall apply and employees shall evacuate from the danger area whenever an emergency occurs, provided the associated contract does not require AECOM to provide emergency response services

4.6.3 AECOM Employees are not expected to take action or to participate in rescues or responses to chemical releases beyond the initial discovery of the release and immediate mitigation actions such as closing a valve, placing absorbents, and notifying the client and or public emergency response system (911).

- If AECOM Employees are to participate in the response to a chemical release beyond the initial reaction, there shall be a contractual provision for this response and the Employees shall be specifically trained for this response;
- This document is designed to provide guidelines on how to prepare a written plan that will confirm prompt and proper response to an emergency situation that arises during field investigations and to outline the duties of AECOM Employees during a field emergency and the associated training requirements.

4.6.4 Site specific SH&E plans that are prepared to comply with the HAZWOPER standard (29 CFR 1910.120) shall address emergency response. This standard specifically outlines the elements that shall be contained in an emergency response plan. However, the definition of emergency response, as written in 29 CFR 1910.120, focuses on emergencies involving the uncontrolled release of hazardous substances. Under 29 CFR 1910.120, an employer can opt to evacuate employees from the danger area when such an emergency occurs. AECOM does not expect its Employees to actively assist in the handling of uncontrollable chemical releases that may occur during the implementation of field programs. As such, and as provided by the HAZWOPER standard, AECOM is exempt from the emergency response plan requirements of the standard as long as it provides an emergency action plan within the SH&E PLAN that complies with 29 CFR 1910.38 (a). Therefore, all emergency response plans required under 29 CFR 1910.120 will be written to comply with 29 CFR 1910.38 (a).

- There are two types of emergency situations that AECOM personnel shall be prepared for and that shall be addressed in the emergency response plan. These include:
  - Emergencies related to the operations of our clients at the facility where AECOM is working;
  - Emergencies related to our own on-site activities/investigations.
- Employees are not to accept the role of Incident Commander without specific authority from the SH&E Manager and the Manager responsible for the project. Assuming the role of the Incident Commander requires training beyond the scope of this Procedure.

4.6.5 The HAZWOPER standard does not prohibit AECOM Employees from performing limited response activities.

- Appropriately trained AECOM Employees can provide voluntary First Aid services;
- AECOM Employees can provide response assistance by placing absorbent pillows or vermiculite around a small, contained spill that occurs during sampling efforts;
- Refer to Spill Response, Incidental procedures contained herein which describes the specific procedures that AECOM will follow when responding to an incidental chemical spill.

4.6.6 Field Project Preparation

- Every SH&E Plan that is prepared by AECOM will contain a Location Specific Emergency Response Plan in which the required elements of an emergency action plan will be addressed. Refer to *S3AM-010-PR1 Emergency Response Planning*;
- When AECOM is working at an operating facility, the emergency response procedures of the facility will be appended to the SH&E Plan or the Location Specific Emergency Response Plan;
- As a minimum, each emergency response plan shall contain the following topics as required by 29 CFR 1910.38 (a):
    - Procedures and contact information for reporting emergencies to public service responders and on-site (client or host employer) emergency control centers;
    - Pre-emergency planning and coordination with outside parties;
    - Emergency escape procedures and emergency escape route assignments;
    - Procedures to be followed by employees who remain to operate critical site operations before they evacuate;
    - Procedures to account for all employees after emergency evacuation is complete;
    - Rescue and medical duties for those employees who are trained to perform them;
    - Preferred means of reporting fires and other emergencies;
    - PPE to protect employees from expected exposures and potential exposures during an emergency;
    - Names of persons or departments who can be contacted for further information (i.e. emergency reference sheet);
    - Site security and control;
    - Availability of medical surveillance for workers who might have been exposed to chemicals, bloodborne pathogens, or other biological agents as a result of project work or emergency response;
    - Emergency medical treatment and first aid;
    - Emergency alerting and response procedures;
    - Critique of response and follow-up.
- In addition, each plan shall establish the specific alarm system that will be used on site to warn employees of an AECOM emergency. The chosen alarm signals should not conflict with alarm signals already in place at the facility.

4.6.7 Client Facility Emergency Response Procedures

- AECOM implements field programs on active properties, including manufacturing facilities. These facilities have typically developed an emergency response plan that is specific to facility-related emergencies. If AECOM is working at an operating facility, emergency procedures established by the facility shall be followed in the event of a facility catastrophe.

AECOM personnel shall be aware of and familiar with the alarm signals used at the facility to alert personnel to an emergency. AECOM personnel shall also know where to assemble in the event of a facility evacuation as the facility shall be able to account for all personnel, including subcontractors such as AECOM in the event of an evacuation.

- The first priority in AECOM's preparation of a project emergency action plan is to confirm that the responsibilities under the client's emergency response plan are fully understood. Because of the nature of their business, many of our clients have in-house fire brigades, medical staff, and hazardous materials teams that can assist AECOM in the event of an emergency related to our field activities. In many instances, our clients prefer or require that subcontractors seek emergency assistance through their facility first before calling outside responders to the site.
- A copy of the facility's procedures shall be made available to AECOM so that the information can be incorporated into the SH&E Plan or attached to the Location Specific Emergency Response Plan. If this information is not available to AECOM prior to arriving on site, the SSO shall meet with client representatives upon arrival to the facility to review procedures in the event of an emergency related to plant operations.

4.6.8 Escape Routes and Procedures

Although emergency evacuation procedures are included in AECOM's initial 40-hour HAZWOPER training, emergency procedures at each site will be different. Employees shall be instructed about the location specific emergency response plan. Updating training is required anytime escape routes or procedures change. An evacuation drill will be conducted for projects that are scheduled for one month or longer. Visitors and untrained employees shall not be allowed into the project area until they receive a safety briefing including evacuation alarms and procedures.

Prior to the commencement of on-site activities, the SSO shall determine how AECOM employees will evacuate each AECOM work area of the site:

- Two or more routes that are separate or remote from each other for each work area shall be identified. Multiple routes are necessary in case one is blocked by fire or chemical spill. These routes shall not overlap because, if a common point were obstructed, all intersecting routes would be blocked;
- Prominent wind direction should also be considered when designating escape routes and assembly areas. Escape routes and assembly areas should be upwind of the site whenever possible;
- Upon arrival to the site, the SSO shall verify that the selected routes are appropriate for evacuation. During an emergency, the quickest and most direct route should be selected. However, when working at an operating facility, the established escape routes of the facility should be used whenever possible;
- In the event of a facility-related emergency, all AECOM employees shall meet at the facility's assembly area so that the client can verify that AECOM has evacuated the property.

4.6.9 Alarm Signals

An emergency communication system shall be in effect at all sites.

- The most simple and effective emergency communication system in many situations will be direct verbal communications. However, verbal communications shall be supplemented any time voices cannot be clearly perceived above ambient noise levels and any time a clear line of sight cannot be easily maintained among all AECOM personnel because of distance, terrain, or other obstructions;
- Portable two-way radio communications may be used when employees shall work out of the line of sight of other workers;
- When it is necessary to supplement verbal communications, Employees shall be informed of the established emergency signals. The following emergency signals, or other appropriate signals, shall be implemented using handheld portable air horns, whistles, or similar devices.

Signals shall be capable of being perceived above ambient noise by all employees in the affected portions of the workplace:

- One Blast: General Warning—A relatively minor and localized, yet important, on-site event. An example of this type of an event would be a minor chemical spill where there is no immediate danger to life or health yet personnel working on the site should be aware of the situation so that unnecessary problems can be avoided. If one horn blast is sounded, personnel shall stop all activity and equipment on-site and await further instructions from the SSO;
- Three Blasts: Medical Emergency—A medical emergency for which immediate first aid or emergency medical care is required. If three horn blasts are sounded, all First Aid Providers should respond as appropriate. All other activity and equipment should stop and personnel should await further instructions from the SSO;
- Three Blasts Followed by One Continuous Blast: Immediate Threat to Life and Health — A situation that could present an immediate danger to life and health of personnel onsite. Examples include fires, explosions, large hazardous chemical release, severe weather-related emergencies, or security threats. If three horn blasts followed by a continuous blast are sounded, all activity and equipment shall stop. All personnel shall evacuate the site and meet in the designated assembly area where the SSO will account for all employees. The SSO will arrange for other emergency response actions if necessary. Information concerning the need to follow decontamination procedures during an emergency evacuation will be addressed in the Location Specific Emergency Response Plan;

- The SSO or his designate will acknowledge the distress signal with two short blasts on the air-horn or whistle;
- One Continuous Blast Following Any of the Above: All Clear/Return to Work — Personnel who sound the initial alarm are required to send an all clear signal when the emergency is over.

4.6.10 Accounting Method for All Employees after Evacuation

The SSO is responsible for determining that all AECOM employees have been successfully evacuated from the work area(s):

- It is the responsibility of each AECOM subcontractor to verify that all of its employees evacuated the site and to report this information to the SSO. All employees shall meet at the designated assembly area;
- A headcount is an acceptable way to determine complete evacuation when the field team is of a small size. The site log-in book or equivalent should be referenced when attempting to account for more than 10 people. In the event of a facility-related emergency, the SSO shall notify facility representatives that all AECOM employees and AECOM subcontract employees have successfully evacuated the work area(s);
- The SSO shall notify emergency responders if any employee is unaccounted for and where on the site they were last seen;
- In the event of a project-related emergency, the SSO will provide off-site emergency responders or on-site HAZMAT teams or fire brigades (Incident Commander) with all available knowledge about the emergency situation upon their arrival to the scene.

4.6.11 Employees Who Remain to Operate Critical Site Operations Before They Evacuate

All equipment and operations are required to cease in accordance with the established alarm signal procedures. The only exception will be related to health and safety:

- The SSO shall determine at the time of the emergency if health and safety will be jeopardized by immediate stoppage of any particular piece of equipment;

- If such a determination is made, personnel involved in critical operations shall be minimized. Once it is determined that the operation is no longer needed or the threat to the operators is imminent, operations will cease and the operators will immediately evacuate.

4.6.12 Rescue and Medical Response

- Only currently trained individuals will administer first aid, CPR or an AED. Refer to *S3AM-012-PR1 First Aid*.
- In the event of an incident, refer to material's SDS labels to confirm proper first aid is administered for the hazardous material and call the nearest Poison Centre or 911. Refer to *S3AM-012-PR1 First Aid*.
    - The American National Standards Institute (ANSI) Standard for Emergency Eyewash and Shower Equipment (ANSI Z358.1-1998) recommends that the affected body part shall be flushed immediately and thoroughly for at least 15 minutes using a large supply of clean fluid under low pressure. However, other references recommend a minimum 20-minute flushing period if the nature of the contaminant is not known. The flushing or rinsing time can be modified if the identity and properties of the chemical are known. For example, at least:
        - 5 minutes flushing time for mild irritants;
        - 20 minutes for moderate to severe irritants;
        - 20 minutes for non-penetrating corrosives;
        - 60 minutes for penetrating corrosives;
        - If irritation persists, repeat the flushing procedure.
- It is important to note that ingestion of any chemical is not likely to occur in the workplace. If ingestion does occur, evidence indicates that inducing vomiting is not necessary in most situations where there has been an occupational chemical ingestion.
    - Induction of vomiting should only be recommended if the chemical has very high, short-term (acute) toxicity, and medical follow-up is not readily available;
    - In these cases, first aiders should receive special training on how to safely and effectively induce vomiting in the appropriate circumstances.
- If the injury is life threatening, the Emergency Medical System (EMS) should be called (911). Depending on the procedures established for the project, the SSO would contact an emergency responder directly or notify the facility representatives for medical assistance;
- If the employee needs medical attention that cannot be provided on-site, the SSO shall escort the individual to the local hospital identified on the emergency reference sheet and shall remain with the person until release or admittance is determined. The escort will relay all appropriate medical information to the Manager and SH&E Manager.

4.6.13 On-site and Off-site Communications

Regardless of the size or location of AECOM's field projects, it is extremely important that both on-site and off-site communications be maintained so that in the event of an emergency employees can contact each other or place a phone call immediately with the appropriate responder(s).

A reliable and approved form of communication (e.g. two way radio, cell phone, etc.) is required when members of the field team are working in separate areas of the site and verbal communications are no longer effective because of distance. A communication device shall be available for each team that is working in a separate area of the site.

When AECOM is working at an occupied facility, a telephone may be accessible. When AECOM is working on abandoned properties or when there is no access to a phone, as appropriate, a cellular telephone, two-way radio, or satellite telephone shall be brought to the work location.

4.6.14 Preferred Means of Reporting

Employees shall immediately notify the Supervisor of incidents and emergencies, and report in accordance with *S3AM-004-PR1 Incident Reporting, Notification & Investigation*:

- Unless facility representatives specifically indicate that they prefer AECOM personnel to notify them first of an emergency, the SSO will directly contact the appropriate emergency responders listed on the Location Specific Emergency Response Plan;
- Additional communications within AECOM concerning an emergency event may be required as per *S3AM-010-PR1 Emergency Response Planning* and *SR1-003-WI2 Disruptive Event Response Instruction*;
- "Dangerous occurrences" shall be reported immediately to the police, employer, vehicle owner/leaser and the dangerous goods owner. Such events would include spills, bulk container damage, fire, explosion, and transportation accidents involving dangerous goods;
- Confirm and seek direction on external reporting requirements. Each jurisdiction has regulations governing the minimum quantities for reporting based on the type of product spilled or release refer to *S3AM-117-ATT1 Spill Notification Numbers for North America*;

Individuals who have knowledge of a spill, release, or unlawful discharge, shall notify authorities immediately. Reporting does not imply guilt or assign blame. The following details are to be reported:

- Location and time of spill;
- Description of circumstances leading to spill;
- Type and quantity of material or substance spilled;
- Details of any action taken at the site of the spill;
- Description of location of spill and immediately surrounding the area;
- Any additional information in respect of the spill that the Minister, Environmental Protection Officer or person designated by regulations requires.

4.6.15 First Responder

First responders shall have sufficient training or have had sufficient experience to objectively demonstrate competency in the following areas:

- An understanding of what hazardous substances are, and the risks associated with them in an incident;
- An understanding of the potential outcomes associated with an emergency;
- The ability to recognize the presence of hazardous substances and physical hazards in an emergency;
- An understanding of the role of the first responder;
- The ability to realize the need for additional resources and to make appropriate notifications to the communication center.

4.6.16 First Responder HAZWOPER Operations Level

First responders at the operations level are individuals who respond to releases or potential releases of hazardous substances as part of the initial response to the site for the purpose of protecting nearby persons, property, or the environment from the effects of the release:

- They are trained to respond in a defensive fashion without actually trying to stop the release; Their function is to contain the release from a safe distance, keep it from spreading, and prevent exposures;

- First responders at the operational level shall have received at least eight hours of training or have had sufficient experience to objectively demonstrate competency in the following areas in addition to those listed for the awareness level and the employer shall so certify:
    - Knowledge of the basic hazard and risk assessment techniques;
    - Know how to select and use proper personal protective equipment provided to the first responder operational level;
    - An understanding of basic hazardous materials terms;
    - Know how to perform basic control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available with their unit;
    - Know how to implement basic decontamination procedures;
    - An understanding of the relevant standard operating procedures and termination procedures;

4.6.17 Hazardous Materials Technician

Hazardous materials technicians shall have received at least 24 hours of training equal to the first responder operations level and in addition have competency in the following areas and the employer shall so certify:

- Know how to implement the employer's emergency response plan;
- Know the classification, identification, and verification of known and unknown materials by using field survey instruments and equipment;
- Be able to function within an assigned role in the Incident Command System, refer to *Federal Emergency Management Agency—FEMA: Incident Command System*;
- Know how to select and use proper specialized chemical PPE provided to the hazardous materials technician;
- Understand hazard and risk assessment techniques;
- Be able to perform advance control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available with the unit;
- Understand and implement decontamination procedures;
- Understand termination procedures;
- Understand basic chemical and toxicological terminology and behavior.

4.6.18 Hazardous Materials Specialist

Hazardous materials specialists shall have received at least 24 hours of training equal to the technician level and in addition have competency in the following areas and the employer shall so certify:

- Know how to implement the local emergency response plan;
- Understand classification, identification, and verification of known and unknown materials by using advanced survey instruments and equipment;
- Know the state or applicable jurisdictional emergency response plan;
- Be able to select and use proper specialized chemical PPE provided to the hazardous materials specialist;
- Understand in-depth hazard and risk techniques;
- Be able to perform specialized control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available;

- Be able to determine and implement decontamination procedures;
- Have the ability to develop a site safety and control plan;
- Understand chemical, radiological, and toxicological terminology and behavior.

4.7 Decontamination Procedures

4.7.1 When possible, all necessary steps shall be taken to reduce or minimize contact with chemicals and impacted materials while performing field activities (e.g., avoid sitting or leaning on, walking through, dragging equipment over, tracking, or splashing potential or known impacted materials).

4.7.2 All personal decontamination activities shall be performed with an attendant (buddy) to provide assistance to personnel that are performing decontamination activities. An attendant may not be required for Level D equipment removal and decontamination. Depending on specific site hazards, attendants may be required to wear a level of protection that is equal to the required level in the exclusion zone.

4.7.3 All persons and equipment entering the EZ shall be considered contaminated, and thus, shall be properly decontaminated prior to entering the SZ. No equipment, including personal protective equipment or contaminated clothing shall be taken or worn into the SZ.

4.7.4 Decontamination procedures may vary based on site conditions and nature of the contaminant. If chemicals or decontamination solutions are used, care should be taken to minimize reactions between the solutions and contaminated materials. In addition, personnel shall assess the potential exposures created by the decontamination chemical(s) or solutions. The safety data sheets shall be reviewed, implemented, and filed by personnel contacting the chemicals/solutions.

4.7.5 All contaminated personal protective equipment (PPE) and decontamination materials shall be stored and disposed of in accordance with site-specific requirements identified in the approved work plan.

4.7.6 For all Level A and B ensembles, adequate supplied air shall be available to allow the employee to safely complete all necessary decontamination steps.

4.7.7 Where decontamination procedures involving radioactive materials are required, the removable limits for both personnel and equipment will be specified by a Certified Health Physicist or Certified Industrial Hygienist in the project's approved Radiation Protection Plan or approved safety planning document.

4.7.8 Materials Needed to Decontaminate Personnel and/or Equipment

- The equipment required to perform decontamination may vary based on site-specific conditions and nature of the contaminant(s). The following equipment is commonly used for decontamination purposes:
  - Soft-bristle scrub brushes or long-handled brushes to remove contaminants;
  - Hoses, buckets of water or garden sprayers for rinsing;
  - Large plastic/galvanized wash tubs or children's wading pools for washing and rinsing solutions;
  - Large plastic garbage cans or similar containers lined with plastic bags for the storage of contaminated clothing and equipment;
  - Metal or plastic cans or drums for the temporary storage of contaminated liquids;
  - Paper or cloth towels for drying protective clothing and equipment; and
  - Poly or plastic sheeting to lay down and form the base for the CRZ, as well as to contain contaminants and decontamination fluids.

4.7.9 Personal Decontamination Steps

- The decontamination plan shall be in writing and shall specify the exact steps in either wet or dry decontamination or personnel exiting the EZ to the SZ. The decontamination plan shall also address respirator cartridge change out, SCBA bottle changes and equipment decontamination.

4.7.10 Decontamination Steps during a Medical Emergency

- If decontamination can be done:
  - Wash, rinse and/or cut off protective clothing and equipment.
- If decontamination cannot be done:
  - Wrap the victim in blankets, plastic sheeting, or rubber to reduce contamination of other personnel;
  - Alert emergency and offsite medical personnel to potential contamination;
  - Instruct them about specific decontamination procedures if necessary;

4.7.11 Equipment Decontamination Steps

- All equipment leaving the EZ shall be considered contaminated and shall be properly decontaminated to minimize the potential for exposure and off-site migration of impacted materials. Such equipment may include, but is not limited to: sampling tools, heavy equipment, vehicles, PPE (hoses, cylinders, etc.), and various handheld tools;
- All Employees performing equipment decontamination shall wear the appropriate PPE to protect against exposure to contaminated materials. The level of PPE may be equivalent to the level of protection required in the EZ. Other PPE may include splash protection, such as face-shields and splash suits, and knee protectors. Following equipment decontamination, Employees may be required to follow the proper personal decontamination procedures above;
- For larger equipment, a high-pressure washer may need to be used. Some contaminants require the use of a detergent or chemical solution and scrub brushes to confirm proper decontamination. Personnel operating a high pressure washer will be trained in the operation of the equipment and follow the manufacturer's operational instructions;
- For smaller equipment, use the following steps for decontamination:
  - Remove majority of visible gross contamination in EZ;
  - Wash equipment in decontamination solution with a scrub brush and/or power wash heavy equipment;
  - Rinse equipment;
  - Visually inspect for remaining contamination;
  - Follow appropriate personal decontamination steps outlined above.
- All decontaminated equipment shall be visually inspected for contamination prior to leaving the CRZ. Signs of visible contamination may include an oily sheen, residue or contaminated soils left on the equipment. All equipment with visible signs of contamination shall be discarded or re-decontaminated until clean. Depending on the nature of the contaminant, equipment may have to be analyzed using a wipe method or other means.

4.8 Employee Exposure Monitoring

4.8.1 Explosive levels, oxygen levels, and airborne contaminants may present potential hazards to HAZWOPER personnel working within controlled work areas and to non-HAZWOPER workers and the general public present outside the controlled work areas.

4.8.2 As appropriate, exposure monitoring at HAZWOPER sites will be conducted to determine explosive and oxygen levels, monitor and control employee exposures to airborne contaminants, and to determine and regulate controlled work area boundaries (e.g., support zone, contamination reduction zone, and exclusion zone) for the protection of non-HAZWOPER workers and the general public.

4.8.3 Specific exposure monitoring requirements will be established in individual SH&E Plans. Refer to *S3AM-127-PR1 Exposure Monitoring*. All monitoring efforts using direct reading instruments and will remain part of the project file.

4.8.4 Work Area Exposure Monitoring

- Work area exposure monitoring will include breathing zone readings for the maximum exposed worker(s);
- Results will be used to determine adequacy of PPE (especially respiratory protection). Specific criteria for upgrade/downgrade will be established in the SH&E Plan.

4.8.5 Perimeter Exposure Monitoring

- Perimeter air samples will be collected when the potential exists for airborne contaminants to migrate off-site and will be collected near the work zones when performing work at an active client facility. Refer to *S3AM-127-PR1 Exposure Monitoring*;
- Perimeter exposure monitoring will be conducted at locations downwind from the project activities at a minimum (also upwind if the potential exists for offsite contamination to migrate onto the site).

4.8.6 Exposure results will be posted on site and explained in a safety briefing.

4.8.7 Employees will receive a written statement of results within 15 days of receipt from the laboratory.

4.8.8 Results of all personal exposure monitoring will be provided to the SH&E department for inclusion in the employee medical records, refer to *S3AM-017-PR1 Injury & Illness Recordkeeping***.**

5.0 Records

5.1 All forms and documents generated during a HAZWOPER project will be maintained in the project file.

5.2 All medical screening and surveillance documentation shall be retained for 30 years.

6.0 Attachments

6.1 S3AM-117-ATT1 Spill Notification Number for North America

Americas

Spill Notification Numbers for North America

S3AM-117-ATT1

Jurisdiction	Name	Phone
Within the United States		
National Response Center		1-800-424-8802
AECOM Incident Reporting Number		1-800-348-5046
Within Canada		
AECOM Incident Reporting Number		1-800-348-5046
Alberta	Environmental Service Response Centre	1-800-222-6514
British Columbia	Provincial Emergency Program	1-800-663-3456
Manitoba	Conservation Emergency Response Program	1-204-944-4888
New Brunswick	Canadian Coast Guard	1-800-565-1633
Newfoundland & Labrador	Canadian Coast Guard	1-800-563-9089
NWT & Nunavut	Spill Report Line	1-867-920-8130
Nova Scotia	Canadian Coast Guard	1-800-565-1633
Ontario	Spill Action Centre	1-800-268-6060
Prince Edward Island	Canadian Coast Guard	1-800-565-1633
Quebec	National Environmental Emergencies Center	1-866-283-2333
Saskatchewan	Spill Report Centre	1-800-667-7525
Yukon Territory	Spill Report Centre	1-867-667-7244

Americas

Hearing Conservation

S3AM-118-PR1

1.0 Purpose and Scope

1.1 Establishes procedures to confirm that personal noise exposure remains within acceptable limits and establishes the requirements of an acceptable hearing conservation program.

1.2 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 **ABC System** – The system used in Canada to classify hearing protectors on the basis of the attenuation provided by the hearing protection.

2.2 **Action Level** – May also be referred to as **Monitoring Level**. An eight-hour, time-weighted average established by the applicable jurisdiction, measured on the A-scale, slow response. Depending upon jurisdiction, this can vary anywhere from 74dBA to 85dBA, and may additionally be defined as 50% of the allowable noise dose. In the absence of a specified jurisdictional action level, 85dBA shall be used as the default action level.

2.3 **Attenuation –** The reduction of the sound level at the ears of a person wearing hearing protectors.

2.4 **Decibel (dB)** – Logarithmic unit of measurement of sound level.

2.5 **Established Exposure Limit** – The maximum regulatory noise exposure to which an individual may be exposed to for an 8- hour time weighted average (TWA).

- This limit is referred to by different terminology depending upon the given jurisdiction (e.g. Permissible Exposure Limit (PEL), Contamination Limit, Occupational Exposure Limit (OEL), Threshold Limit Value (TLV), etc.).
- Acceptable methods of adjusting this limit to correspond to a different exposure period (e.g. 10 hours) vary by jurisdiction.

2.6 **Standard Threshold Shift (STS)** – When one's hearing threshold has changed (relative to the baseline audiogram) an average of 10 dB or more at 2000, 3000, or 4000 Hz in either ear).

2.7 **Noise Reduction Rating (NRR)** – The measure, in decibels, of how well a hearing protector reduces noise (attenuation), as specified by the United States of America Environmental Protection Agency. It is a requirement in the USA that all hearing protectors have the NRR stamped on their packaging.

2.8 **Time-Weighted Average (TWA) Sound Level** – That sound level, which if constant over an 8-hour exposure, would result in the same noise dose as is measured.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-127-PR1 Exposure Monitoring

3.3 S3AM-128-PR1 Medical Screening & Surveillance

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **SH&E Manager**

- Provide access to initial and refresher hearing conservation training.

- Inform employees of noise monitoring results when full-shift noise exposure is at or above the action level.
- Designate areas and tasks where employees' exposure is at or above the action level.
- Conduct noise monitoring and supervise noise surveys, as applicable, and support hazardous noise assessment/evaluation efforts.

4.1.2 **Manager**

- Implement the hearing conservation program.
- Confirm that a hazardous noise assessment/evaluation has been conducted.
- Confirm that a hazardous noise assessment/evaluation is conducted when a change in equipment, procedures, or personnel may increase employee exposure to noise.
- Implement engineering controls to reduce noise levels when such measures are considered feasible and when required by regulation.
- Purchase, monitor, and replenish for employees' use, a supply of hearing protection devices with a minimum Noise Reduction Rating (NRR) of 26 dBA, or of the appropriate classification for the applicable jurisdiction.
- Confirm that individuals included in the program receive training and that the training meets the criteria outlined in this program.
- Investigate and implement corrective action to all reports of non-conformance with this procedure, including reports of standard threshold shifts or employees' failure to wear hearing protectors in designated areas.
- Maintain an awareness of the noise levels in work areas for which he/she is responsible.
- Place warning signs in areas where sound levels would require the use of hearing protectors.
- Request that a hazardous noise assessment/evaluation be conducted when a change in equipment, procedures, or personnel may increase employee exposure to noise above action levels.
- Confirm that all employees are aware of the requirements for hearing protection for any designated area or task.
- Enforce the use of hearing protection by employees in designated areas and for designated tasks.

4.1.3 **Employee**

- Comply with the requirements of the Hearing Conservation program.
- Wear hearing protection devices in designated areas or for designated tasks.
- Inspect and maintain hearing protection devices.
- Report any suspected change in noise levels of work area to supervisor.
- Report any signs or symptoms experienced that could be the result of overexposure to noise to supervisor.
- Participate in audiometric testing and hearing protection training when required.

4.2 General Requirements

4.2.1 The requirements of this procedure apply to all locations/facilities/projects where employee noise exposure may equal or exceed the action level.

4.2.2 SH&E Plans and Task Hazard Assessments (THA) shall identify applicable hazards related to noise exposure. Identify established exposure limits and action levels specified by the applicable jurisdiction, or in the absence of specifications, an 8-hour TWA of 85 dBA.

- The below chart is intended to provide basic established exposure limits by jurisdiction. Please consult the applicable jurisdictional legislation to obtain further information and to verify accuracy.

	8hr TWA Established Exposure Limit (dBA)	8hr TWA Action Level (dBA)
OSHA	90	85
Canada - Federal	87	74
Alberta	85	85
British Columbia	85	82
Manitoba	85	80
New Brunswick	85	80
Newfoundland	85	85
Northwest Territories	85	80
Nova Scotia	85	85
Nunavut	85	85
Ontario	85	85
Prince Edward Island	85	85
Quebec	90	85
Saskatchewan	85	80
Yukon	85	80

- Acceptable methods of adjusting this limit to correspond to a different exposure period (e.g. 10 hours) vary by jurisdiction.

4.2.3 When processes or areas present noise exposures that are or could be at or above the action level identified for the given jurisdiction, monitoring and interpretation of results shall be undertaken by a trained and competent individual using approved equipment (sound level meters, sound dosimeters) to assess the hazard.

4.2.4 Resulting documentation (e.g. noise maps, results of the sound level survey data, etc.) will be posted at the location.

4.2.5 Noise assessments shall be repeated when there is any change in processes or equipment that could affect the noise level or the exposure duration.

4.2.6 Eliminate noise sources or reduce noise levels to the extent possible prior to implementing hearing protection PPE. Examples of controls that shall be considered include:

- Adding or replacing mufflers on motorized equipment.
- Adding mufflers to air exhausts on pneumatic equipment.
- Following equipment maintenance procedures to lubricate dry bearings and replace worn or broken components.
- Isolating loud equipment with barriers.
- Replacing loud equipment with newer and quieter models.
- Using caution signs and Hearing Protection Required signs to designate noisy work areas.
- Installing hearing protection device-dispensing stations at the entrance to noisy work areas.

4.2.7 Where practicable, a clearly visible warning sign shall be posted at every approach to an area in the workplace where the sound level regularly exceeds 85 dBA.

4.3 Hearing Protectors

4.3.1 Hearing protectors will be used in the event that administrative or engineering controls are either not effective or not feasible.

4.3.2 Selection of appropriate hearing protectors shall be based on actual or anticipated exposure levels, the attenuation provided by the device, and the manufacturer's information about the use and limitations of the device.

4.3.3 At a minimum, hearing protectors shall provide a level of protection that brings actual or anticipated exposure below the established exposure limit for the applicable jurisdiction. Additional information relative to hearing protector use is as follows:

- The use of hearing protectors is required in any location where powered or motorized equipment, portable tools or any other noise source could reasonably be expected to exceed noise levels specified by the applicable jurisdiction, or in the absence of specifications, an 8-hour TWA of 85 dBA.
- Hearing protection will be mandatory for all employees working in any area that has not been evaluated for noise exposure and the ambient noise level in the area is such that a raised voice is necessary to have a normal conversation with someone less than three feet (1 meter) away, and/or when within 25 feet (7.6 meters) of an operating piece of heavy equipment.
- Hearing protection will be mandatory for all employees who work on or near heavy equipment unless personal dosimetry or other techniques have been used to document actual exposure.
- Hearing protectors will be made available to all employees at no cost to the employees who may be exposed to noise levels specified by the applicable jurisdiction, or in the absence of specifications, an 8-hour TWA of 85 dBA.
- Hearing protection will be mandatory for all employees exposed to 85 dBA for any period of time and who have experienced an STS.
- Whenever information indicates that any employee's exposure may equal or exceed specified levels (or as applicable, an 8-hour TWA of 85 dBA), the manager will be responsible for enforcing the proper use of hearing protectors.
- At least two types of hearing protectors shall be available to employees free of charge, and the type of hearing protector shall be suitable to the task and approved to the applicable jurisdiction.
- Hearing protectors shall be used in accordance with manufacturer's specifications to effectively protect hearing. Refer to *S3AM-118-ATT1 Hearing Protection Guidelines*.

4.3.4 Evaluate the effectiveness of the hearing protectors chosen.

4.3.5 The manufacturer's assigned noise reduction rating (NRR) or attenuation for hearing protection devices can seldom be achieved in workplace conditions; therefore this rating shall be adjusted for real world conditions and use.

- For devices with an NRR rating, subtract 7 from the NRR of the protector provided by the manufacturer. Divide this result by 2, and then subtract the remained from the observed "A" scale sound level measurement collected in the employee's work area (see Section 4.B). If this number is below 85, the hearing protectors are adequate for use in the work area.

4.3.6 Implement a hearing conservation program as applicable and in accordance with jurisdictional requirements

4.4 Training

4.4.1 All employees with potential exposure above the action levels applicable to their jurisdiction, or who otherwise utilize any type of hearing protector will participate in a hearing conservation training program. Refer to *S3AM-003-PR1 SH&E Training*.

4.4.2 The initial and subsequent annual hearing conservation training will address, at a minimum, the following topics:

- The effects of noise on hearing, recognizing hazardous noise, and symptoms of overexposure to hazardous noise.
- When and/or where hearing protectors are required to be worn.
- The purpose of hearing protectors.
- The advantages, disadvantages, and effectiveness of various types of protectors.
- Instructions on care and use of hearing protectors, including its limitations, proper fitting, inspection and maintenance and, if applicable, the cleaning and disinfection of the protector.
- The purpose of audiometric testing, including an explanation of the test procedures.
- Hearing Conservation Program requirements and responsibilities.

4.4.3 Hearing protection training is conducted annually for all affected employees or more frequently for employees who do not properly use hearing protectors or otherwise fail to comply with this policy.

4.5 Audiometric Testing

4.5.1 All AECOM personnel with exposure greater than the action level shall be enrolled in the medical surveillance program and undergo a baseline audiogram within 6 months of the first exposure (consult local jurisdiction for more stringent timelines).

4.5.2 Thereafter, annual audiograms will be compared with the baseline exam. Testing to establish a baseline audiogram will be preceded by 14 hours without exposure to noise, including noise exposure away from work. Hearing protectors may be used as a substitute for the requirement that a baseline audiogram will be preceded by 14 hours without exposure to noise.

4.5.3 Enrolled employees will receive audiograms during their exit physicals; refer to *S3AM-128-PR1 Medical Screening & Surveillance Program.*

- Audiometric tests will be performed by a person meeting the requirements specified by the applicable jurisdiction.
- The medical surveillance provider will notify employees of the need to avoid high levels of non-occupational noise exposure during the 14-hour period immediately preceding the audiometric examination.
- For multi-year projects, an annual audiogram will be obtained for each employee exposed at or above the level specified by the applicable jurisdiction, or in the absence of specifications, an 8-hour TWA of 85 decibels.

4.5.4 Each employee's annual audiogram will be compared to that employee's baseline audiogram to determine if the audiogram is valid, and if there is a standard threshold shift (STS).

4.5.5 When a Standard Threshold Shift (STS), as identified by the AECOM Medical Consultant, is noted between the last valid baseline and the annual audiogram, the following steps will be taken:

- A retest will be conducted within 30 days to confirm the STS. The employee will not be exposed to workplace/hobby noise for 14 hours or will be provided with adequate hearing protection prior to testing.
- If the STS persists, ear protection will be evaluated and refitted, and may be upgraded to one with a greater NRR or classification. The hearing protection will have a minimum NRR of 26 dBA, or be of the appropriate classification for the applicable jurisdiction.
- The employee will be counselled and AECOM will obtain information regarding the employee's possible noise exposure away from the workplace or existing ear pathology.
- Qualified medical personnel will review the audiograms. This group will determine the need for a medical referral.

- The employee will be notified in writing by either the **SH&E Manager** or the AECOM Medical Provider of the STS, within 21 days of determination, or as required by the applicable jurisdiction.
- The employee's supervisor will be notified of the shift in hearing threshold.

4.5.6 An employee who has experienced an STS shall comply with any recommendations made by medical personnel as they relate to the employees assigned work duties (e.g. dual hearing protection of earplugs and earmuffs).

4.6 Employee Monitoring

4.6.1 When information indicates that any employee's exposure may equal or exceed the applicable action level, the SH&E Manager shall develop and implement a site-specific monitoring program to identify employees for inclusion in the hearing conservation program and to enable the proper selection of hearing protectors. Refer to *S3AM-118-FM1 Site-Specific Hearing Conservation Program* and *S3AM-127-PR1 Exposure Monitoring*.

4.6.2 Noise surveys shall be conducted in a manner that reasonably reflects the exposure of the affected employees. Surveys shall be conducted under the supervision of an AECOM SH&E Manager. Refer to *S3AM-118-FM2 Sound Level Survey* and *S3AM-118-FM3 Noise Dosimetry Record*.

4.6.3 Sound-level meters and audio dosimeters used to determine employee exposure to noise sources shall be Type II (accurate to within +/- 2 dBA), operated in “slow” response, on the “A” scale, and be calibrated to factory guidelines (including periodic factory recalibration).

5.0 Records

5.1 Noise exposure measurement records, surveys and Site-Specific Hearing Conservation Plans will be retained at the project/facility for the duration of the project.

5.2 Audiogram records will be retained in the employee’s medical records as per *S3AM-128-PR1 Medical Screening & Surveillance Program*.

5.3 Employee training session documentation will be retained in accordance with *S3AM-003-PR1 SH&E Training*.

6.0 Attachments

6.1 S3AM-118-ATT1 Hearing Protection Guidelines

6.2 S3AM-118-FM1 Site-Specific Hearing Conservation Program

6.3 S3AM-118-FM2 Sound Level Survey

6.4 S3AM-118-FM3 Noise Dosimetry Record

Americas

Site-Specific Hearing Conservation Program

S3AM-118-FM1

Site (Project): _____ **Location :** _____

This program developed by:	Date:
Description of noise monitoring to be conducted (refer to *S3AM-118-FM2 Sound Level Survey* and *S3AM-118-FM3 Noise Dosimetry Report*) :	
Such monitoring will consist of (*check those that apply*): ☐ Noise Dosimetry ☐ Sound Level Meter Survey	

Monitoring

Specific instrumentation to be used is (make/model):

Make	Model
and will be calibrated at a frequency of _____ and documented in the _____.	

Monitoring strategy is as follows (*list all equipment and activities on site that may involve sound pressure levels above 80 dBA and an explanation of the strategy to document actual exposures*):

Area/Equipment	Monitoring Strategy

Where areas or equipment are not clearly identified, all monitoring will be documented utilizing an illustrated layout (*attach illustration developed for the specific site*). Monitoring frequency will be in accordance with the strategy outlined above and when the following changes in site conditions/activities occur:

1.
2.
3.
4.
5.

Employee Notification

All site employees exposed above the regulated action level of _____ dBA will be notified of the monitoring results by (*insert name/title*) _____ at an interval not to exceed _____ after completion of monitoring.

Notification shall be written, with a copy to the SH&E Department. Documentation of employee notifications and corresponding signatures of notified employees will be kept in the site health and safety logbook/files.

Observation of Monitoring

All employees affected by the monitoring, or a designated employee representative, shall be given the opportunity to observe noise monitoring procedures. This will be achieved by:

Audiometric Testing Program and Requirements

AECOM employees who perform field activities where noise exposure above action levels is expected are required to participate in an audiometric testing program. Additionally, any subcontractors performing work on AECOM projects where noise levels exceeding action level will be required to provide documentation that they participate in an audiometric testing program that meets the applicable regulations. Documentation of participation in the testing program will be maintained by _____ and will be located at _____.

Hearing Protectors and Estimating Attenuation

A selection of suitable hearing protectors will be made available to all employees who are expected to have 8-hour TWA noise exposures above dBA. The types anticipated to be available include:

Protection Type	Attenuation

Hearing protector attenuation will be evaluated by (*insert name/title*) for specific noise environments according to the following method prior to determining their suitability for use:

1.
2.
3.

The following employees will be required to wear hearing protectors during specific activities according to the results of site-specific monitoring conducted in accordance with this procedure. (This section can be completed after monitoring, if necessary).

Employee Name	Activity Type	Type of Protection

As applicable, hearing protectors will be properly fitted by _____ upon initial distribution to site workers.

Training in the use and care of hearing protectors shall be conducted by _____ during the initial site-specific health and safety training. Training contents shall meet the requirements set forth in this procedure and the applicable regulations.

Hearing protectors will be distributed by _____ from the storage location at the _____ _____.

Access to Information and Training Materials

All information required by regulation to be made available to the employees will be posted by *(insert name / title)* _____ _____ at the _____.

Local Occupational Health and Safety Regulations will also be kept on site.

Recordkeeping

Records required by AECOM's Hearing Conservation Program and Regulations shall be completed by _____ and shall be maintained at the _____ and placed on permanent file at the _____ for the minimum duration required by the standard. Employees can access their individual records by contacting _____.

All records required by this section will be transferred to any employee's successive employer if AECOM ceases to do business.

Approvals

Manager (print):

Signature: _____ Date: _____

SH&E Manager (print): _____

Signature: _____ Date: _____

Americas

Sound Level Survey

S3AM-118-FM2

Location: _____ **Date:** _____

Conducted By: _____

Sound Level Meter: _____ **Serial #:** _____

Calibrator Model: _____ **Serial #:** _____ **Class:** ☐ 1 ☐ 2

Battery Check Completed: ☐ **Date of Factory Calibration:** _____

Test No.	Description Location/Equipment	Distance	dBA	Hearing Protection Required?		Comments
				Yes	No	
				☐	☐	
				☐	☐	
				☐	☐	
				☐	☐	
				☐	☐	
				☐	☐	
				☐	☐	
				☐	☐	
				☐	☐	
				☐	☐	
				☐	☐	
				☐	☐	
				☐	☐	
				☐	☐	
				☐	☐	
				☐	☐	
				☐	☐	
				☐	☐	
				☐	☐	

Drawing of Equipment or Work Layout

Reference Numbers refer to the Test Numbers on Page 1

Americas

Noise Dosimetry Record

S3AM-118-FM3

Sample Identification

Sample #: _____ Date: _____

Employee Monitored: _____ Employee #: _____

Job: _____ Location: _____

Dosimeter Information

Model: _____ Serial # _____

Criterion Level (in dBA): _____ Threshold (in dBA): _____ Exchange Rate (in dBA): _____

Calibration (in dBA): Initial _____ Final _____

Weighting: Fast ☐ Slow ☐

Calibrator Information

Model: _____ Serial #: _____ Class ☐ 1 ☐ 2

Battery Check Completed: ☐ Date of Factory Calibration: _____

Sample Information

Time On: _____ Time Off: _____ Total Run Time (in min): _____

Time Weighted Average (in dBA): _____ %Dose: _____ Est. %Dose: _____

Average Sound Level (L_{avg}): _____ Peak Sound Level (L_{pk}): _____

Maximum Sound Level (L_{max}): _____ Minimum Sound Level (L_{min}): _____

Workplace Conditions

Scheduled Hours per Shift: _____ Operations: Normal? ☐ Abnormal? ☐

Explain: _____

Hearing Protection: Type _____ % of Time Worn _____

Work Description/Comments

_____

_____

_____

Sampled By: _____

Americas

Hearing Protection Guidelines

S3AM-118-ATT1

Comparison of Hearing Protection	
Ear Plugs	**Ear Muffs**
Advantages: • small and easily carried • convenient to use with other personal protection equipment (can be worn with ear muffs) • more comfortable for long-term wear in hot, humid work areas • convenient for use in confined work areas • may be disposable (cleaning not necessary)	***Advantages:*** • less attenuation variability among users • designed so that one size fits most head sizes • easily seen at a distance to assist in the monitoring of their use • not easily misplaced or lost • may be worn with minor ear infections
Disadvantages: • requires more time to fit • more difficult to insert and remove • require good hygiene practices • may irritate the ear canal • easily misplaced • more difficult to see and monitor usage	***Disadvantages:*** • less portable and heavier • more inconvenient for use with other personal protective equipment • more uncomfortable in hot, humid work area • more inconvenient for use in confined work areas • safety or prescription glasses can reduce hearing protection by breaking the seal between the earmuff and the skin. • must be cleaned/decontaminated as necessary

1.0 Care and Use

1.1 Follow the manufacturer's instructions.

1.2 Inspect the earplugs prior to use. Dirty earplugs and insertion with dirty hands can result in ear infections. Moldable or foam earplugs should be discarded if dirty or the pliability has been lost

1.3 To correctly insert earplugs pull the ear up and back with the opposite hand in order to widen and straighten the ear canal. Foam earplugs should be compressed to insert deeply into the canal. Hold the plug in place until the foam expands to ensure optimal blockage. Confirm hair or clothing does not impede the fit.

1.4 Ensure the earmuff ear cushion seal around the ear is complete and is not compromised by hair, clothing or glasses. If equipped with a headband, the fit should be snug, but not so tight as to produce discomfort.

1.5 Check hearing protection regularly for wear and tear.

1.6 Replace ear cushions or plugs that are no longer pliable or cracked.

1.7 Hearing protection using head bands shall be replaced when the ear cushions are not kept snugly against the head, or semi-insert earplugs are not adequately held in place.

1.8 Disassemble ear muffs to clean.

1.9 Wash ear muffs with a mild liquid detergent in warm water, and then rinse in clear warm water. Sound-attenuating material inside the ear cushions must not get wet.

1.10 Use a soft brush to remove skin oil and dirt that can harden ear cushions.

1.11 Squeeze excess moisture from the plugs or cushions and then place them on a clean surface to air dry.

1.12 Store earplugs and earmuffs in a cool, dry and clean place.

Americas

Non-Ionizing Radiation

S3AM-121-PR1

1.0 Purpose and Scope

1.1 Provides the requirements and guidelines to control occupational and public exposure to non-ionizing radiation, including lasers and radiofrequency (RF), infrared (IR), and ultraviolet (UV) radiation.

1.2 This procedure applies to all AECOM Americas employees and operations, and any other entity and its personnel contractually required to comply with this document's content, except where local or governmental regulations are more stringent.

2.0 Terms and Definitions

2.1 **Controlled Environment** – An area where the occupancy and activity of those within is subject to control and supervision for the purpose of protection from radiation hazards.

2.2 **Hazard Distance** – Distance from a radiofrequency emitter at which the power density equals the Uncontrolled Environment Maximum Permissible Exposure Limit power density level as established by the latest edition of the ANSI C95.1.

2.3 **ANSI Z136.1 Safe Use of Lasers**– American National standard issued applicable to the safe use of lasers and laser systems emitting laser radiation in the wavelength range 180 nanometres to 1 millimetre. The standard defines the classification of lasers (Class 1, 1M, 2, 2M, 3R, 3B and 4) based on Accessible Emission Limit (AEL) and viewing conditions.

2.4 **Infrared (IR)** – Electromagnetic radiation having a wavelength just greater than that of the red end of the visible light spectrum but less than that of microwaves. Infrared radiation has a wavelength from about 800 nm to 1 mm, and is emitted particularly by heated objects

2.5 **Laser –** An acronym for Light Amplification by Stimulated Emission of Radiation.

2.6 **Maximum Permissible Exposure (MPE) Limits** – The level of exposure which is considered as the limit between safe and potentially harmful.

2.7 **Non-ionizing Radiation** – Any type of electromagnetic radiation that does not carry enough energy to ionize atoms or molecules. Examples include radiofrequency radiation, microwave radiation, ultraviolet radiation, visible light, infrared radiation, lasers, static electric and magnetic fields, etc.

2.8 **Radio frequency (RF)** – Any of the electromagnetic wave frequencies that lie in the range extending from around 3 kHz to 300 GHz, and includes frequencies used for communication signals (e.g. radio, cell-phone, etc.) or radar signals.

2.9 **Ultraviolet (UV)** – Electromagnetic radiation having wavelengths between that of ordinary, visible violet light that of x-rays. Ultraviolet radiation is made up of three types of rays; A (UVA), B (UVB), and C (UVC). UV radiation is present in sunlight, and also produced by electric arcs and specialized lights (e.g. mercury-vapor lamps, black lights).

2.10 **Uncontrolled Environment** – Locations where there is the exposure of individuals who have no knowledge or control of their exposure.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-120-PR1 Radiation

3.3 S3AM-128-PR1 Medical Screening & Surveillance

3.4 S3AM-208-PR1 Personal Protective Equipment

3.5 S3AM-209-PR1 Risk Assessment & Management

3.6 S3AM-325-PR1 Lockout Tagout

3.7 S3AM-332-PR1 Hot Work

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Corporate SH&E Management System & Prequalification Manager**

The SH&E Department will maintain this procedure and include it in the annual review of the AECOM Americas SH&E procedures.

4.1.2 **SH&E Manager (or designee)**

The SH&E Manager will provide technical guidance to projects that involve the use/survey of non-ionizing sources as well as identifying the proper controls to mitigate employee exposure to non-ionizing radiation sources, including UV radiation. In addition, SH&E Managers will:

- Review and approve all exposure plans, such as Non-Ionizing Radiation Protection Plans (NIRPP);
- Conduct non-ionizing radiation hazard assessments;
- Confirm applicable awareness training on non-ionizing radiation hazards is available to project teams. Refer to *S3AM-003-PR1 SH&E Training*;
- Authorize the use of a Class 3B and 4 lasers.

4.1.3 **Manager**

Managers are responsible for the overall safety and planning for a project. Managers are also responsible for:

- Verifying that the presence of non-ionizing radiation sources at project work sites are identified in the applicable SH&E Plan and Task Hazard Assessment (THA) prior to commencing field activities;
- Addressing and controlling potential non-ionizing radiation hazards through consultation with the SH&E Manager, subject matter experts (as appropriate), and/or development of a NIRPP;
- Verifying incident and injury reporting procedures are followed when a suspected overexposure to non-ionizing radiation, an incident of sunburn, or other excessive non-ionizing radiation exposure occurs in the workplace;
- Monitoring employee compliance with the requirements of this policy;
- Confirming employees complete non-ionizing radiation awareness training as directed by the SH&E Manager.

4.1.4 **Employee**

- Will not disturb or handle any non-ionizing radiation sources or work in any identified non-ionizing radiation hazard area (e.g.., Controlled Environment) without appropriate training and safety procedures;
- Will work in accordance with all established manufacturer, client, and NIRPP requirements;
- Will identify both known and suspected non-ionizing radiation sources on the THA and report any change in site conditions related to non-ionizing radiation sources to the Manager;
- Will immediately notify the Manager of the presence or suspected presence of previously unidentified non-ionizing radiation sources in the workplace, and cease all work activities involving potential exposure to non-ionizing radiation until further direction is received;
- Will use suitable personal protective equipment to the non-ionizing radiation hazards.

4.2 Hazard Assessment

4.2.1 AECOM will identify and assess the hazards associated with work where the potential exists for employees to be exposed to laser radiation or other non-ionizing radiation sources, develop appropriate elimination and control measures, and document this in the location or project specific SH&E Plan.

- If routine exposures to laser radiation or other non-ionizing radiation sources are expected, an appropriate plan, such as a Non-Ionizing Radiation Protection Plan (NIRPP) should be developed. The plan (e.g. NIRPP) may be included in the location or project specific SH&E Plan;
- Consultation with subject matter experts may be necessary depending upon the extent, number, and type of non-ionizing radiation (e.g., Laser Safety Officer);
- Task specific hazards and associated controls shall also be identified in the respective THA;
- Refer to *S3AM-209-PR1 Risk Assessment & Management*.

4.2.2 In addition to the SH&E Plan, appropriate personal protective equipment will be identified and documented in the THA or other relevant hazard assessment documentation.

4.2.3 AECOM will develop and implement an appropriate NIRPP to control identified hazards where the potential to exceed the applicable Maximum Permissible Exposure (MPE) limits exist.

4.3 Laser Protection Requirements

4.3.1 Only qualified and trained employees will be assigned to install, adjust, and operate laser equipment for surveys, alignment/grade-checks, tunnel work, etc.

4.3.2 Laser equipment will bear a label to indicate maximum power output, ANSI class, and beam spread.

4.3.3 Looking into the primary beam is prohibited, and care will be taken to avoid looking at specular reflections of the beam, including those from lens surface work.

4.3.4 Where direct or reflected laser light greater than 0.005 watts (5 milliwatts) for ≥ ¼ second exists, employees will be provided with laser safety goggles that will protect them for the specific wavelength of the laser and be of an optical density (OD) adequate for the energy involved. The laser safety goggles will be selected in accordance with the requirements of ANSI Z136.1-2014 (or the most current edition).

4.3.5 Operation of an ANSI Class 3B or 4 laser should be assessed for exposure hazards and whether medical surveillance is appropriate. Refer to *S3AM-128-PR1 Medical Screening & Surveillance*.

4.3.6 Use of an ANSI Class 4 laser requires the approval of the SH&E Manager.

4.3.7 All protective goggles will bear a label identifying the following data:

- The laser wavelength for which use is intended;
- The optical density of that wavelength;
- The visible light transmission.

4.3.8 Class 1 Lasers

- Safe for the unprotected eye and through optical instruments (prescription lenses, telescopes, beam reducers, etc.);
- Very low power lasers or enclosed lasers;
- MPE is never exceeded, even for very long exposure (hours), or with the use of optical instruments;
- Nominal Hazard Zone: none.

4.3.9 Class 1M Lasers

- Safe for the unprotected eye only, but potentially hazardous when optical instruments are used;
- Medium power lasers either collimated with a large beam or highly divergent;
- MPE can be exceeded when using optical instruments;
- Nominal Hazard Zone: none for the unprotected eye.

4.3.10 Class 2 Lasers

- Safe for unintended exposure, (less than 0.25 seconds) but hazardous when looking at for more than 0.25 seconds;
- Visible (wavelength of 400–700 nanometers) low power lasers;
- MPE is not exceeded provided the viewings are accidental only. MPE calculation assumes the blink reflex will stop the light after 0.25 second;
- Nominal Hazard Zone: none for accidental exposure.

4.3.11 Class 2M Lasers

- Safe for the unprotected eye when the exposure is unintended, (less than 0.25 seconds) but hazardous when looking at for more than 0.25 seconds or when optical instruments are used;
- Visible (wavelength of 400–700 nanometers) medium power lasers either collimated with a large beam or highly divergent;
- MPE is not exceeded provided the viewings are accidental only and only with unprotected eyes. MPE calculation assumes the blink reflex will stop the light after 0.25 seconds. Using optical instruments might bring the exposure above the MPE as well;
- Nominal Hazard Zone: none for accidental exposure to the unprotected eye.

4.3.12 Class 2M Lasers and Greater

- Areas where a Class 2M or higher, non-enclosed path laser beam is in use will be posted with standard laser-warning placards;
- Beam shutters or caps will be used, or the laser turned off, when laser transmission is not actually required. When the laser is left unattended for a period of time (e.g., >5 minutes), such as during the lunch hour, overnight, or at change of shifts, the laser will be turned off;
- Only mechanical or electronic means will be used as a detector for guiding the internal alignment of the laser. Aligning the laser with the unprotected eye is prohibited;
- The laser beam will not be directed at employees. Laser units will be set above or below the heads of employees;
- Employee exposure will be controlled to stay within the MPE limits specified in ANSI Z136.1-2014 (or the most current edition).

4.3.13 Class 3R Lasers

- Unsafe, except when handled carefully by experienced users. Accidental short exposure is considered as a small hazard;
- Low power lasers;
- MPE can be exceeded up to 5 times;
- Nominal Hazard Zone: hazard area for the eye, none for the skin.

4.3.14 Class 3B Lasers

- Unsafe without exception, laser safety goggles shall be worn within the nominal hazard zone. Focused lasers of this class are a potential fire hazard;

- Medium power lasers;
- MPE is exceeded more than 5 times. Skin MPE is not generally exceeded, except at focus;
- Nominal Hazard Zone: hazard area for the eye, none for the skin.

4.3.15 Class 4 Lasers

- Dangerous, Personal Protective Equipment (PPE) for eyes and skin shall be worn within the nominal hazard zone. Class 4 lasers are fire hazards as well. Diffuse reflections may be hazardous;
- High power lasers;
- Ocular and skin MPE are exceeded. Diffuse reflections exceed the MPE;
- Nominal Hazard Zone: hazard area for the eye and for the skin.

4.4 Radiofrequency Radiation Protection

4.4.1 Reduction in radiofrequency (RF) exposures can be accomplished through the implementation of appropriate administrative, work practice and engineering controls. Should routine occupational RF exposures be part of a project, a suitable plan shall be developed such as an NIRPP.

4.4.2 Generally, where RF emitters are identified, employees will:

- Remain outside any demarcated area where an RF hazard exists;
- Remain within the General Public exposure region;
- If the preceding requirements cannot be met or determined, AECOM will obtain a hazard assessment from the emitter's operator for controlling entity and provide it to the SH&E Manager for evaluation and determination of the relevant hazard mitigation measures.

4.4.3 If the above information is not available, an RF emitter survey will be required to assess the potential exposure hazards. An RF emitter survey shall be performed by an individual trained to effectively assess RF exposures.

4.4.4 Unless using an RF meter under the direction of an individual trained to effectively assess RF exposures, employees will not enter any area which is located within the RF hazard distance identified by the RF emitter survey. AECOM personal may enter a controlled area if the emitter has been de-energized and locked-out using standard Lockout/Tagout procedures in accordance with *S3AM-325-PR1 Lockout Tagout.*

4.5 Infrared Radiation Protection

4.5.1 Infrared (IR) radiation may be encountered during furnace operations, pouring, casting, hot dipping, laser and high-intensity light sources, curing, annealing and plastic welding.

4.5.2 Performance of welding and oxygen/acetylene cutting operations (torch cutting, brazing, welding) involves the use of an exposed high-temperature flame. This flame produces infrared (IR) radiation and UV radiation at the welding location which can cause cataracts, skin cancer, and thermal burns to the welder or other persons located nearby.

4.5.3 Skin Protection

- Long sleeve, flame-resistant shirts and/or forearm length Nomex gloves will be worn;
- Leather welder's apron or equivalent protection;
- Long pants shall be worn during any hot work task;
- Welding screens shall be utilized where feasible to protect the general public or other unprotected employees.

4.5.4 Eye Protection

- A welder's helmet or goggles with the appropriate lens shade will be worn. Refer to

S3AM-208-PR1 Personal Protective Equipment.

4.6 Ultraviolet Radiation Protection

4.6.1 Broad-spectrum UV radiation is classified as a known human carcinogen. UV radiation can cause harmful effects from both chronic and acute exposures including reddening of the skin (regardless of skin tone), accelerated skin aging, and damage to the eyes (e.g., cataracts, retinal burns, or welder's flash), and sunburn. Employees may be exposed to UV radiation from natural sunlight or manmade sources such as germicidal lamps (e.g., UV groundwater treatment systems) and welding.

4.6.2 While not required, the completion of an exposure or UV risk assessment will assess the risk posed by UV at the site. Such an assessment can be included in the SH&E plan and as part of a Task Hazard Assessment (THA). Special consideration should be given to work activities at higher elevations as the intensity of UV exposures are significantly higher than at lower elevations. Typically, UV exposure can increase 4-5% for every 1000 feet ascended. Also, some medications (e.g., Tetracycline) can increase sensitivity to UV exposure.

4.6.3 Control measures will be implemented at a worksite according to the conditions and work performed.

4.6.4 Engineering Controls

- Operations producing IR or UV radiation may be segregated or separated from other operations (e.g. use of automated systems, walls, screens, etc.);
- Employees will be encouraged to maximize use of the shade provided by trees, buildings, and other structures;
- Where there is limited access to natural shade, fixed or portable shade structures will be provided where practical;
- It is acknowledged that the provision of shade does not provide total protection from UV; therefore, it is recommended that outdoor workers adopt personal protection strategies such as protective clothing, sunscreen, and the wearing of hats in addition to using shade.

4.6.5 Administrative Controls

Consideration will be given to the reorganization of outdoor work programs to reduce UV exposure including, but not limited to:

- Use of the UV Index to assess UV hazards;
- Rescheduling work hours to enable workers to start earlier during May-September;

The UV Index, shown in Table 1, can help employees be aware of the expected level of UV radiation exposure on any given day.

Table 1. UV Index

Exposure Category	Index Number	Sun Protection Messages
Low	< 2	Wear sunglasses on bright days. In winter, reflections off of snow can nearly double UV strength. If you burn easily, cover up and use sunscreen.
Moderate	3-5	Take precautions, such as covering up and using sunscreen.
High	6-7	Protection against sunburn is needed.
Very High	8-10	Take extra precautions. Unprotected skin will be damaged and can burn quickly.
Extreme	11+	Take all precautions. Unprotected skin can burn in minutes.

4.6.6 Personal Protective Equipment

Employees who work outdoors shall provide and utilize personal outer clothing (e.g. shirt and trousers) that meets the established general clothing requirements per *S3AM-208-PR1 Personal Protective Equipment*. For those circumstances where the outer clothing requirements exceed the general clothing requirements, AECOM will provide the necessary clothing. The selection of appropriate protective clothing will take into account both the need to block UV and the need to reduce the effects of heat.

- Protective Clothing
    - Full length trouser pants and shirts that cover shoulders at a minimum (where practical, the fabric will have a close weave);
    - Where possible, clothing will be lightweight, loose fitting and have a collar;
    - Clothing and head wear with a sun (UV) protection factor (SFP) is encouraged but not required.
- Secondary hazards such as fire resistance will be considered.
- Head, Face, and Neck Protection
    - Hats provide shade and the larger the brim the greater the amount of shade that is provided;
    - Full brim hard hats are recommended (for additional protection, neck flaps are recommended);
    - In circumstances where the wearing of a broad-brimmed hard hat causes difficulties due to its size, sunscreen and other protective measures will be used.
- Eye Protection
    - Wrap-around, close-fitting, large safety glasses will reduce the amount of UV and glare that may pass around the edges of the glasses (the color or darkness of the lenses does not indicate the level of UV protection; therefore, verification with the manufacturer should be performed);
    - Safety glasses shall provide the level of protection appropriate to the potential non-ionizing radiation hazard exposures;
    - For hot work activities that may produce ultraviolet radiation, eye protection shall utilize the proper welding shade.
- Sunscreen
    - Sunscreen does not offer complete protection against the sun and should always be used in conjunction with other protective measures;
    - A broad spectrum and water-resistant sunscreen with a SPF of 30+, or a rating of no less than three stars, will be provided;
    - Expiration dates on the sunscreen will be regularly checked to confirm it has not expired per the manufacturer's instructions;
    - Sunscreen should be placed in an easily accessible location and employees instructed on the correct application and use;
    - Sunscreen should be generously applied to all areas of exposed skin at least 20 minutes before going outside and reapplied every two hours, or as needed by the work conditions.

4.7 Non-ionizing Radiation Training Program

4.7.1 Employees will receive training where the need for non-ionizing radiation control measures has been identified in the SH&E Plan and if developed, the Non-Ionizing Radiation Protection Plan.

4.7.2 Awareness training on the applicable non-ionizing radiation source will be provided to employees prior to the start of work in the area where the hazard exists as well as when employees are required to enter non-ionizing radiation Controlled Environments. Training curricula will be determined by the SH&E Department.

5.0 Records

5.1 Training records shall be maintained in accordance with *S3AM-003-PR1 SH&E Training.* RF emitter surveys will be maintained in applicable project files.

6.0 Attachments

6.1 None

Americas

Respiratory Protection

S3AM-123-PR1

1.0 Purpose and Scope

1.1 This procedure establishes a written respiratory protection program with the required elements and work site-specific procedures for respirator selection, use, and maintenance for any workplace where respirators are necessary to protect the health of an Employee.

1.2 The primary objective shall be to prevent exposure to atmospheric contaminants as far as feasible by accepted engineering control measures (e.g. enclosure or confinement of the operation, general and local exhaust ventilation [LEV], and substitution of less toxic materials). If respiratory hazards remain, suitable administrative controls and respiratory protective equipment requirements shall be established.

1.3 This procedure applies to all AECOM Americas-based employees and operations, and any other entity and its personnel contractually required to comply with this document's content, except where local or governmental regulations are more stringent**.**

2.0 Terms and Definitions

2.1 **Action Level (AL)** – An airborne concentration of a potentially toxic or hazardous substance, measured in parts per million by volume (ppm), microgram per cubic meter (µg/m3) milligram per cubic meter (mg/m3) or fibres per cubic centimetre (f/cc), that triggers certain provisions as required by the applicable jurisdictional legislation. In many cases the action level is 50% of the established exposure limit.

2.2 **Air-purifying respirator** – A respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.

2.3 **Approved** – Equipment tested and listed by the Bureau of Mines, jointly by the Mining Enforcement and Safety Administration (MESA), and the National Institute for Occupational Safety and Health (NIOSH), or jointly by the Mine Safety and Health Administration (MSHA) and NIOSH. Please note Canadian Standards Association (CSA) bases respirator selection on NIOSH criteria for the testing and certification of respirators.

2.4 **Assigned protection factor (APF)** – The ratio of the ambient concentration of an airborne substance (outside the respirator) to the concentration of the substance inside the respirator.

2.5 **Atmosphere-supplying respirator** – A respirator that supplies the user with breathing air from a source independent of the ambient atmosphere, including supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units.

2.6 **Breakthrough** – The first perception of an odor, taste or irritation experienced while wearing an air-purifying respirator. Breakthrough is generally an indication that the cartridges are saturated and are no longer filtering out the contaminant. Breakthrough can also be an indication of an improperly functioning respirator.

2.7 **Established Exposure Limit** – The maximum regulatory exposure concentration to which an individual may be exposed to for an 8- hour time weighted average (TWA).

- This limit is referred to by different terminology depending upon the given jurisdiction (e.g. Permissible Exposure Limit (PEL), Contamination Limit, Occupational Exposure Limit (OEL), Threshold Limit Value (TLV), etc.).
- Acceptable methods of adjusting this limit to correspond to a different exposure period (e.g. 10 hours) vary by jurisdiction and substance.

2.8 **Filtering facepiece (dust mask)** – A negative pressure particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium.

2.9 **Fit factor** – A quantitative estimate of the fit of a particular respirator to a specific individual, typically estimating the ratio of the concentration of a substance in ambient air to its concentration inside the respirator when worn.

2.10 **Fit test** – The use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual. (See also Qualitative fit test [QLFT] and Quantitative fit test [QNFT].)

2.11 **Hazardous atmosphere** – Any atmosphere, either immediately or not immediately dangerous to life or health, that is oxygen-deficient or that contains a toxic or disease-producing contaminant exceeding the legally established permissible exposure limit or, where applicable, the Threshold Limit Value established by the American Conference of Governmental Industrial Hygienists.

2.12 **Immediately dangerous to life or health (IDLH)** – An atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere.

2.13 **Maximum use concentration (MUC)** – The maximum concentration of an airborne contaminant from which an employee is expected to be protected when wearing a respirator, determined by the assigned protection factor of the respirator or class of respirators and the occupational exposure limit for that contaminant. The MUC is usually determined mathematically by multiplying the assigned protection factor (APF) specified for a respirator by the established exposure limit, which can include a short-term exposure limit and a ceiling limit or any other exposure limit used for that chemical agent, as defined by the authority having jurisdiction.

MUC = APF x established exposure limit

2.14 **Negative pressure respirator (tight fitting)** – A respirator in which the air pressure inside the facepiece is negative during inhalation with respect to the ambient air pressure outside the respirator.

2.15 **Oxygen-deficient atmosphere –** An atmosphere with oxygen content below 19.5 percent by volume.

2.16 **Physician or other licensed health care professional (PLHCP)** – An individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide or be delegated the responsibility to provide some or all of the health care services required by local or governmental respiratory protection standards.

2.17 **Positive pressure respirator** – A respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.

2.18 **Powered air-purifying respirator (PAPR)** – An air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.

2.19 **Pressure demand respirator** – A positive pressure atmosphere-supplying respirator that admits breathing air to the facepiece when the positive pressure is reduced inside the facepiece by inhalation.

2.20 **Qualitative fit test (QLFT)** – A pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent.

2.21 **Quantitative fit test (QNFT)** – An assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.

2.22 **Self-contained breathing apparatus (SCBA)** – An atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

2.23 **Supplied-air respirator (SAR) or airline respirator** – An atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.

2.24 **Tight-fitting facepiece** – A respiratory inlet covering that forms a complete seal with the face.

2.25 **User seal check** – An action conducted by the respirator user to determine if the respirator is properly sealed to the face.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-114-PR1 Compressed Gases

3.3 S3AM-128-PR1 Medical Screening & Surveillance

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Respiratory Protection Program Administrator**

The Respiratory Protection Program Administrator will be established at each project/location where employees are required to wear respirators. The Respiratory Protection Program Administrator will:

- Verify full compliance with this procedure.
- Assist with the arranging of any required medical evaluations or any other additional medical attention related to the use of a respirator.
- Perform or arrange suitable providers to perform the program evaluations described in this procedure.
- Maintain required inspections and testing/certifications of SCBA units

4.1.2 **Manager /Supervisor**

- Verify compliance with the respiratory protection program set forth in this procedure.
- Verify that only those employees who are medically qualified, properly trained, and fit tested are assigned to respirator work.
- Verify that respirators are provided, repaired, or replaced as may be required due to wear and deterioration.
- Confirm that the emergency rescue service is available to respond prior to any employees entering the IDLH area.

4.1.3 **SH&E Manager (or designee)**

- Monitor compliance with the various aspects of this program.
- Provide technical assistance regarding respirator selection and use, evaluate the effectiveness of this program, and support respirator training and fit testing (e.g. determine cartridge change out schedule for negative air respirators).
- Audit company compliance with this procedure.

4.1.4 **Employee**

- Use respiratory protection in accordance with instructions and training received.
- Maintain the respirator in accordance with this procedure and the manufacturer's instructions.
- Immediately report any malfunction of the respirator to the Supervisor or Manager or other responsible person.
- For employees who wish to wear respirators on a voluntary basis when not required to by AECOM or a regulatory agency, the employee shall complete *S3AM-123-FM2 – Voluntary Use of Respirators* or an equivalent form.

4.2 Training

4.2.1 Employees who wear respiratory protection shall receive training before they are assigned to a task that requires the use of respiratory protection.

4.2.2 Employees that may be exposed to a respiratory hazard will be instructed on the hazard and the controls prior to beginning work.

4.2.3 Atmospheric testing will be carried out by qualified personnel trained in the use, calibration, and interpretation of the test equipment.

4.2.4 Retraining shall be administered annually, and when the following situations occur:

- Changes in the workplace or the type of respirator render previous training obsolete;
- Inadequacies in the Employee's knowledge or use of the respirator indicate that the Employee has not retained the requisite understanding or skill; or
- Any other situation arises in which retraining appears necessary to verify safe respirator use.

4.2.5 Basic Respirator Training Program

Respirator training classes will include, at a minimum, the following**:**

- Instruction in the nature of the respiratory hazards, whether acute, chronic, or both, and a description of potential health effects if the respirators are not used;
- Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator;
- The limitations and capabilities of the respirator;
- Proper fitting, including demonstrations and practice in wearing, adjusting, determining the fit of, and performing a user seal check each time respirator is donned. Refer to *S3AM-123-ATT1 Fit Testing Protocol*, *S3AM-123-FM1 Respiratory Equipment Fit Test* and *S3AM-123-ATT2 User Seal Check*;
- How to inspect, put on, use and remove the respirator;
- How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions;
- The procedures for maintenance and storage of the respirator;
- How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators; and
- The general requirements of local or governmental Respiratory Protection Standards.

4.3 Medical Surveillance

4.3.1 No Employee shall be assigned to a task that requires the use of a respirator unless it has been determined that he/she is physically able to perform the work while using the required respirator.

4.3.2 Prior to wearing a respirator and in accordance with the applicable jurisdictional requirements, Employees shall complete medical screening to identify any relevant psychological or physiological impediments to respiratory protection use. Screening may require an initial baseline medical surveillance examination, based on jurisdictional requirements or screening results, performed by a PLHCP in accordance with the requirements of *S3AM-128-PR1 Medical Screening & Surveillance Program.*

4.3.3 Additional medical examinations will be provided to employees who wear respirators when:

- An Employee reports medical signs or symptoms that are related to ability to use a respirator;
- A PLHCP, Supervisor, or the Respiratory Protection Program Administrator determines that an Employee needs to be reevaluated;
- Information from the Respiratory Protection Program, including observations made during fit testing and program evaluation, indicates a need for Employee reevaluation; or

- A change occurs in workplace conditions (e.g., physical work effort, protective clothing, temperature, etc.) that may result in a substantial increase in the physiological burden placed on an Employee.

4.3.4 All medical surveillance examinations shall be at no cost to the employee and occur during normal working hours; shall be convenient, understandable, and confidential; and the Employee will be given the chance to discuss results with examining physician.

4.4 Respirator Selection

4.4.1 The location or project specific SH&E Plan shall identify applicable respiratory hazards and develop appropriate controls, which may include respiratory protection. If respiratory protection is necessary the SH&E Plan shall detail the requirements.

4.4.2 SH&E Managers or his/her designated representative shall select and provide an appropriate respirator based on:

- The respiratory hazard(s) to which the employee may be exposed, including oxygen deficiency. Identify potential contaminants, concentrations, and the physical state of airborne contaminants:
    - Particulates (dust, fibers, micro-organisms, smoke, fumes).
        - Indicate the presence of any oil in particulate hazards. (may be produced by motor vehicles, air compressor systems using oil lubricators) If unknown, oil shall be assumed to be present.
    - Vapor and gases
        - Gases which may produce an oxygen deficiency (i.e. helium, argon, carbon monoxide and nitrogen).
        - Gases which are acids or produce acids when in contact with moisture (i.e. sulphur oxides, carbon dioxide, hydrogen chloride).
        - Gases which are alkaline or produce alkalis in reaction with moisture (i.e. ammonia, amines, phosphine).
        - True gases or vapors from evaporation of organic liquids (i.e. acetone, toluene, benzene).
        - Metal reacted with an organic compound (i.e. tetra-ethyl lead: was used in leaded fuel and still in aviation fuel, organic phosphates).
        - Mercury vapor.
        - Radon.
- The eye and face hazards to which the employee may be exposed (absorption, irritant, impact).
- Workplace or user factors that may affect respirator performance and reliability.

4.4.3 SH&E Managers or his/her designated representative shall identify and evaluate the respiratory hazard(s) in the workplace. Evaluations shall include a reasonable estimate of employee exposures to respiratory hazard(s) and an identification of the contaminant's chemical state and physical form.

4.4.4 Respiratory protection is required for those operations in which engineering controls or work practice controls are not feasible to reduce toxic or hazardous substance exposure at or below the AL (or if applicable, established exposure limit).

4.4.5 Where the employee exposure cannot be identified or reasonably estimated, the atmosphere shall be considered IDLH.

4.4.6 Only approved respirators shall be selected and they shall be used in compliance with the conditions of their certification.

4.4.7 Respirators shall be selected from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user.

4.5 Fit Testing Procedures

4.5.1 After the medical assessment is complete, employees using a tight-fitting respirator shall pass an appropriate QLFT or QNFT prior to initial use of the respirator, whenever a different respirator facepiece (size, style, model or make) is used, and at least annually (or as required by the applicable jurisdiction) thereafter. Refer to *S3AM-123-ATT1 Fit Testing Protocol*.

4.5.2 Fit testing shall be performed using the same make, model, style and size of respirator the user would be expected to use.

4.5.3 Should the fit test fail, alternative makes, models, styles and sizes shall be tested to find a correct fit for the user.

4.5.4 Respiratory protective equipment shall not be used unless a satisfactory fit test has been achieved for that particular equipment.

4.5.5 Fit testing shall also verify user competency in donning, doffing, inspecting and performing of seal checks.

4.5.6 Additional fit tests will be performed:

- Whenever there is an indication that changes in the Employee's physical condition might have an effect on respirator fit (such conditions include, but are not limited to, facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight);
- If the Employee notifies his/her Supervisor or SH&E Manager that the fit of his/her respirator is unacceptable.

4.6 Interference with Facepiece Seal

4.6.1 AECOM shall not permit respirators with tight-fitting facepieces to be worn by Employees who have:

- Facial hair that comes between the sealing surface of the facepiece and the face or that interferes with valve function; or
- Any condition that interferes with the face-to-facepiece seal or valve function.

4.6.2 If an employee wears corrective glasses or goggles or other personal protective equipment, the Supervisor or Manager shall confirm that such equipment is worn in a manner that does not interfere with the seal of the facepiece to the face of the user.

4.6.3 Employees shall perform a user seal check each time they don the respirator. Refer to *S3AM-123-ATT2 User Seal Check Procedures*.

4.7 Specification of Proper Level of Respiratory Protection

4.7.1 The SH&E Manager or his/her designated and qualified representative shall provide guidance on the proper selection and use of all respiratory protective devices, including half-face and full-face air purifying respirators, airline respirators, and self-contained breathing apparatus. This information is generally specified as part of the written site-specific SH&E plan and Task Hazard Assessment (THA).

4.7.2 Employees engaged in activities not covered by a THA or SH&E plan shall stop work and consult with the SH&E Manager or his/her designated representative to determine the proper equipment to use prior to resuming activities. Whenever appropriate, exposure levels will be measured to verify that the actual use conditions are within the limitations of the approvals specified by NIOSH/MSHA for the selected respirator.

4.8 Cartridges

4.8.1 NIOSH certifies three classes of filters*:

Three categories of resistance to filter efficiency degradation:	Three levels of filter efficiency:
N (**N**ot resistant to oil)	95% (called “95”)
R (**R**esistant to oil)	99% (called “99”)
P (oil **P**roof)	99.97% (called “100”)

*Filters are available in any combination of the above.

4.8.2 Generally cartridge color denotes the type of contaminant the cartridge was designed to filter:

Olive:	Multi-contaminant
White:	Acid gas
Black:	Organic vapors
Green:	Ammonia gas
Yellow:	Acid gas and organic vapors
Blue:	Carbon Monoxide
Purple (Magenta):	Radioactive material, except tritium & noble gases
Purple:	Any particulates - P100
Orange:	Any particulates - P95, P99, R95, R99, R100
Teal:	Any particulates free of oil - N95, N99, or N100

Please note; this is only a basic listing and should only be used as a reference. Combinations, deviations or additional types may be encountered. To ensure proper cartridge selection consult the cartridge supplier to ensure applicability to the contaminant(s) anticipated

4.8.3 Filter cartridges shall be changed out whenever an increase in breathing resistance is detected by the user.

4.8.4 When available, chemical cartridges that are equipped with end-of-service life indicators (ESLI) shall be utilized. In those cases, cartridges should be changed when indicated by the ESLI. A buddy system should be used so coworkers can monitor each other’s cartridge color condition.

4.8.5 In the absence of cartridges equipped with an ESLI, employees shall change chemical cartridges on the following schedule:

- Immediately if breakthrough is perceived or if resistance to breathing is detected by the user; and
- In accordance with the change out schedule based upon the anticipated contaminant concentration, environmental conditions, employee work rate, and the specific data provided by manufacturer.

4.8.6 When PAPRs are worn, the same rules apply with the exception that filter cartridges should be changed when airflow through the filter elements decreases to an unacceptable level, as indicated by the manufacturer’s test device.

4.9 Air-Supplying Respirator Use

4.9.1 Air-supplying respirators will be specified for use when it has been determined that any of the following conditions exist:

- The oxygen concentration is less than 19.5 percent;
- The contaminant is unknown or its concentration cannot be quantified;
- The airborne contaminant concentration is above its IDLH;
- An air-purifying respirator canister or cartridge that removes the contaminant is not available;
- The contaminant concentration is above the concentration for which an air-purifying canister or cartridge is approved; or
- The contaminant concentration is above the MUC of a full-face air-purifying respirator.

4.9.2 No Employee may engage in an operation requiring the use of an air-supplied respirator unless the SH&E Manager or his/her designated representative has reviewed the operation and approved its use.

4.9.3 The determination of the type of air-supplying respirator (i.e., SCBA, airline, demand, pressure demand, etc.) appropriate for the job, outside standby persons, communication, proper training and equipment, notification procedures, and necessary action should be part of the THA or SH&E Plan. Mandatory equipment including SCBA or SAR with auxiliary air supply and emergency appropriate retrieval equipment or equivalent rescue means shall be made by the SH&E Manager or his/her designated representative at the time of the THA or SH&E Plan review. The need for any additional precautions (i.e., equipment specific training, on-site health and safety support, etc.) shall also be determined by the SH&E Manager or his/her designated representative.

4.10 Minimum Procedures for IDLH Atmospheres

4.10.1 One Employee or, when needed, more than one Employee shall be located outside the IDLH atmosphere. This employee shall be responsible for communicating with the Employees in the IDLH atmosphere, alerting rescue services if needed, and restricting entrance to the IDLH area by untrained and unapproved persons.

4.10.2 Visual, voice, or signal line communication shall be maintained between the Employee(s) in the IDLH atmosphere and the employee(s) located outside the IDLH atmosphere.

4.10.3 The Employee(s) located outside the IDLH atmosphere shall be trained and equipped to provide effective emergency rescue or to initiate on-site rescue services.

4.10.4 If on-site rescue services are to be used, the Manager or Supervisor shall confirm that the service is available to respond prior to any employees entering the IDLH area.

4.10.5 Employee(s) located outside the IDLH area and/or on-site rescue services shall be equipped with:

- Pressure demand or other positive pressure SCBAs, or a pressure demand or other positive pressure supplied-air respirator with auxiliary SCBA; and either
- Appropriate retrieval equipment for removing the employee(s) who enter(s) these hazardous atmospheres where retrieval equipment would contribute to the rescue of the employee(s) and would not increase the overall risk resulting from entry; or
- Equivalent means for rescue where retrieval equipment would create a hazard to the Employees in the IDLH area.

4.11 Breathing Air

4.11.1 Compressed air used for respiration shall be of high purity and shall meet, as a minimum, the requirements of the specification for Grade D breathing air as described in Compressed Gas Association Specification G-7.1 (ANSI Z86.1).

4.11.2 Oxygen shall NOT be used as a source of breathing air at any time in open-circuit SCBAs or airline respirators.

4.11.3 Compressor Supplied Breathing Air

- All compressors used for filling SCBA air cylinders or for supplying airline respirators shall be equipped with the following safety and standby devices:
    - The compressor intake shall be located to verify that only respirable (uncontaminated) air is admitted. This requires attention to the location of the compressor intake with respect to compressor engine exhaust, chemical storage or use areas, and suitable intake screening or filtration.
    - Alarms to indicate compressor failure (such as low-pressure air horns, etc.) shall be installed in the system.
    - A receiver of sufficient capacity to enable the respirator wearer to exit from a contaminated atmosphere shall be provided.
- If an oil-lubricated compressor is used to supply breathing air, it shall be equipped with both of the following devices:
    - A continuous reading carbon monoxide monitoring system set to alarm should the carbon monoxide concentration exceed 10 parts per million; and,
    - A high temperature alarm which will activate when the discharge air exceeds 110 percent of the normal operating temperature in degrees Fahrenheit.
- An in-line purifying filter assembly to remove oil, condensed water, particulates, odors, and organic vapors shall be used in conjunction with the air compressor.

4.11.4 Compressed Air Cylinder Systems for Airline Respirators

- Compressed air cylinders shall meet the requirements of *S3AM-114-PR1 Compressed Gases*.
- Compressed air cylinder systems used to supply airline respirators shall be equipped with low pressure warning bells (e.g., Scott Pak-Alarm) or similar warning devices to indicate air pressure in the manifold below 500 pounds per square inch (psi). When such systems are used, one employee shall be assigned as safety standby within audible range of the low pressure alarm.
- Airline hose couplings shall be incompatible with outlets for other gas systems to prevent inadvertently supplying airline respirators with non-respirable gases or oxygen.
- The air pressure at the hose connection to airline respiratory equipment shall be within the range specified in the approval of the equipment by the manufacturer.
- Routine inspection and maintenance of the air compressor shall be performed.

4.11.5 Compressed Air Cylinder Systems for Recharging SCBAs

- When a cascade system is used to recharge SCBA air cylinders, it shall be equipped with a high-pressure supply hose and coupling rated at a capacity of at least 3,000 psi.

4.11.6 Escape/Egress Units

- Escape/egress unit respirators are intended for use in areas where escape with a short-term (minimum 5 minutes) air supply is necessary. It is important that escape bottle size be provided that will allow the employee to get to a safe location considering breathing rate and distance.
- Escape bottles are required on air-line respirators used in IDLH and high hazard work conditions.
- They may be used as adjuncts to airline pressure demand respirators as a backup air supply or as independent emergency devices in areas where respiratory protection is not normally required.

- Appropriate training shall be conducted and documented prior to assigning Employees to tasks or locations subject to the use of these respirators.
- Escape/egress units (minimum 5 minutes) shall never be used to enter a hazardous atmosphere or as primary standby respirators for confined space entry.

4.12 Respirator Inspection, Cleaning, Maintenance, and Storage

When respirator use is required, only properly cleaned and maintained NIOSH/MSHA approved respirators shall be used.

4.12.1 Inspection

- Respirators should be inspected before and after use using *S3AM-123-FM3 Respiratory Equipment Inspection*, or equivalent. The respirator should not be used and removed and marked out of service if any item on the checklist fails inspection.
- Respirators for emergency use should be inspected once per month.
- Defects shall be reported to their Supervisor or Manager. No defective respirator shall be issued or worn.

4.12.2 Cleaning and Maintenance

- Respirator facepiece assemblies shall be cleaned and sanitized minimally after each day of use in accordance with the requirements specified in *S3AM-123-ATT3 Respirator Cleaning*.
- The respirator should also be inspected for any damaged parts (repair should only be done by trained personnel with the proper tools).
- Respiratory equipment shall not be passed from one person to another until it has been cleaned and sanitized.
- Respiratory equipment shall be maintained according to manufacturer's instructions.
- In field situations, a pre-moistened towelette (e.g., baby wipes) can be used. The mask should then be rinsed with clean warm water and dried. Towelettes or wipes shall be compatible with the respirator materials.
- Alcohol should never be used to clean masks as it can damage the facepieces and rubber parts.
- Where respirators are assigned to individual employees, management shall verify compliance with cleaning and maintenance requirements by periodic inspection and field audits of respiratory equipment.

4.12.3 Storage

- Store clean respirators so that they are protected from dust, excessive moisture, damaging chemicals, temperature extremes and direct sunlight or UV light. They should be placed in a sealed plastic bag and stored in the original box or similar container which blocks light.

4.13 Hygiene

4.13.1 Employees shall leave the work area to wash, change cartridges, or if they detect breakthrough or resistance.

4.14 Costs

4.14.1 The costs for training, medical examinations, fit testing, respirators, spectacle kits, and cleaning materials should be considered as operational costs.

4.15 Program Evaluation

4.15.1 The SH&E Manager or his/her designated representative shall conduct evaluations of the workplace as necessary to verify that the provisions of the current written program are being effectively implemented and that it continues to be effective.

4.15.2 The SH&E Manager shall regularly (i.e., during annual training) consult Employees required to use respirators to assess their views on program effectiveness and to identify any problems. Any problems that are identified during this assessment shall be corrected. Factors to be assessed include but are not limited to:

- Respirator fit (including the ability to use the respirator without interfering with effective workplace performance);
- Appropriate respirator selection for the hazards to which the Employee is exposed;
- Proper respirator use under the workplace conditions the Employee encounters; and
- Proper respirator maintenance.

5.0 Records

5.1 Medical records under this section shall be maintained at a minimum in accordance with *S3AM-128-PR1 Medical Screening & Surveillance.*

5.2 Fit Test Records shall be maintained in the Employee's health and safety records. *S3AM-123-FM1 Respiratory Equipment Fit Test*, or equivalent, will be used to document each fit test.

5.3 Training Records shall be maintained in accordance with *S3AM-003-PR1 SH&E Training***.**

6.0 Attachments

6.1 S3AM-123-ATT1 Fit Testing Protocol

6.2 S3AM-123-ATT2 User Seal Check

6.3 S3AM-123-ATT3 Respirator Cleaning

6.4 S3AM-123-FM1 Respiratory Equipment Fit Test

6.5 S3AM-123-FM2 Voluntary Use of Respirators

6.6 S3AM-123-FM3 Respiratory Equipment Inspection

Americas

Corrosive & Reactive Materials

S3AM-125-PR1

1.0 Purpose and Scope

1.1 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content where corrosive and/or reactive materials are used or stored.

1.2 The purpose of this procedure is to protect employees from the hazards of corrosive and reactive materials. This procedure considers a corrosive material as one that has a pH less than 2.0 (acid), or greater than 12.5 (base). A reactive material is a chemical that may be sensitive to shock, or may react with air or water depending upon its makeup.

2.0 Terms and Definitions

2.1 None

3.0 References

3.1 S3AM-115-PR1 Hazardous Materials Communication

3.2 S3AM-116-PR1 Hazardous Materials Shipping

3.3 S3AM-123-PR1 Respiratory Protection

3.4 S3AM-208-PR1 Personal Protective Equipment

4.0 Procedure

4.1 Implementation of this procedure is the responsibility of the Manager directing activities of the facility, site, or project location.

4.2 Appoint a responsible person who will:

4.2.1 Inspect storage areas periodically.

4.2.2 Monitor the quantity of corrosive and reactive materials on site, as well as that of incoming materials.

4.2.3 Review work practices that involve corrosive and reactive materials.

4.3 Require that all employees working with corrosive or reactive materials, or who may be exposed to such materials, are trained in accordance with *S3AM-115-PR1 – Hazardous Materials Communication*.

4.4 Control the use of corrosive and reactive materials by AECOM personnel.

4.4.1 Order only those materials and quantities that are needed to complete a job.

4.4.2 Check incoming corrosive and reactive materials for proper labeling in accordance with *S3AM-115-PR1 Hazardous Materials Communication*.

- Label materials, if needed, as they arrive on site.
- Mark reactive materials containers with the date of receipt of the chemical.

4.4.3 Check incoming corrosive and reactive materials for safety data sheets (SDS). If SDSs are not provided or are already on file, order them from the manufacturer, distributor, or vendor.

4.4.4 Add incoming corrosive and reactive chemicals to the hazardous materials inventory, if not already present, following procedures set forth in *S3AM-115-PR1 Hazardous Materials Communication.*

4.4.5 Do not store any quantity of corrosive or reactive materials in an office (with the exception of limited quantities of consumer products). These materials are to be stored off site, or at an on-site laboratory or storage area.

4.5 Store corrosive and reactive materials as indicted in the MSDS:

4.5.1 In a cool, dry environment, free from extremes of temperature and humidity.

4.5.2 In a manner that separates them from other materials (including flammables and oxidizers) and from each other.

- Separate acids and bases.
- Separate reactive materials from acids and bases, and protect from contact with water.

4.5.3 On materials that are acid-resistant (Teflon-coated, plastic, etc.) for small containers.

4.5.4 Covered, not stacked on one another, on acid-resistant material for carboys (approximately 5 gallons/22 liters).

4.5.5 On individual racks or securely blocked on skids, with closure (plug) facing upward to prevent leakage from drums.

4.6 Require that labeling and signage are in place.

4.6.1 Label containers with the appropriate warning word to indicate the hazard, such as: DANGER; WARNING; CAUTION; CORROSIVE; OXIDIZER.

4.7 Use corrosive and reactive materials appropriately.

4.7.1 Prior to use and in accordance with MSDS, safe-handling procedures shall be developed for each operation, and type and concentration of the chemical. In all cases, review the MSDS and product information before use.

4.7.2 Follow *S3AM-208-PR1 Personal Protective Equipment* when working with or around corrosive and reactive materials. Review the MSDS for the chemical used to determine the specific type of PPE needed, to include at a minimum:

- Chemical-splash goggles
- Chemical-resistant gloves
- Chemical-resistant apron

4.7.3 Obtain medical care immediately in the event of:

- Skin or eye exposure (e.g., splash) to corrosive liquids
- Inhalation of vapors of corrosive liquids that cause respiratory discomfort.

4.7.4 Require an eyewash station to be located in all areas where acids or bases are used. Safety showers shall be nearby if significant acid or base quantities are involved.

- Place emergency eyewashes and showers in accessible locations that require no more than 10 seconds to reach, and are in a travel distance no greater than 25 feet (7.5 meters) from the hazard.
- Keep the areas surrounding eyewashes and safety showers free of stored materials or debris at all times.
- Mark emergency eyewashes and showers with a highly visible sign.
- Require the area around emergency eyewashes and showers to be well lighted and visible.
- Where portable eyewash units are used, a process shall be in place to change the water and clean the unit, as required by the manufacturer's instructions.
- Require emergency showers and shower/eyewash combinations connected to a self-contained water supply to deliver a minimum 20 gallons (85 liters) per minute for 15 minutes.

- Require emergency showers and shower/eyewash combinations permanently connected to a potable water supply to deliver at least 30 gallons (127.5 liters) per minute continuously.
- Require emergency eyewashes to be capable of delivering to the eyes not less than 0.4 gallon (1.5 liters) per minute for 15 minutes.

4.8 Be prepared to clean up spills of corrosive and reactive materials.

4.8.1 Have a written spill response plan in place before materials are stored on site.

4.8.2 Have commercial spill kits available for cleanup of small quantities of materials. At a minimum, kits should contain appropriate protective clothing (including full-body suits, gloves, and boots) and spill control equipment (including absorbents, pillows, shovels, containers, etc.).

4.8.3 Where necessary, confirm that appropriate respiratory protection equipment is provided to spill responders. For additional information, see *S3AM-123-PR1 Respiratory Protection*.

4.8.4 Clean up or respond to spills promptly.

4.8.5 Confirm that personnel responding to a spill have been trained in the hazards associated with the spilled material, as well as use of the spill control equipment, including PPE required for the task.

4.8.6 Do not use combustible organic materials such as sawdust, excelsior, wood chips and shavings, paper, rags, or burlap bags to absorb or clean up spills.

4.9 Develop a waste management plan and procedures, including procedures for collection, storage, labeling, pick-up and transport, and final disposal.

4.10 Dispose of corrosive and reactive materials appropriately.

4.10.1 Segregate organic acids, inorganic acids, and basic wastes.

4.10.2 Contract hazardous waste disposal services should be obtained, as necessary, to dispose of waste materials. All waste shall be appropriately packaged for off-site transportation, if applicable.

4.10.3 Wastes shall be marked, labeled, and shipped in accordance with regulatory requirements. For additional information, see *S3AM-116-PR1 Hazardous Materials Shipping*.

4.11 Inspect corrosive and reactive storage and use areas periodically.

4.11.1 Inspect office, laboratory, and project settings quarterly.

4.11.2 Use the inspection sheet provided as *S3AM-125-FM1 Corrosive & Reactive Materials Inspection* or equivalent, to inspect sites.

5.0 Records

The following information will be maintained in the location or project file:

5.1 Completed Corrosive and Reactive Material Inspection Sheets.

5.2 Worker Right-to-Know training documentation.

5.3 Written Spill Response Plan.

5.4 Waste Management Plan.

5.5 Documentation of training for spill response personnel.

5.6 Documentation of hazard communication training for personnel exposed to corrosive and/or reactive materials.

6.0 Attachments

6.1 S3AM-125-FM1 Corrosive & Reactive Materials Inspection

Americas

Corrosive & Reactive Materials Inspection

S3NA-125-FM1

Location: _____

Name of Inspector: _____ **Date Inspected:** _____

Labeling

1.	Original containers are labeled with: • Name of chemical • Signal word (e.g., DANGER; WARNING; CAUTION, etc.) • Manufacturer	☐ Yes	☐ No	☐ NA

Pre-Job Activities

2.	Corrosives and reactives are stored in a cool, dry environment, free from temperature extremes	☐ Yes	☐ No	☐ NA
3.	Corrosives and reactives are stored in their properly labeled original containers, cushioned against shock, and stored to prevent leaks	☐ Yes	☐ No	☐ NA
4.	Corrosives are not stored in the vicinity of oxidizers	☐ Yes	☐ No	☐ NA
5.	Hydrofluoric acid is stored only in acid-proof polyethylene- or ceresin-lined containers	☐ Yes	☐ No	☐ NA
6.	Corrosives are stored on acid-resistant material	☐ Yes	☐ No	☐ NA
7.	Chromic acid, nitric acid, perchloric acid, and potassium permanganate (all oxidizers) are stored separately from other corrosives and flammables	☐ Yes	☐ No	☐ NA

Handling

8.	The following minimum required PPE is used when working with corrosives: • Chemical splash goggles • Chemical resistant gloves • Chemical resistant apron	☐ Yes	☐ No	☐ NA
9.	Bottles or carboys are opened slowly to guard from splashes.	☐ Yes	☐ No	☐ NA
10.	The outside of the container is washed off with water after use to clean off any droplets of material.	☐ Yes	☐ No	☐ NA
11.	An eyewash is located in all areas where corrosives are used.	☐ Yes	☐ No	☐ NA
12.	An eyewash is:			
	• Within 25 feet (7.62 meters) or 10 seconds of travel	☐ Yes	☐ No	☐ NA
	• Marked with a highly visible sign	☐ Yes	☐ No	☐ NA
	• Well lit and visible	☐ Yes	☐ No	☐ NA
	• Working and delivering a minimum of 1.5 liters of water per minute for 15 minutes	☐ Yes	☐ No	☐ NA
13.	Where substantial quantities of corrosives and/or reactives are stored, access to an emergency shower is available.	☐ Yes	☐ No	☐ NA
14.	Spill control materials compatible with chemicals are available for emergency use.	☐ Yes	☐ No	☐ NA

Waste Disposal

15.	Organic acid, inorganic acid, and basic waste are kept segregated.	☐ Yes	☐ No	☐ NA
16.	Corrosive waste is disposed in accordance with regulatory and client requirements.	☐ Yes	☐ No	☐ NA
17.	A waste management plan or procedure is in place.	☐ Yes	☐ No	☐ NA
18.	Arrangements for waste collection, transport, and disposal are in place.	☐ Yes	☐ No	☐ NA

Comments:

Americas

Flammable & Combustible Liquids

S3AM-126-PR1

1.0 Purpose and Scope

1.1 This procedure applies to all AECOM Americas based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

1.2 The purpose of this procedure is to provide information regarding the proper storage, handling, and work practices associated with flammable and combustible liquids.

2.0 Terms and Definitions

2.1 **Flashpoint** – The minimum temperature at which a liquid gives off vapor within a test vessel in sufficient concentration to form an ignitable mixture with air near the surface of the liquid. The flash point is normally an indication of susceptibility to ignition.

2.2 **Safety can** – Safety can: an approved container, of not more than 5 gallons (18.9 liters) capacity, having a spring-closing lid and spout cover and so designed that it will safely relieve internal pressure when subjected to fire exposure

3.0 References

3.1 S3AM-011-PR1 Fire Protection

3.2 S3AM-115-PR1 Hazardous Material Communication

3.3 S3AM-208-PR1 Personal Protective Equipment

3.4 S3AM-332-PR1 Hot Work

4.0 Procedure

4.1 Implementation of this standard is the responsibility of the AECOM manager directing activities of the facility, site, or project location.

4.2 Appoint a Responsible Person who will:

4.2.1 Determine if flammable or combustible liquids are stored on-site. Flammable liquids and combustible liquids are classified or categorized differently by jurisdiction. As a general definition that aligns the different classifications or categories, flammable and combustible liquids are any liquid that has a flashpoint at or below 199.4°F (93°C). Refer to *S3AM-126-ATT1 Flammable & Combustible Liquid Classifications.*

4.2.2 Inspect storage areas monthly.

4.2.3 Monitor the quantity of flammable and combustible liquids on the site.

4.2.4 Review work practices involving flammable and combustible liquids.

4.2.5 Safety data sheets (SDS) for all hazardous substances, including flammable and combustible liquids, must be provided by vendors or subcontractors, and maintained on site. For more information, see *S3AM-115-PR1 Hazardous Material Communication*.

4.2.6 Furnish portable fire extinguishers in such quantities, sizes, and types as needed for the special hazards of operation and storage. For more information, see *S3AM-011-PR1 Fire Protection*.

4.3 Control flammable and combustible liquids entering the site by ordering only those materials and quantities needed to complete a job.

4.4 Cylinders – General Use & Transport

4.4.1 Open and close cylinder valves using the appropriate tools provided by the cylinder supplier.

4.4.2 Remove regulators and replace caps before transporting cylinders.

4.4.3 Do not roll or drop cylinders. Transport cylinders in a vertical and secured positing using a cylinder basket, cylinder cart or other secure equipment.

4.4.4 Do not use cylinders if the cap cannot be removed by hand. Do not use tools (e.g., hammer) to loosen caps. Tag the cylinder "Do Not Use" and return the cylinder to a designated storage area to be returned to the cylinder supplier.

4.5 General Storage

4.5.1 Use only approved containers, tanks, and pumping equipment for storage and handling of flammable and combustible liquids. Use approved (UL or FM) metal safety cans (with spring-closing lid and spout cover, and optional flash-arresting screen) for the handling and use of flammable liquids in 1- to 5-gallon (3.8- to 18.9-liter) quantities. For additional information, see *S3AM-126-ATT1 Flammable & Combustible Liquid Classifications.*

4.5.2 Place all rags, waste, etc., soiled by combustible or flammable materials in tightly closed metal containers for daily disposal.

4.5.3 Take precautions, including proper ventilation, to prevent the ignition of flammable vapors. Sources of ignition include, but are not limited to: open flames; lightning; smoking; cutting and welding; hot surfaces; frictional heat; static, electrical, and mechanical sparks; spontaneous ignition; chemical reactions; and radiant heat.

4.5.4 Require approved personal protective equipment for all persons handling flammable or combustible liquids, as outlined by the appropriate SDS.

4.5.5 Train employees exposed to flammable or combustible liquids in the hazards of these materials; in their safe handling, use and disposal; in their protection from ignition sources; in the type, use, and placement of containers and cabinets; in the location of fire extinguishers; in the protection against toxic vapors; and in the procedures to follow in case of spill or fire.

4.6 Indoor Storage

4.6.1 Keep indoor storage of flammable liquids to a minimum. Do not store more than 25 gallons (95 liters) of flammable or combustible liquids outside of an approved storage cabinet.

4.6.2 Do not store flammable or combustible liquids in areas used for exits, stairways, or normally used for the safe passage of people.

4.6.3 Do not store more than of flammable and combustible liquids in a single flammable storage cabinet in excess of that specified by the applicable jurisdiction. Refer to *S3AM-126-ATT1 Flammable & Combustible Liquid Classifications*.

4.6.4 Do not store oxidizers and other reactive chemicals in flammable cabinets.

4.6.5 Up to three cabinets may be grouped together. Groups of cabinets must be separated by at least 100 feet (30.5 meters).

4.6.6 Conspicuously label all cabinets "Flammable — Keep Fire Away."

4.6.7 Indoor flammable liquid storage rooms must conform to NFPA codes, including requirements regarding fire ratings, spill containment, maximum capacity, electrical classifications, and ventilation requirements.

4.7 Outside Storage

4.7.1 Maintain a minimum of 20 feet (6.1 meters) between flammable and combustible storage areas and any building.

4.7.2 Maintain a minimum distance of 50 feet (15.2 meters) between flammable and combustible storage areas and hot work activities. Refer to *S3AM-332-PR1 Hot Work*.

4.7.3 Grade the storage area in a manner to divert possible spills away from buildings, and curb or dike so as to contain entire volume of liquids and prevent spills from impacting soil or groundwater.

4.7.4 Keep the entire storage site free from accumulation of unnecessary combustible materials. Closely cut weeds and grass, and establish a regularly scheduled cleanup procedure for the whole area.

4.7.5 Maintain adequate access-ways to open-yard storage to allow access by fire-fighting equipment. Equipment that is blocking access must be manned at all times so that it may be readily moved if necessary.

4.8 Labeling and Signage

4.8.1 Post a "NO SMOKING OR OPEN FLAME" sign in all areas where flammable and combustible materials are stored, handled, and processed.

4.8.2 Require all containers and cylinders to be labeled with the contents and adequate hazard warnings per *S3AM-115-PR1 Hazardous Materials Communication.*

4.9 Use of Materials on Site

4.9.1 Use flammable and combustible liquids in a manner that is consistent with the label and SDS for the product.

4.9.2 Use only those amounts of materials needed for the job. Transfer of these materials to ready-to-use containers is encouraged.

4.9.3 Use personal protective equipment stated on the product label and SDS. For additional information, consult *S3AM-208-PR1 Personal Protective Equipment*.

4.9.4 For dispensing and/or fueling operations, ensure:

- Signs are posted with instructions on the dispensing or fueling process.
- Operators have been trained in the dispensing or fueling process.
- Equipment being refueled has the engine shut off prior to fueling.
- Smoking is prohibited in vehicle and equipment refueling areas.
- Adequate protection is provided to safeguard dispensing pumps from physical damage from vehicles.
- Dispensing nozzles have auto shut-off or self-closing valves and provisions for containing or controlling over-spillage.
- Heating equipment installed in lubrication or service areas, where flammable liquids are dispensed, is of an approved type, and where feasible, is installed at least 8 feet (2.4 meters) above the floor.
- Tank cars and trucks being loaded or unloaded and flammable storage tanks and systems are properly bonded and grounded.
- Transfer of flammable liquids from one container to another is done only when containers are electrically interconnected (bonded).
- Proper PPE is required during the dispensing or fueling process. For additional information, see *S3AM-208-PR1 Personal Protective Equipment*; and *S3AM-126-FM1 Flammable and Combustibles Inspection.*

4.10 Spill Control

4.10.1 Have a written spill response plan in place before materials are stored or used on site.

4.10.2 Have spill clean-up materials in the vicinity of the materials being stored.

4.10.3 Clean up or respond to spills promptly according to applicable local, state, and federal regulations. This may require notification of authorities if a Reportable Quantity (RQ) is exceeded.

4.10.4 Move leaking cylinder to a ventilated area away from ignition sources. Do not attempt to repair a leaking cylinder. Contact the cylinder supplier to determine proper response methods.

4.11 Disposal

4.11.1 Keep solvent waste and flammable liquids in fire-resistant, covered containers until they are removed from the worksite.

4.11.2 Do not place flammable or combustible waste in municipal garbage.

4.11.3 Do not pour flammable or combustible liquids down drains or onto the ground.

4.11.4 Dispose of flammable or combustible hazardous materials with a licensed and approved hazardous material disposal company.

4.12 Inspection

4.12.1 Inspect flammable and combustible storage and use areas on a monthly basis.

4.12.2 Use *S3AM-126-FM1 Flammable & Combustibles Inspection* or equivalent to inspect the storage areas.

4.12.3 Inspect cylinder regulators, gauges, valves, hoses and connections before use. Any damaged equipment shall be tagged out-of-service.

4.13 Training

4.13.1 Require that hazard communication training includes specific hazard information for the flammables and combustibles used.

4.14 Compliance

4.14.1 Review and comply with country and client/customer-specific requirements.

5.0 Records

5.1 The following information will be maintained in the project file.

5.1.1 Location of the SDS inventory.

5.1.2 Completed *S3AM-126-FM1 Flammable & Combustibles Inspection* or equivalent.

6.0 Attachments

6.1 S3AM-126-ATT1 Flammable & Combustible Liquid Classifications

6.2 S3AM-126-FM1 Flammable & Combustibles Inspection

Americas

Flammable & Combustible Liquid Classifications

S3AM-126-ATT1

NFPA 30, WHMIS Canada

Flammable Liquid	Flash Point	Boiling Point
Class 1A	< 73° F (22.8°C)	< 100° F (37.8°C)
Class 1B	< 73° F (22.8°C)	> 100° F (37.8°C)
Class 1C	> 73° F (22.8°C) < 100° F (37.8°C)	
Combustible Liquid		
Class 2	> 100° F (37.8°C) < 140° F (60°C)	
Class 3A	≥ 140° F (60°C) <200°F (93.3°C)	
Class 3B	>200°F (93.3°C)	

Do not store more than 25 gallons (95 liters) of Class IA liquids in containers of" flammable or combustible liquids outside of an approved storage cabinet.

Do not store more than 120 gallons (454 liters) of Class IB, IC, II, or III liquids in containers of flammable and combustible liquids in a single flammable storage cabinet.

Maximum Allowable Size of Containers and Portable Tanks

Container Type	Flammable Liquids			Combustible Liquids	
	Class 1A	Class 1B	Class 1C	Class II	Class III
Glass or approved plastic	1 pint (0.5 liter)	1 quart (1 liter)	1.3 gallons (5 liters)	1.3 gallons (5 liters)	1.3 gallons (5 liters)
Metal (other than drums) or approved plastic	1.3 gallons (5 liters)	5.3 gallons (20 liters)	5.3 gallons (20 liters)	5.3 gallons (20 liters)	5.3 gallons (20 liters)
Safety cans	2.6 gallons (10 liters)	5.3 gallons (20 liters)	5.3 gallons (20 liters)	5.3 gallons (20 liters)	5.3 gallons (20 liters)
Metal drums (DOT specifications)	119 gallons (450 liters)	119 gallons (450 liters)	119 gallons (450 liters)	119 gallons (450 liters))	119 gallons (450 liters)
Approved metal portable tanks	793 gallons (3,002 liters)	793 gallons (3,002 liters)	793 gallons (3,002 liters)	793 gallons (3,002 liters)	793 gallons (3,00 liters)

OSHA 29 CFR 1910.106

Flammable Liquid	Flash Point	Boiling Point
Category 1	< 73.4° F (23°C)	< 95° F (35°C)
Category 2	< 73.4° F (23°C)	> 95° F (35°C)
Category 3*	> 73.4° F (23°C) < 140° F (60°C)	
Category 4**	>140°F (60°C) ≤199.4°F (37.8°C)	

* When a Category 3 liquid with a flashpoint at or above 100 °F (37.8 °C) is heated for use to within 30 °F (16.7 °C) of its flashpoint, it shall be handled in accordance with the requirements for a Category 3 liquid with a flashpoint below 100 °F (37.8 °C).

** When a Category 4 flammable liquid is heated for use to within 30 °F (16.7 °C) of its flashpoint, it shall be handled in accordance with the requirements for a Category 3 liquid with a flashpoint at or above 100 °F (37.8 °C).

Maximum Allowable Size of Containers and Portable Tanks

Container Type	Flammable Liquids			
	Category 1	Category 2	Category 3	Category 4
Glass or approved plastic	1 pint (0.5 liter)	1 quart (1 liter)	1 gallons (3.8 liters)	1 gallons (3.8 liters)
Metal (other than drums) or approved plastic	1 gallons (3.8 liters)	5 gallons (18.9 liters)	5 gallons (18.9 liters)	5 gallons (18.9 liters)
Safety cans	2 gallons (7.6 liters)	5 gallons (18.9 liters)	5 gallons (18.9 liters)	5 gallons (18.9 liters)
Metal drums (DOT specifications)	60 gallons (227 liters)	60 gallons (227 liters)	60 gallons (227 liters)	60 gallons (227 liters)
Approved metal portable tanks	660 gallons (2498 liters)	660 gallons (2498 liters)	660 gallons (2498 liters)	660 gallons (2498liters)

Not more than 60 gallons (227 liters) of Category 1, 2 and/or 3 flammable liquids or 120 gallons (454 liters) of Category 4 flammable liquids shall be stored in any one storage cabinet. Not more than three such cabinets may be located in a single storage area. Quantities in excess of this shall be stored in an inside storage room.

Storage of containers (not more than 60 gallons [227 liters] each) shall not exceed 1,100 gallons (4164 liters) in any one pile or area. Piles or groups of containers shall be separated by a 5-foot clearance. Piles or groups of containers shall not be nearer than 20 feet (6.1 meters) to a building.

Americas

Exposure Monitoring

S3AM-127-PR1

1.0 Purpose and Scope

1.1 This procedure applies to the operations of AECOM and its subsidiary companies, and any other entity and its personnel contractually required to comply with this document's content, where employees may be exposed to airborne concentrations of hazardous air contaminants potentially exceeding permissible limits. Note that this standard does not cover monitoring for asbestos operations (S3AM-109-PR1), toxic and hazardous substances (S3AM-110-PR1), radiation (S3AM-120-PR1), non-ionizing radiation (S3AM-121-PR1), confined spaces (S3AM-301-PR1), heat stress (S3AM-113-PR1), or noise (S3AM-118-PR1).

1.2 The purpose of this procedure is to assist and provide guidance to AECOM personnel who need to conduct personal industrial hygiene monitoring and to control employee exposures to toxic or hazardous substances to the lowest level practicable, including those specified under applicable jurisdictional legislation. Monitoring will be conducted to evaluate the potential exposure of AECOM employees to airborne concentrations of hazardous particulates, fibers, gases, vapors, mists, pathogens, hazardous biological agents, or to oxygen-deficient atmospheres.

1.3 Personal monitoring shall be conducted under the following conditions:

1.3.1 Where directed by a facility or site-specific health and safety plan.

1.3.2 Where employees are exposed to known or suspected human carcinogens (e.g., beryllium, vinyl chloride, etc.).

1.3.3 Where regulations require "initial exposure assessments" (e.g., lead, asbestos, methylene chloride, hexavalent chromium). Certain regulations allow for an exemption to initial exposure assessments when exposure monitoring of similar exposure groups has been conducted under the same site conditions and for equivalent tasks within 1 year prior to the start of work on the current project or site.

1.3.4 When directed by a client or required by contract.

1.3.5 At the direction of a Safety Manager in response to employee concerns or incidents involving chemical exposure.

1.3.6 Co-sampling during regulatory inspections.

1.3.7 Routine monitoring in compliance with regulatory requirements.

2.0 Terms and Definitions

2.1 **Action Level (AL)** – An airborne concentration of a potentially toxic or hazardous substance, measured in parts per million by volume (ppm), microgram per cubic meter (µg/m^3) milligram per cubic meter (mg/m^3) or fibres per cubic centimetre (f/cc), that triggers certain provisions as required by the applicable jurisdictional legislation. In many cases the action level is 50% of the established exposure limit.

2.2 **Established Exposure Limit** – The maximum regulatory exposure concentration to which an individual may be exposed to for an 8- hour time weighted average (TWA).

- This limit is referred to by different terminology depending upon the given jurisdiction (e.g. Permissible Exposure Limit (PEL), Contamination Limit, Occupational Exposure Limit (OEL), Threshold Limit Value (TLV), etc.).

Acceptable methods of adjusting this limit to correspond to a different exposure period (e.g. 10 hours) vary by jurisdiction and substance.

3.0 References

3.1 S3AM-109-PR1 Asbestos

3.2 S3AM-301-PR1 Confined Spaces

3.3 S3AM-113-PR1 Heat Stress

3.4 S3AM-118-PR1 Hearing Conservation

3.5 S3AM-123-PR1 Respiratory Protection

3.6 S3AM-110-PR1 Toxic & Hazardous Substances

4.0 Procedure

4.1 Implementation of this standard is the responsibility of the AECOM manager directing activities of the facility, site, or project location.

4.2 Hazard assessments shall be completed to identify potential employee exposure to toxic or hazardous substances. Industrial hygiene monitoring conducted and prioritized as appropriate to the potential risk and in accordance with regulatory requirements.

4.3 Procedures for Personal Industrial Hygiene Monitoring

4.3.1 Personal industrial hygiene monitoring documentation shall include accurate and detailed descriptions of the work environment and of the work activities of each employee being monitored to evidence monitoring results are tied to the work operations conducted. This permits demonstration that suggested corrective actions are appropriate or adequate to control the exposure.

4.3.2 Individuals responsible for equipment maintenance and collection shall be appropriately trained. Engage applicable subject matter experts as necessary (e.g., industrial hygienists / technicians).

4.3.3 Maintain, service, and calibrate sampling equipment in accordance with the manufacturer's recommendations and, as applicable, the approved sampling methodology (may include both pre- and post-calibration to confirm consistent flow rates).

4.3.4 Collect samples using current applicable methodologies established by the National Institute for Occupational Safety and Health (NIOSH) *Manual of Analytical Methods*, U.S. Department of Labor – Occupational Safety and Health Administration (OSHA) *Sampling and Analytical Methods*, American Society for Testing Materials (ASTM), the Environmental Protection Agency (EPA), or applicable guidelines for the host country.

4.3.5 Select an analytical laboratory accredited by the American Industrial Hygiene Association (AIHA), or equivalent host country certification, licensing, or accreditation, to analyze the personal air samples.
Note: There are several programs under which a laboratory may receive AIHA accreditation. The laboratory shall be currently accredited for the specific program, scope category, and field of testing for the analysis that will be performed, not merely hold AIHA accreditation.

4.3.6 Confirm samples are submitted to the laboratory for analysis in a timely manner to confirm sample viability.

4.3.7 Require the selected laboratory to use the applicable analytical methodologies and document quality control procedures.

4.3.8 Confirm equipment is maintained, serviced, and calibrated in accordance with manufacturer's recommendations.

4.3.9 Document personal monitoring activities and work operations using the appropriate AECOM Industrial Hygiene Monitoring Form; require that all laboratory chain-of-custody forms be properly completed; and confirm samples are sealed and secured according to Quality Assurance procedures.

4.3.10 Confirm workers are being protected (e.g., engineering controls, administrative controls, and PPE, including respiratory protection) during the monitoring phase. Refer to *S3AM-123-PR1 Respiratory Protection* and *S3AM-208-PR1 Personal Protective Equipment*.

4.3.11 Reassessment of exposure hazards shall be conducted as appropriate when there are changes in conditions or work processes, and at suitable intervals based on potential risk and regulatory requirements.

4.3.12 Determine whether medical surveillance is required. Refer to jurisdictional requirements and *S3AM-128-PR1 Medical Screening & Surveillance*.

4.4 Evaluation of Personal Monitoring Results

4.4.1 Samples sent out for independent laboratory analysis will follow chain of custody requirements.

4.4.2 An AECOM Certified Industrial Hygienist (CIH) approved by a Safety Manager should evaluate the analytical results when feasible.

4.4.3 Obtain a written evaluation report from the SH&E manager. If exposures exceed the Action Level and/or Established Exposure Limit for the air contaminant(s) of concern, a verbal report is to be made to the senior facility, project, or site manager immediately, and follow up with the written report within any established timeframe. The evaluation report will include required corrective actions.

4.4.4 Complete evaluation reports within 5 working days of the receipt of the analytical results.

4.4.5 Results of all personal exposure monitoring will be provided to the SH&E department for inclusion in the employee medical records, refer to *S3AM-017-PR1 Injury & Illness Recordkeeping.*

4.5 Procedures for Direct-Read Air Monitoring

4.5.1 Direct-read air monitoring instruments are used primarily as screening tools to provide real-time evaluations of hazardous airborne contaminants at a project site.

4.5.2 Select an appropriate air monitor for the air contaminant to be measured.

4.5.3 Calibrate monitor in accordance with manufacturer's recommendations. Dates of full instrument calibration will be recorded on the direct-read instrument and on any associated calibration data sheets. If instrument calibrations are not performed daily, then daily bump tests (exposure to a known concentration of contaminant) will be performed to verify calibration and confirm alarms are working appropriately.

4.5.4 Conduct air monitoring using techniques identified by the instrument manufacturer and according to any identified methods (e.g. NIOSH, EPA, etc.).

4.5.5 Confirm equipment is maintained, serviced, and calibrated in accordance with manufacturer's recommendations.

4.5.6 Document personal monitoring activities using the appropriate AECOM Industrial Hygiene Monitoring Form.

4.5.7 Confirm workers are being protected (e.g., engineering controls, administrative controls, and PPE, including respiratory protection) during the monitoring phase. Determine whether medical surveillance is required.

4.5.8 Where required by client request or by unique or high hazard areas, individual portable direct-read monitors shall be used.

4.6 Evaluation of Personal Monitoring Results

4.6.1 Compare measured results with project-specific Action Levels and/or published Established Exposure Limits. If exposures exceed the Action Level and/or Established Exposure Limit for the air contaminant(s) of concern, take corrective actions as identified in the site-specific SH&E plan. If the SH&E Plan did not account for the identified hazard, or where questions exist about the results, contact the SH&E Manager to evaluate the analytical results for appropriate corrective action (this may involve consultation with a Certified Industrial Hygienist). The SH&E Plan should be updated accordingly.

4.7 Communication of Sample Results and Evaluation

4.7.1 Provide copies of the evaluation report to the employee(s) monitored and to employees working in the area for which the exposures could be representative, within 5 days of receipt of lab results.

4.7.2 Exposure results will be posted on site and explained in a safety briefing.

4.7.3 Provide a copy of the evaluation report and monitoring data to the client, owner, or manager directing activities of the facility or site for filing purposes.

4.7.4 Personal identifiers (e.g., name, address, employee number) or information which could reasonably be used to identify specific employees (e.g., exact age, height, weight, race, sex, date of initial employment, job title), shall be removed from analysis reports before access to the exposure data is provided.

4.8 Corrective Actions

4.8.1 Implement required corrective actions immediately.

4.8.2 If the exposure hazard cannot be eliminated or otherwise controlled through the use of engineering controls, the reason shall be documented and suitable administrative controls and personal protective equipment requirements developed.

4.8.3 Workers who may be exposed above the Established Exposure Limit or Action Limit, shall be appropriately trained and wear respiratory protection in accordance with *S3AM-123-PR1 – Respiratory Protection Program*.

4.9 Exposure Records

4.9.1 Exposure records include work activities / process descriptions, workplace monitoring, biological monitoring, material safety data sheets and chemical inventories. Sampling results, the collection methodology (sampling plan), a description of the analytical and mathematical methods used, and a summary of other background data relevant to interpretation of the results obtained, shall retained for at least thirty (30) years.

5.0 Records

The following documents will be maintained in the project profile:

5.1 Calibration data.

5.2 Completed IH Monitoring Form(s).

5.3 Evaluation Report with sample results (provide copy to affected employee as well).

5.4 Corrective actions, including engineering controls.

5.5 Relevant prior initial exposure assessments.

6.0 Attachments

6.1 S3AM-127-FM1 General Industrial Hygiene Survey

6.2 S3AM-127-FM2 Industrial Hygiene Sample Field Sheet

6.3 S3AM-127-FM3 Total Dust Industrial Hygiene Sample Field Sheet

6.4 S3AM-127-FM4 Respirable Dust Industrial Hygiene Sample Summary

6.5 S3AM-127-FM5 Detector Tube Industrial Hygiene Sample Summary

6.6 S3AM-127-FM6 Gas/Vapor/Fume/Mist Industrial Hygiene Sample Summary

6.7 S3AM-127-FM7 Toxic Gas Monitor Industrial Hygiene Sample Summary

6.8 S3AM-127-FM8 PID/FID Monitoring Report

6.9 S3AM-127-FM9 Industrial Hygiene Evaluation Form

6.10 S3AM-127-FM10 Instrument Calibration Log

Americas

Medical Screening & Surveillance

S3AM-128-PR1

1.0 Purpose and Scope

1.1 Provides a streamlined process to determine if employees meet the physical requirements to perform assigned duties as defined by applicable regulations.

1.2 Designed to provide a means to collect data relevant to exposure to chemical and physical agents for the protection of the workers and to confirm the effectiveness of health and safety programs.

1.3 Applies to all AECOM Americas employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 **Employee Exposure Record** - A record containing any of the following kinds of information:

- Environmental (workplace) monitoring or measuring of a toxic substance or harmful physical agent, including personal, area, grab, wipe or other form of sampling, as well as related collection and analytical methodologies, calculations and other background data relevant to interpretation of the results obtained.
- Biological monitoring results which directly assess the absorption of a toxic substance or harmful physical agent by body systems (e.g., the level of a chemical in the blood, urine, breath, etc.), but not including results which assess the biological effect of a substance or agent or which assess an employee's use of alcohol or drugs.
- Safety data sheets (SDSs) indicating that the material may pose a hazard to human health.
- In the absence of SDSs, a chemical inventory or any other record which reveals where and when used and the identity (e.g., chemical, common, or trade name) of a toxic substance of harmful physical agent

2.2 **Medical Director –** A physician, board-certified in occupational medicine, employed by the Medical Services Provider (MSP). The Medical Director manages the services provided by the MSP and provides to AECOM guidance on medical matters.

2.3 **Medical Services Provider (MSP) –** Manages all occupational medical services, including medical surveillance programs, travel medicine, documentation, and injury intervention for first aid support for employees with occupational injuries or illnesses.

2.4 **Participating Employee** – Those employees required to participate in the medical screening and surveillance program will be identified by the Supervisor, Operations and SH&E Manager. Medical surveillance is required for employees who are or may be:

- Exposed to substances at or above the occupational exposure limits.
- Required to participate by regulatory provisions (e.g., asbestos, lead OSHA standards, designated substances).
- Fit-tested for or wearing a respirator in the field.
- Working on sites/projects with specific state, provincial/territorial or federal medical surveillance requirements.
- Driving a commercial motor vehicle.
- Performing safety sensitive tasks.

2.5 **Physical Activity Restriction –** To prevent aggravation of an existing condition, the Medical Doctor recommends a physical activity restriction to limit exposure to a chemical or class of chemicals (e.g., benzene, lead), a physical agent (e.g., noise), or an activity (e.g., heavy lifting).

3.0 References

3.1 S3AM-214-PR1 International Travel

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Employees**

- Ensuring that he/she maintains a current work clearance as required for the performance of assigned work duties.
- All employees designated to participate, called Participating Employees, in the medical surveillance program as a condition of employment or participate voluntarily and will be notified in advance if they will be assigned to a location, project or client which requires a Medical Screening and Surveillance program.
- If employee knows or suspects that he/she may have an adverse reaction to completing elements of the physical, (such as blood draws, physical limitation, etc.) then the employee should notify the MSP at the time they schedule the physical so that appropriate safeguards may be taken to protect the health of the employee.
- Communicate any change in medical condition (e.g. medications, pregnancy), to MSP to allow for evaluation of the need for additional precautions.

4.1.2 **Supervisors and Operations Managers**

- Evaluates the duties of each employee and prospective employee reporting to him or her for potential participation in the medical screening and surveillance program.
- Responsible for ensuring that the employee is enrolled in the medical screening and surveillance program if the employee's position requires participation. Consult with a SH&E Manager if assistance is needed in determining if an employee is required to participate in the program.
- Assures employees in positions that require medical surveillance in order to meet their job description may not be on site until they have satisfactorily completed the baseline or pre-employment medical examination.

4.1.3 **Safety, Health, & Environment (SH&E) Department**

- Serves as the primary point of contact between the employee, employee's supervisor, the MSP and the SH&E Department.
- Provides information regarding medical surveillance documentation, forms, and scheduling of services.
- Maintains a medical surveillance database and other associated documents (medical records are maintained by the MSP).
- Assists employees with scheduling of exams with the MSP.
- Participates in initial SH&E training and subsequent reviews and updates that will provide guidance on exam protocols.

4.1.4 **SH&E Manager**

- Reviews employee assignments with managers to ensure that all employees who should be participating in the medical surveillance program have been enrolled.
- Provides all assistance necessary to ensure all required information is provided to the Medical

Director.

- Report any change in requirements, protocols or concerns with the MSP to the Occupational Health Manager.

4.1.5 **Occupational Health Manager**

- Provide the MSP with appropriate references (e.g., a copy of this procedure, regulations).
- Designate other employees to participate in certain parameters of the medical screening and surveillance program after consultation with the Medical Director.

4.1.6 **Medical Director**

- Requires an exposure-specific examination when he/she has reason.
- Determine the frequency of the exposure-specific medical examinations.
- Consults with the Occupational Health Manager.

4.2 General Requirements

4.2.1 All AECOM employees whose work assignments involve potential exposure to harmful chemical and/or physical agents should participate in the medical surveillance program. Guidance as to harmful potential exposures is presented in *S3AM-128-FM1 Medical Surveillance Evaluation (MSE).* The form provides the primary guidance for determining whether medical screening is required for an employee and the frequency of periodic exams. The MSE is to be completed by the employee and his/her supervisor at the time of hire for any employee who may work outside an office environment. At each annual performance review, the MSE is to be reviewed for accuracy. Other reviews are required whenever there is a change in job tasks.

4.2.2 In addition, employees may be requested to participate in the medical surveillance program if they perform a task that requires an assessment for fitness for duty (e.g., lifting, climbing, etc.). The Supervisor, Operations Manager and SH&E Manager will identify activities/tasks that will require fit-for-duty assessments.

4.2.3 Medical screening and surveillance will only be performed where required by regulatory requirements or this procedure. Screening and surveillance provided at no cost to employees.

- If the employee does not wish to participate in part or all of the medical screening and surveillance program and is permitted by the applicable jurisdiction, the employee must provide a written statement of refusal. Please refer to *S3AM-128-FM4 Waiver of Medical Screening & Surveillance Program*.

4.2.4 For medical screening and surveillance related to international travel, refer to *S3AM-214-PR1 International Travel*.

4.3 Types of Medical Examinations

The medical surveillance program consists of the following types of examinations:

- Baseline (initial)
  - The baseline medical examination is used to identify physical capabilities and medical limitations that may have an impact on the candidate's ability to perform in the position for which he/she is being considered and to provide a baseline against which periodic or project-specific monitoring can be compared. The baseline medical examination is used to determine the suitability of an existing employee for a new assignment (pre-placement) or a candidate's suitability to be hired (pre-employment) for a particular position.
- Periodic (annual or biennial)
  - The periodic medical examination is used to evaluate an employee's continued fitness for duty and to assess any impact occupational exposures may have on his/her health status. The periodic examination includes an update to the medical and work history, results of any occupational exposure assessments and a detailed medical examination tailored to the job description.

- The SH&E Manager will assist in determining the frequency of the periodic medical examinations based on regulatory requirements, the position held by the employee, and the level of exposure to physical, chemical, and biological agents.
- Employees performing work activities on HAZWOPER sites will receive exams based on the following schedule:

Annual	Working in an exclusion zone and the regulatory required exposure limit is exceeded for 30 or more days a year.
Biennial	Working in an exclusion zone more than 30 days a year and the regulatory required exposure limit is not exceeded.

- Exposure-specific
  - The exposure-specific examination consists of medical tests to assess the impact of occupational exposures associated with a particular activity or project. The Medical Director or SH&E Manager will require an exposure-specific examination when he/she has reason to believe occupational exposures are impacting or may be impacting the health of an employee.
- Exit/termination
  - Employees currently participating in an examination program will receive exit exams when they leave their work assignment as identified in *S3AM-128-ATT1 Exit Exam Determination.* In the event an employee declines the exit exam, the employee will be requested to sign *S3AM-128-FM2 Waiver of Exit Medical Surveillance Exam*.
  - An exit medical examination is offered when an employee leaves the medical surveillance program, either because of termination of employment with AECOM or because of reassignment to a position not designated to participate in the medical surveillance program or if conditions in the workplace no longer constitutes the need for the medical surveillance (e.g., change in product).
  - The exit examination assesses any impact occupational exposures may have had on the employee's health status.

4.4 Exam Protocols

4.4.1 *S3AM-128-ATT2 Exam Protocol* identifies the medical exam components of exam.

4.4.2 The evaluation will be confidential and provided during normal business hours. Employees will be offered the opportunity to discuss the results of the evaluation with the MSP. All exam results are considered personal and confidential information, and will not be stored in any unsecured records not transmitted without the employee's permission.

4.5 Participating Employee Guidance and Documentation

4.5.1 When necessary, based on the position being filled, the hiring Supervisor and Human Resources Representative informs the candidate that the offer of employment is contingent on the candidate being physically and medically qualified to perform the duties of the position for which he/she is being hired. The hiring Supervisor and Human Resources Representative may not allow the candidate to begin employment until the conditions of the offer letter have been satisfied.

4.5.2 When designated to participate in the medical surveillance program, the Employee completes and signs the following documents:

- Medical and Work History Questionnaire (provided by the MSP).
- Medical Records Release authorizing MSP to receive the work clearance certificate.

4.5.3 Any Employee that has not completed the required medical evaluation after 30 days of an expiration date will be issued a non-qualified statement. The Employee is not permitted to perform the associated task and/or work until the required medical evaluation is completed and a qualified statement is issued by the Medical Director.

4.5.4 If an exam becomes due during an employee's pregnancy, it is advised to defer the exam until after delivery and the employee returns to work from family/medical leave status.

4.5.5 Human Resources Representative

- Notifies the SH&E Manager or designee to arrange for exit medical examination, upon notification of termination or impending termination from the Supervisor. In the event an employee declines the exit exam, the employee will be requested to sign *S3AM-128-FM2 Waiver of Exit Medical Surveillance Exam*.
- Place the original waiver in the employee's Human Resources personnel file and send a copy the MSP.

4.5.6 Medical Services Provider (MSP)

- Provides notification approximately 30 days before subsequent periodic or exposure-specific medical examination is due.
- Notify the employee 30 days before the periodic or exposure-specific medical examination is due.
- Provides notification of delinquent medical examinations.

4.5.7 Operations Manager

- Facilitate the management and exchange of documentation regarding the medical screening and surveillance program between AECOM (typically employee's supervisor) and MSP using the *S3AM-128-FM3 Scheduling Request Form*. If exams for multiple employees is required, the information from page 1 of the Scheduling Request Form and the requested exams can be placed in a spreadsheet and sent to the MSP.
- Schedule the initial exam for newly hired or re-assigned employees as needed. Special requests should be coordinated with the SH&E Manager, prior to contacting MSP to schedule.
- Assist employees with scheduling examinations as necessary.
- Coordinate medical surveillance program information exchange between Human Resources Representative and the MSP as necessary.
- Notify the candidate's manager and Human Resources upon receipt of the work clearance.
- Provide information from previous examinations that may not be readily available.

4.5.8 SH&E Manager

- Provides such assistance as is requested by the hiring Supervisor to ensure the job description for the position being filled adequately describes the physical, chemical, and biological stresses of the position, and the PPE used or which may be used, including respiratory protection.
- Provides all necessary assistance to ensure that required and appropriate information is provided with the request and authorization for medical examination.
- Provides assistance to the hiring Supervisor to interpret physical activity restrictions if such restrictions are noted on the work clearance certificate.
- Confirms that all relevant exposure assessments have been appropriately annotated to show the applicability to the employee and forwarded to the MSP.
- Confirms that employees on the delinquent medical examination list have been removed from designated assignments.
- Provides assistance to ensure that terminating and reassigned employees are offered the opportunity to take an exit medical examination.

4.5.9 Supervisor

- Arranges work assignments so that the employee is available to take the medical examination before the work clearance certificate expires.

- Removes the employee from the work assignment before the work clearance certificate expires until the medical evaluation is completed and a qualified statement is issued by the Medical Director.
- Contacts the Human Resources Representative, upon notification of termination or reassignment and requests they arrange for the MSP to perform an exit medical examination.
- Releases the terminating or reassigned employee from duties as necessary to complete the exit medical examination.

4.6 Reports

4.6.1 Report of Examination

- The MSP provides AECOM and the employee with a copy of the work clearance certificate, which will include any medical restrictions and address the employee's ability to use personal protective equipment. AECOM requires the employee to preserve the work clearance certificate in a safe place and provide copies to AECOM managers and clients when requested.
- The MSP will mail a confidential letter detailing the results of the exam to the employee's home address within 30 days of the exam date.

4.6.2 Examinations Due Report

- The MSP produces a list by organization code of employees due to be examined 30 days before the expiration of their work clearance certificate. This list is provided to SH&E Department, who ensures each Supervisor is notified of the employees in his/her charge who are due examinations so they may be scheduled appropriately.
- The MSP notifies each employee via email or phone to the office of record 30 days before the periodic or exposure-specific medical examination is due.

4.6.3 Delinquent Examinations Report

- The MSP distributes a report of delinquent medical examinations to the SH&E Department.
- When an employee's name appears on the delinquent examination report for two consecutive months, the SH&E Department must notify the SH&E Manager, who will bring this to the attention of the employee's Supervisor for resolution. If the delinquency issue is not resolved, the employee's regional management will be notified for final resolution.

4.6.4 Physical Activity Restriction Report

- The Supervisor maintains a list of employees who have physical activity restrictions.
- The SH&E Manager shall evaluate locations and projects periodically to ensure employees with physical activity restrictions are not exceeding their limitations. Concerns of an employee exceeding his/her physical activity restriction is brought to the attention of the employee's Supervisor for resolution.

4.6.5 Annual Reports

- The MSP provides annual reports of utilization, medical trends, and statistical analyses. These reports are prepared to improve the service, manage trends, and reduce the cost of the medical screening and surveillance program.

5.0 Records

5.1 Employees who participate in a medical surveillance or physical examination program or had exposure monitoring conducted will have access to all employee exposure and medical records maintained for that employee by AECOM and the MSP.

5.2 Upon an employee entering into a medical surveillance or physical examination program, the employee shall be informed of the following:

- The existence, location and availability of any records covered by this procedure
- The MSP responsible for maintaining and providing access to records and
- The employee's right of access to these confidential records.

5.3 Employees in medical monitoring programs are notified initially and annually thereafter, of the existence, location and ability to access medical records maintained by the MSP. Upon request, each employee (or designated representative) will have access to the employee's medical records. Prior to the release of health information to the employee (or designated representative), a specific written consent must be signed by the employee. Records will be provided in a reasonable time and manner at no cost to the employee.

5.4 Medical records must be preserved and protected in accordance with applicable legislative requirements for the duration of employment plus 30 years, verify local, state of federal regulations to confirm time period. Medical records contain information that is protected by the Privacy Act. To meet the obligations of preserving the medical records and protecting the information they contain, AECOM has arranged for the MSP to manage the medical records.

5.5 An employee or designated representative may request to review his/her medical records. Such a request must be in writing and be signed and dated. The SH&E Manager or the SH&E Department will forward the request to the MSP, who will provide the employee with a copy of the medical records.

The MSP provides employees with a copy of their results after each physical. If employee would like a copy of their historical records, the MSP will supply the copy within 15 days after the request has been submitted by the employee or designated representative.

MSP performs quality control checks on all medical records to ensure examining physicians appropriately record the findings of the examination and tests. The MSP has access to all medical records to perform quality assurance checks to ensure proper recording and preservation.

5.6 Projects that use local clinics or employer/client clinics may store records at that site, but at the termination of the project, all employee medical records must be transferred to long-term record retention.

5.7 If in the event AECOM ceases operations, medical records will be transferred to the successor employer. If no successor employer is available, records will be transferred to the National Institute for Occupational Safety and Health.

6.0 Attachments

6.1 S3AM-128-ATT1 Exit Exam Determination

6.2 S3AM-128-ATT2 Exam Protocols

6.3 S3AM-128-FM1 Medical Surveillance Evaluation

6.4 S3AM-128-FM2 Waiver of Exit Medical Surveillance Exam

6.5 S3AM-128-FM3 Scheduling Request Form

6.6 S3AM-128-FM4 Waiver of Medical Screening & Surveillance Program

Americas

Medical Screening & Surveillance

S3AM-128-PR1

1.0 Purpose and Scope

1.1 Provides a streamlined process to determine if employees meet the physical requirements to perform assigned duties as defined by applicable regulations.

1.2 Designed to provide a means to collect data relevant to exposure to chemical and physical agents for the protection of the workers and to confirm the effectiveness of health and safety programs.

1.3 Applies to all AECOM Americas employees and operations and any other entity and its personnel contractually required to comply with this document's content.

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- Safety data sheets indicating that the material may pose a hazard to human health.
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- Driving a commercial motor vehicle.
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3.0 References

3.1 S3AM-214-PR1 International Travel

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Employees**

- Ensuring that he/she maintains a current work clearance as required for the performance of assigned work duties.
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Director.

- Report any change in requirements, protocols or concerns with the MSP to the Occupational Health Manager.

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- Designate other employees to participate in certain parameters of the medical screening and surveillance program after consultation with the Medical Director.

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- Place the original waiver in the employee's Human Resources personnel file and send a copy the MSP.

4.5.6 Medical Services Provider (MSP)

- Provides notification approximately 30 days before subsequent periodic or exposure-specific medical examination is due.
- Notify the employee 30 days before the periodic or exposure-specific medical examination is due.
- Provides notification of delinquent medical examinations.

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- Facilitate the management and exchange of documentation regarding the medical screening and surveillance program between AECOM (typically employee's supervisor) and MSP using the *S3AM-128-FM3 Scheduling Request Form*. If exams for multiple employees is required, the information from page 1 of the Scheduling Request Form and the requested exams can be placed in a spreadsheet and sent to the MSP.
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- Provides such assistance as is requested by the hiring Supervisor to ensure the job description for the position being filled adequately describes the physical, chemical, and biological stresses of the position, and the PPE used or which may be used, including respiratory protection.
- Provides all necessary assistance to ensure that required and appropriate information is provided with the request and authorization for medical examination.
- Provides assistance to the hiring Supervisor to interpret physical activity restrictions if such restrictions are noted on the work clearance certificate.
- Confirms that all relevant exposure assessments have been appropriately annotated to show the applicability to the employee and forwarded to the MSP.
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- Provides assistance to ensure that terminating and reassigned employees are offered the opportunity to take an exit medical examination.

4.5.9 Supervisor

- Arranges work assignments so that the employee is available to take the medical examination before the work clearance certificate expires.

- Removes the employee from the work assignment before the work clearance certificate expires until the medical evaluation is completed and a qualified statement is issued by the Medical Director.
- Contacts the Human Resources Representative, upon notification of termination or reassignment and requests they arrange for the MSP to perform an exit medical examination.
- Releases the terminating or reassigned employee from duties as necessary to complete the exit medical examination.

4.6 Reports

4.6.1 Report of Examination

- The MSP provides AECOM and the employee with a copy of the work clearance certificate, which will include any medical restrictions and address the employee's ability to use personal protective equipment. AECOM requires the employee to preserve the work clearance certificate in a safe place and provide copies to AECOM managers and clients when requested.
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- The MSP notifies each employee via email or phone to the office of record 30 days before the periodic or exposure-specific medical examination is due.

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- When an employee's name appears on the delinquent examination report for two consecutive months, the SH&E Department must notify the SH&E Manager, who will bring this to the attention of the employee's Supervisor for resolution. If the delinquency issue is not resolved, the employee's regional management will be notified for final resolution.

4.6.4 Physical Activity Restriction Report

- The Supervisor maintains a list of employees who have physical activity restrictions.
- The SH&E Manager shall evaluate locations and projects periodically to ensure employees with physical activity restrictions are not exceeding their limitations. Concerns of an employee exceeding his/her physical activity restriction is brought to the attention of the employee's Supervisor for resolution.

4.6.5 Annual Reports

- The MSP provides annual reports of utilization, medical trends, and statistical analyses. These reports are prepared to improve the service, manage trends, and reduce the cost of the medical screening and surveillance program.

5.0 Records

5.1 Employees who participate in a medical surveillance or physical examination program or had exposure monitoring conducted will have access to all employee exposure and medical records maintained for that employee by AECOM and the MSP.

5.2 Upon an employee entering into a medical surveillance or physical examination program, the employee shall be informed of the following:

- The existence, location and availability of any records covered by this procedure
- The MSP responsible for maintaining and providing access to records and
- The employee's right of access to these confidential records.

5.3 Employees in medical monitoring programs are notified initially and annually thereafter, of the existence, location and ability to access medical records maintained by the MSP. Upon request, each employee (or designated representative) will have access to the employee's medical records. Prior to the release of health information to the employee (or designated representative), a specific written consent must be signed by the employee. Records will be provided in a reasonable time and manner at no cost to the employee.

5.4 Medical records must be preserved and protected in accordance with applicable legislative requirements for the duration of employment plus 30 years, verify local, state of federal regulations to confirm time period. Medical records contain information that is protected by the Privacy Act. To meet the obligations of preserving the medical records and protecting the information they contain, AECOM has arranged for the MSP to manage the medical records.

5.5 An employee or designated representative may request to review his/her medical. Such a request must be in writing and be signed and dated. The SH&E Manager or the SH&E Department will forward the request to the MSP, who will provide the employee with a copy of the medical records.

The MSP provides employees with a copy of their results after each physical. If employee would like a copy of their historical records, the MSP will supply the copy within 15 days after the request has been submitted by the employee or designated representative.

5.6 MSP performs quality control checks on all medical records to ensure examining physicians appropriately record the findings of the examination and tests.

The MSP has access to all medical records to perform quality assurance checks to ensure proper recording and preservation

5.7 Projects that use local clinics or employer/client clinics may store records at that site, but at the termination of the project, all employee medical records must be transferred to long-term record retention.

5.8 If in the event AECOM ceases operations, medical records will be transferred to the successor employer. If no successor employer is available, records will be transferred to the National Institute for Occupational Safety and Health.

6.0 Attachments

6.1 S3AM-128-ATT1 Exit Exam Determination

6.2 S3AM-128-ATT2 Exam Protocols

6.3 S3AM-128-FM1 Medical Surveillance Evaluation

6.4 S3AM-128-FM2 Waiver of Exit Medical Surveillance Exam

6.5 S3AM-128-FM3 Scheduling Request Form

6.6 S3AM-128-FM4 Waiver of Medical Screening & Surveillance Program

Americas

Medical Surveillance Evaluation

S3AM-128-FM1

This information will be used to determine routine medical screening exams for employees who work outside of an office setting. In addition, site-specific health and safety plans may specify project-related medical surveillance for regulated substances.

Please answer each entry:

Date: _____

Name: _____

Phone #: _____

Employee #: _____

Job Title: _____

Location: _____

Business Group: _____

Business Unit: _____

Supervisor: _____

SH&E Manager: _____

Choose One:

☐ New employee ☐ Current employee with job change

☐ Transfer from _____

The following questions assess medical screenings and surveillance requirements:

Respirator	☐ Yes ☐ No	Does your job require you to wear a respirator or to be certified for respirator use? If yes, how many days per year? ☐ 1–29 ☐ 30+
Hearing	☐ Yes ☐ No	Does your job require you to wear hearing protection because you: a) Work in an environment where noise levels equal or exceed an 8-hour time-weighted average of 85 decibels? b) Perform construction activities or work on a construction site around heavy equipment more than 50 percent of the time?
Asbestos	☐ Yes ☐ No	Do you perform intrusive work with asbestos (i.e., sampling, demolition, etc.)?
Silica	☐ Yes ☐ No	Do you perform intrusive work with silica?
Lead	☐ Yes ☐ No	Are you currently performing construction work where you may be exposed to airborne lead concentration at or above the OSHA action level or are you currently in a job that requires you to be in a medical surveillance program for lead (i.e., removal of lead-based paint or other demolition activities)?

Radiation	☐ Yes ☐ No	Are you classified as a radiation worker?
DOT Driver	☐ Yes ☐ No	Do you drive a truck with a gross vehicle weight rating of 10,000 pounds or more during company trips?
Operator	☐ Yes ☐ No	Do you operate a: ☐ Crane ☐ Forklift?
Diving	☐ Yes ☐ No	Do you perform diving activities?
Biohazard	☐ Yes ☐ No	Does you job require work with bloodborne pathogens?
Remediation	☐ Yes ☐ No	Do you perform remediation construction activities, field construction sampling, or supervision activities at hazardous waste remediation sites or hazardous waste treatment, storage, or disposal (TSD) facilities that could expose you to hazardous substances above permissible exposure levels (i.e., work in exclusion zones)? If yes, how many days per year? ☐ 1–29 ☐ 30+
Field and Lab	☐ Yes ☐ No	Answer Yes if you do ANY of the following: a) Work at HAZWOPER sites 30 or more days per year b) Perform waste disposal activities c) Work in a chemistry laboratory 30 or more days per year d) Work on a pilot plant project 30 or more days per year e) Conduct bench-scale operations 30 or more days per year
Specific Jobs	☐ Yes ☐ No	Do you perform the following job duties: ☐ Air Traffic Control ☐ CDF or ☐ Naval Ordinance ☐ Engine Run (military locations) ☐ Fuel Cell (military locations) ☐ Ground Personnel (military locations)
Other	☐ Yes ☐ No	Site- or project-specific biological monitoring or toxicological screening as specified by the project-specific health and safety plan.

If 'Yes' was answered above, an employee is required to be in the medical screening and surveillance program. Complete *S3AM-128-FM3 Scheduling Request Form* and forward to the MSP. If additional assistance is required, contact an SH&E Manager.

Employee Signature _____ Date _____

Supervisor Signature _____ Date _____

The below applies **ONLY IF SPECIFICALLY PERMITTED BY THE APPLICABLE JURISDICTION:

If the employee does not wish to participate in part or all of the medical screening and surveillance program and is permitted by the applicable jurisdiction, the employee must provide a written statement of refusal. *S3AM-128-FM4 Waiver of Medical Screening & Surveillance Program* may be used to fulfill the written statement of refusal requirement.

Americas

Competent Person Designation

S3AM-202-PR1

1.0 Purpose and Scope

1.1 Outlines the process and minimum requirements necessary for classifying an AECOM employee as a "Competent Person" to oversee and/or self-perform activities involved with tasks listed in this procedure. Employee competency to perform work activities is addressed elsewhere.

1.2 This procedure applies to all AECOM Americas-based employees and operations where AECOM is self-performing the identified activities and where AECOM controls projects performing activities requiring a Competent Person. This procedure also applies to any other entity and its personnel contractually required to comply with this document's content. Client-mandated requirements may apply on a project-specific basis and shall be addressed in supplemental documents (e.g. Task Hazard Assessment, SH&E Plan, etc.).

1.3 It is recognized that local regulations and legislation may contain alternate definitions for Competent Person and it will be the responsibility of the manager responsible for the work (e.g. Manager, Superintendent) in conjunction with the local SH&E Manager to determine if conflicts exist between AECOM and applicable regulatory/legislative definitions and resolve the conflict.

1.4 When a qualified employee within AECOM is not available to be designated as the AECOM Competent Person, the Manager in coordination with their SH&E Manager may designate an appropriately qualified and trained Contractor employee as the Competent Person for the AECOM operations.

2.0 Terms and Definitions

2.1 **Competent Person –** An employee, through education, training and experience who has knowledge of applicable regulatory requirements, is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

3.0 References

3.1 S3AM--213-PR1 Subcontractor Management

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 M**anager**

- Confirm that all assigned personnel, including personnel utilized from other offices to support their operations, comply with the requirements of this procedure. The manager responsible for the work shall:
  - Identify the need for a designated Competent Person or persons based on anticipated work activities.
  - Communicate competent person training/experience requirements with the employee and documenting completion of these requirements using *S3AM-202-FM-1 Competent Person Designation* or equivalent.
  - Identify supplemental employee training needs based on local/client requirements.
- For projects controlled by AECOM, when these activities are contracted to another party:
  - Confirm and secure the identity of the Contractor's Competent Person(s) for its activities. Refer to *S3AM-213-PR1 Subcontractor Management*.

- *S3AM-202-FM1 Competent Person Designation* or equivalent may be used for this purpose.
- Provide the Contractor with a copy of this SH&E Procedure to verify the Contractor's capability to comply with the requirements within, and obtain documentation to support the designation of the Contractor employee as a Competent Person for AECOM.

- Verify the designation of the Competent Person for a specific activity is documented and effectively communicated to field personnel on site during daily tailgate safety meetings.

4.1.2 **Safety, Health and Environment (SH&E) Manager**

- Assist the Manager responsible for the work in assessing the competency of all designated persons based on specific requirements outlined in this procedure.
- Assist the Manager in:
  - Establishing competent person training/experience requirements and communicating these requirements to the supervisor.
  - Monitoring the overall implementation of this SH&E Procedure.
  - Monitoring field compliance of this procedure.
  - Providing technical assistance/support as requested.
  - Coordinating internal safety training classes as requested.
- Support the Manager in establishing minimum competent person requirements for regulated job activities based on individual job descriptions, applicable regulatory requirements, operational considerations, and management directives.
- Review as requested by designated operations representatives the Competent Person's qualifications for AECOM employees.

4.1.3 **Competent Person**

- Predict, identify, and control hazards when either AECOM self-performs associated field work or oversees and directs the work of subcontractors.
  - For operations where AECOM is providing oversight of subcontractors (e.g. drilling services), it is the subcontractor's employee who shall be designated as the Competent Person.
- Contractor Competent Persons - Unless AECOM is self-performing, the Contractor shall:
  - Determine the safe means and methods of its work activities.
  - Designate its Competent Person(s) for each category of work the Contractor undertakes and/or controls as required by this procedure.
  - If the contractor is unable to designate a Competent Person, AECOM may designate an appropriate AECOM employee as the contractor's Competent Person only if AECOM is contractually responsible for safety oversight of the contractor's activities.
- The Contractor's Competent Person shall:
  - Technically support the Contractor's site operations for the safe execution of its activities. Identify and remove any field hazards
  - Maintain appropriate knowledge about the work activities, the Contractor's work practices and procedures and compliance with the associated safety and health regulations.

4.2 General Requirements

4.2.1 The AECOM Competent Person project or worksite functions are dependent on the project activities and AECOM's project or worksite function.

4.2.2 Refer to each SH&E Procedure for the activities listed below and the associated legislative standards to determine the details of responsibility.

4.2.3 The following activities require an individual to be designated as a Competent Person:

- Asbestos
- Assured Equipment Grounding Conductor
- Blasting & Explosives
- Concrete & Masonry Construction
- Confined Spaces
- Control of Hazardous Energy (Lockout-Tagout)
- Cranes & Derricks
- Crane Assembly / Disassembly
- Demolition
- Electrical Wiring Design & Protections
- Elevated Work Platforms & Aerial Lifts
- Fall Protection
- Hearing Protection
- Heavy Equipment
- Ionizing Radiation
- Lead
- Material Hoists & Personnel Hoists
- Stairways & Ladders
- Respiratory Protection
- Rigging Equipment
- Scaffolds
- Steel Erection
- Trench & Excavations
- Underground Construction
- Welding & Cutting

4.2.4 Generally, it is the responsibility of the Competent Person(s) to be on site at all times when respective staff (AECOM, subcontractor) are performing work governed by this procedure, make daily inspections of the conditions and work activities, and take actions to control any hazards associated with those activities.

4.2.5 The *S3AM-202-FM1 Competent Person Designation* or equivalent shall be used for all programs or on all projects for documenting Competent Person designations. Documentation shall be filled out completely and updated as necessary.

4.2.6 *S3AM-202-ATT1 Competent Persons in General Industry (29 CFR 1910)* and *S3AM-202-ATT2 Competent Persons in Construction (29 CFR 1926)* include descriptions of various U.S. Occupational Safety and Health Administration requirements for competent persons. The list is not comprehensive and as such 29 CFR 1910 and 1926 shall be consulted for any additional competent person requirements.

5.0 Records

5.1 AECOM Competent Person Designation forms shall be maintained in the program / project file.

5.2 Documentation as to daily inspections and corrective measures by the AECOM Competent Person shall be maintained in the program / project file.

6.0 Attachments

6.1 S3AM-202-FM1 Competent Person Designation

6.2 S3AM-202-ATT1 Competent Persons in General Industry (29 CFR 1910)

6.3 S3AM-202-ATT2 Competent Persons in Construction (29 CFR 1926)

Americas

Environmental Compliance

S3AM-204-PR1

1.0 Purpose and Scope

1.1 This procedure establishes a process for assuring compliance with applicable environmental laws and regulations.

1.2 This procedure applies to all AECOM America-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

The terms and definitions relating to environmental compliance and hazardous waste management are included in the respective laws and regulations in Canada, Latin America and the United States.

2.1 **Applicable Environmental and Hazardous Waste Management Laws and Regulations** – The specific legal requirements that apply to an AECOM office or project. Laws and regulations vary considerably throughout the Americas.

2.2 **Compliance Map** – a document defining and detailing the actions necessary to assure compliance with applicable environmental legal requirements.

2.3 **Reportable Quantity (RQ)** – quantities of hazardous substances, which when released to the environment require notification to the appropriate authorities / agencies (e.g., National Response Center, local police, coast guard, state / provincial / territorial reporting agency, etc.). Multiple agencies and regulations have established RQs; RQs may differ by agency.

2.4 **Subject Matter Expert** – a person who is an expert in a particular topic or area based on experience, technical/regulatory knowledge, and/or training.

2.5 **Hazardous Wastes** – Hazardous waste laws and regulations are complex and vary considerably throughout the Americas. For example, based on the Canadian Environmental Protect Act of 1999, in Canada hazardous wastes and hazardous recyclable materials are defined as those with properties such as flammability, corrosiveness or inherent toxicity. According to EPA regulations, a hazardous waste is a waste with properties that make it dangerous or potentially harmful to human health or the environment. Hazardous waste can take many physical forms and may be solid, semi-solid, liquid, or even contained gases. Hazardous wastes fall into the categories of listed wastes and characteristic wastes. The characteristic wastes exhibit one of more of the following characteristics: ignitability, corrosivity, reactivity and toxicity.

2.6 **Generator of Hazardous Wastes** – For example, based on the Resource Conservation and Recovery Act (RCRA) and Environmental Protection Agency (EPA) regulations in the United States, a hazardous waste generator is any person or site whose processes and actions create hazardous waste. Generators are divided into three categories based on the quantity of waste they produce. Large quantity generators generate 1,000 kilograms per month or more of hazardous waste, more than 1 kilogram per month of acutely hazardous waste, or more than 100 kilograms per month of acute spill residue or soil. Small quantity generators generate more than 100 kilograms, but less than 1,000 kilograms, of hazardous waste per month. Very Small Quantity Generators generate 100 kilograms or less per month of hazardous waste, or 1 kilogram or less per month of acutely hazardous waste, or less than 100 kilograms per month of acute spill residue or contaminated soil, water, or other debris.

2.7 **Storage** – Per EPA regulations, storage is defined as the temporary holding of waste before the waste is treated, disposed of or stored somewhere else.

2.8 **Treatment and Disposal** – Per EPA regulations, treatment and disposal is any process that changes the physical, chemical or biological characteristics of a waste to minimize its threat to the environment.

3.0 References

3.1 AECOM Safety, Health and Environment Policy Statement

3.2 S3AM-004-PR1 Incident Reporting, Notifications & Investigation

3.3 S3AM-017-PR1 Injury & Illness Recordkeeping

3.4 S3AM-109-PR1 Asbestos

3.5 S3AM-116-PR1 Hazardous Materials Shipping

3.6 S3AM-119-PR1 Laboratories

3.7 S3AM-209-PR1 Risk Assessment & Management

3.8 S3AM-216-PR1 Compliance Assurance

4.0 Procedure

Subject matter experts knowledgeable in Canada, Latin Americas and the United States environmental and hazardous waste laws and regulations should be consulted for clarification of the requirements. Hazardous waste laws and regulation may vary by provinces in Canada, countries in Latin Americas and states in the United States. It is critical to understand the specific requirements in the various offices and project locations in the Americas.

4.1 Roles and Responsibilities

4.1.1 Managers (Operations) directing activities of the facility, site, or project location

- Ensure the areas they manage are in compliance with applicable environmental and hazardous waste laws and regulations. The SH&E Plan shall identify all applicable SH&E requirements the particular project/location is responsible for meeting.
- Participate in assessing the applicable activities, products or services for associated environmental impacts. Refer to *S3AM-204-ATT2 Aspects and Environmental Impacts Assessment* as a guideline.
- Ensure the necessary resources exist to comply with these requirements and is responsible for working with the SH&E team to audit compliance.
- Consult subject matter experts on an ongoing basis to ensure up-to-date specific requirements of applicable legislation and regulation are met.
- Ensure relevant information and compliance requirements are communicated to all affected personnel. As applicable, refer to *S3AM-204-ATT3 Environmental Management Plan (Sample)*.

4.1.2 Project / Location Manager

- Identifying and implementing the actions necessary to ensure compliance with the project / location's applicable environmental and hazardous waste requirements. As applicable, this may include:
    - Participating in the assessment of applicable activities, products or services for associated environmental impacts. Refer to *S3AM-204-ATT2 Aspects and Environmental Impacts Assessment* as a guideline.
    - Ensuring procedures for conducting any activities that could have a significant environmental impact are established.
    - Ensuring procedures for identification of significant environmental aspects of goods and services used by AECOM are established.
    - Identifying and understanding the applicable legal requirements that apply to the project / location's activities.

- Verifying that staff have the appropriate environmental and hazardous waste management training prior to performing assigned activities.
- Budgeting the necessary resources into each project / location to achieve compliance with applicable legal requirements.
- As applicable, verifying that Legal Counsel and Office of Risk Management (ORM) have reviewed and approved the signed client's Agency Agreement authorizing AECOM to sign a waste manifest or sign shipping papers "as an agent of that client." NOTE: It is AECOM's policy that AECOM personnel will not sign client waste manifests or shipping papers unless authorized to do so by AECOM Legal Counsel and ORM.
- Obtaining all applicable environmental permits prior to the start of any regulatory permitted activity, including those permits held by the client which may impact AECOM's activities.
- Assessing the compliance status of AECOM's activities.
- Implementing any identified corrective actions relative to noted potential environmental compliance deficiencies.
- Identifying environmental regulatory noncompliance or near misses to AECOM's incident report system

- Ensuring project / location-specific environmental compliance plan is developed and documented in the form of Environmental Management Plans (EMP) or equivalent (refer to *S3AM-204-ATT3 Environmental Management Plan (Sample)* as a guideline and to *S3AM-204-ATT1 Environmental Compliance Maps* for examples of Compliance Maps).
- Consult subject matter experts on an ongoing basis to ensure up-to-date specific requirements of environmental legislation and regulation are met.
- Ensure relevant information and compliance requirements are communicated to all affected staff.

4.1.3 SH&E Manager

- Assisting operations personnel in assuring that activities undertaken by Operations are in compliance with environmental legal requirements, including but not limited to:
  - Assisting operations in identifying applicable environmental and hazardous waste laws and regulations and Subject Matter Experts.
  - Supporting compliance assessments of operations activities as needed. Refer to *S3AM-204-ATT2 Aspects and Environmental Impacts Assessment* as a guideline.
  - Reporting regulatory potential noncompliance events that result in a notice of violation, notice of noncompliance, or other indication of noncompliance to both management and region counsel.
  - Reporting to management and legal counsel, as applicable, on the status of identified corrective actions.

4.1.4 Legal Counsel

- Reviewing, commenting on, and approving a client's signed Agency Agreement letter authorizing AECOM to sign a waste manifest or shipping papers "as an agent of the client."
- Taking appropriate action upon notification that AECOM received a notice of violation or any other written notice of noncompliance, or becoming aware of a noncompliance situation.
- Supporting operation's response to notices of violation or any other written notice of noncompliance issued to AECOM from a regulatory agency.

4.1.5 America's Office of Risk Management

- Reviewing, commenting on, and approving a client's signed Agency Agreement letter

authorizing AECOM to sign a waste manifest or shipping papers “as an agent of the client.”

4.1.6 Employees

- Reporting all environmental releases or permit exceedances immediately as per *S3AM-004-PR1 Incident Reporting, Notifications & Investigation*.
- Performing all project-related tasks in compliance with applicable environmental legal requirements.
- Signing waste manifests only if authorized by the Project Manager and Region Counsel. Refer to *S3AM-116-PR1 Hazardous Materials Shipping*.

4.2 Office Compliance

4.2.1 Overall – AECOM offices must comply with the applicable environmental and hazardous waste laws and regulations. This section describes some potential office related activities that can be subject to environmental laws and regulations.

4.2.2 Shipping Materials – The shipping and manifesting of hazardous materials from an AECOM office is subject to *S3AM-116-PR1 Hazardous Materials Shipping* procedure. Employees associated with shipping (such as with Federal Express, UPS and others) must be trained in their responsibilities and ensure they comply with the applicable shipping and manifesting requirements.

4.2.3 Storage of Chemicals and Wastes - Some AECOM offices may store chemicals and wastes. If so, these offices must comply with the applicable laws and regulations governing these activities.

4.2.4 Applicable Permits – Most AECOM offices will not require an air or water permit for discharges. If hazardous wastes are present in AECOM offices, they should be properly managed, stored, and disposed of in compliance with the applicable regulation and permitting requirements (e.g., United States EPA – storage permit required if hazardous waste is to be stored in excess of 90 days without having obtained regulator extension). The off-site disposal of hazardous waste from AECOM offices shall be properly manifested and both the waste hauler and the disposal facility shall be certified / permitted by the applicable environmental agencies.

4.3 Project Compliance

4.3.1 Obtaining Necessary Permits

4.3.1.1 Air Permits – If a project will result in emissions to the air, the project may require an air permit. It is important to work closely with the client as the permit may need to be applied for by the client.

4.3.1.2 Water Permits – For projects that involve discharges to receiving bodies of water (rivers, streams, etc.), storm sewers and sanitary sewers, AECOM needs to work closely with our clients to ensure all water related permits are obtained prior to start-up of the projects.

4.3.1.3 Waste Management and Waste Storage Permits – Federal, state, provincial and local environmental agencies have many regulations related to proper waste management (i.e. approval of spill containment plans, wastes placed in drums and containers must be properly labeled, etc.). Ensure appropriate approvals and permits are in place where required (i.e. British Columbia – approval of Operational Plan; United States – permit required for hazardous wastes stored on sites longer than generator status allowances). This may require working closely with the client to obtain required approvals and/or permits.

4.3.1.4 For projects where a client is authorizing AECOM to manage their waste, AECOM Employees must never sign a waste manifest indicating AECOM is the generator of the waste unless approved to do so by AECOM Legal Counsel and Americas Office of Risk Management.

4.3.2 Incident Reporting – Employees must promptly report to the client and work closely with the client in reporting to regulatory agencies any spills or releases into the environment. This includes: discharges of contaminated groundwater to a sanitary sewer or storm water sewer system unless authorized by the regulatory agencies involved to do so; spills of oil, petroleum products, or other chemicals to the ground or water bodies; and any release of hazardous substances in amounts greater than their "reportable quantities" –as defined by regulations. Employees must also report these incidents into AECOM's incident reporting system.

4.3.3 Laboratory Operations – Where AECOM has laboratory operations, the disposal of laboratory chemicals into laboratory drains is not allowed. Water discharges from laboratory operations must meet applicable environmental legal requirements.

4.3.4 Asbestos Management – There are many regulations governing asbestos management. Regulations may include implementing an Asbestos Management Plan; providing notice to air and other regulatory agencies relating to demolition or asbestos abatement plans within the specified timelines prior to the start of any abatement operations; and the abatement and disposal of asbestos. Refer to *S3AM-109-PR1 Asbestos*.

4.3.5 Environmental Management Plan (EMP) or equivalent – Documented at the site/office and project level, to ensure proper planning of operations with respect to the environment (as determined by the aspects and impacts assessment). Refer to *S3AM-204-ATT3 Environmental Management Plan (Sample).*

- Initial steps in developing the EMP include assessing environmental impacts of the activities, products or services to be undertaken. Refer to *S3AM-204-ATT2 Aspects and Environmental Impacts Assessment* as a guideline. This completed assessment may be included in the EMP.
- As required, each office / project must identify and document applicable environmental regulatory requirements in their EMP, or equivalent.
    - It is advisable to develop a Compliance Map for those projects where AECOM is a permit holder or where AECOM is operating under a client's permit. Compliance maps can indicate the applicable actions, limits, records retention requirements, and applicable submittals to ensure compliance with applicable environmental legal requirements.
    - Refer *to S3AM-204-ATT1 Environmental Compliance Maps* for examples of Compliance Maps.
- EMP (or equivalent) shall include documented procedures for conducting any activities that could have a significant environmental impact (e.g., requirements to maintain segregation of hazardous wastes from other wastes, disposal requirements, remodeling activities, laboratory operations, etc.).
    - If AECOM is responsible for selecting the waste disposal site/facility, the identified disposal site/facility shall meet regulatory requirements of the applicable jurisdiction.
- EMP shall identify required records management with respect to any environmental-related monitoring equipment (e.g., tank monitoring equipment, pH meters used prior to discharge to sanitary sewers, etc.).
- As applicable, the EMP, or equivalent, shall include procedures for identification of significant environmental aspects of goods and services used by AECOM (e.g., office supplies, utilities, subcontractors, commuting, and project- and overhead-related travel).
- If customer, client, or facility owner EMP fully encompasses AECOM operations, it is not necessary to create an AECOM - specific EMP.
- If not already included in SH&E Plans and Emergency Response plans, the EMP or equivalent shall include procedures to identify the potential for and response to upsets, incidents, and emergency situations. These plans also include procedures for preventing and mitigating the negative impacts of any emergencies.
- EMP (or equivalent) shall include provisions for a commitment to conduct (at least annually) an

evaluation of compliance with relevant environmental legislation, as well as opportunities for improvements.

- As applicable, EMP (or equivalent) shall identify opportunities and procedures to prevent and reduce the generation of waste, as well as recycle or reuse waste, both in the execution of activities or services and in the procurement of goods and services used by AECOM.
- *S3AM-204-ATT3 Environmental Management Plan* may be used as a template to prepare an EMP.

4.3.6 Releases/Spills – Where the possibility of an environmental release exists due to AECOM activities, the Reportable Quantity for regulated substances must be identified prior to the start of work. Any release or spill must be immediately reported to the client and depending on the material and quantity of material released or spilled, reported to regulatory agencies.

4.3.7 Subject Matter Experts – When necessary, project teams will consult with Subject Matter Experts to identify the necessary permitting/licensing and/or applicable regulations governing the planned scope of work. Example guiding questions that project teams may use to initially assess their project's environmental compliance needs include, but are not limited to:

- Will AECOM's activities have the potential to discharge any hazardous or other regulated chemicals/materials to the air?
- Is there any equipment on site that has an air permit or similar regulatory requirement governing air discharges to the environment? Note: This should include client-owned equipment that AECOM will operate and have contractual regulatory liability for during the planned scope of work.
- Will AECOM manage characteristic or listed hazardous waste for the client?
- Will AECOM activities generate nonhazardous, universal, or hazardous waste subject to requirements?
- Is this a site or facility where AECOM will perform activities under the Resource Conservation and Recovery Act (RCRA – United States), Canadian Environmental Protection Act (CEPA – Canada), a Consent Order or any other applicable jurisdictional regulatory body?
- Is the site or facility a hazardous waste generator (e.g., large quantity, small quantity, or very small quantity)?
- Will AECOM be required to select a waste disposal facility?
- What oil storage capacity does the site or facility have (count containers/equipment with capacities of 55 gal or greater)?
- Will AECOM's activities create a discharge into a surface water body?
- Will AECOM's activities disturb ≥ 1 acre of land surface area?
- Will AECOM's activities physically disturb or impact a wetland?

4.4 Environmental Compliance Assessments

4.4.1 AECOM will periodically assess its operations (offices and project sites) and activities to verify ongoing activities comply with applicable environmental legal requirements. Assessments shall be conducted, as a minimum, on an annual basis. The frequency of these documented environmental compliance assessments should be based on the complexity of the project/size of the office and the associated environmental compliance risks to AECOM.

4.4.2 The Managers (Operations) or Project/Location Managers will conduct the assessment or designate a qualified individual to conduct the assessment.

4.4.3 The environmental compliance assessment, refer to *S3AM-204-FM1 Office/Project Environmental Compliance Assessment Checklist,* will provide information to AECOM management on the

environmental compliance performance of specific operations.

4.4.4 The assessment can be combined into a periodic, comprehensive audit; typically, a business systems audit incorporating quality assurance, health and safety, and environmental components.

4.5 Environmental Incident or Non-Compliance

4.5.1 Should an assessment identify non-compliance issues or an environmental incident occurs, the severity level must be assessed for appropriate response. Refer to *S3AM-004-PR1 Incident Reporting, Notifications & Investigation*. Ensure the parties appropriate to the severity are contacted and involved with issue resolution (e.g., Legal Counsel).

4.5.2 If a regulatory Notice of Violation (NOV) is received by an AECOM facility or project, Legal Counsel shall be contacted and involved with issue resolution.

4.5.3 The issue or incident must be investigated and will be documented and tracked. Refer to *S3AM-004-PR1 Incident Reporting, Notifications & Investigation.* The documented investigation must:

- Identify the cause (root cause).
- Identify corrective actions.
- Assign responsibility to implement or modify controls to prevent reoccurrences and establish scheduled date of completion.
- Identify methods to inform impacted staff of any revisions to written procedures.

4.5.4 The documentation must be reviewed for actual completion and effectiveness of controls.

4.5.5 Document, review, and communicate appropriate lessons learned for incidents and near misses (including environmental).

5.0 Records

5.1 Comply with *S3AM-017-PR1 Injury & Illness Recordkeeping* requirements.

5.2 Maintain or keep accessible the following additional records/documentation:

5.2.1 Relevant laws and regulations (may be accessed via the web).

5.2.2 Facility and project non-compliance records.

5.2.3 Training records (maintained at the facility level, with the exception of modules tracked in computer-based training).

5.2.4 Required equipment inspections, waste storage area inspections, maintenance, and calibration information (in accordance with site EMP).

5.2.5 Relevant contractor/supplier information (in accordance with the site EMP or project-specific waste management plans) with respect to waste disposal vendors, transportation companies, etc.

5.2.6 Agency citations/Notice of Violations and any supporting information.

5.2.7 Information on emergency preparation and response.

5.2.8 Copies of Environmental Aspect and Impact Assessments (maintained by the safety representative for office locations or in the project files for project-related assessments). Refer to *S3AM-204-ATT2 Aspects and Environmental Impacts Assessment*.

5.2.9 Completed Compliance Assessment checklists and audit results.

6.0 Attachments

6.1 S3AM-204-FM1 Office/Project Environmental Compliance Assessment Checklist

6.2 S3AM-204-ATT1 Environmental Compliance Maps

6.3 S3AM-204-ATT2 Aspects and Environmental Impacts Assessment

6.4 S3AM-204-ATT3 Environmental Management Plan (Sample)

Americas

Personal Protective Equipment

S3AM-208-PR1

1.0 Purpose and Scope

1.1 Provide an effective Personal Protective Equipment (PPE) Program to protect AECOM employees from potential workplace safety and health hazards.

1.2 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

1.3 The proper use of appropriate PPE, in combination with effective engineering and administrative controls, can provide AECOM employees with protection against potential workplace hazards and can reduce the potential for workplace injury and illness.

2.0 Terms and Definitions

2.1 **ANSI** – American National Standards Institute

2.2 **CSA** – Canadian Standards Association

2.3 **PPE** – Personal Protective Equipment

2.4 **SDS** – Safety Data Sheets

2.5 **THA –** Task Hazard Assessment

3.0 References

3.1 S3AM-123-PR1 Respiratory Protection

3.2 S3AM-209-PR1 Risk Assessment & Management

3.3 S3AM-301-PR1 Confined Spaces

3.4 S3AM-304-PR1 Fall Protection

3.5 S3AM-315-PR1 Working On & Near Water

3.6 S3AM-317-PR1 Hand Safety

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Managers** or **Supervisors**

- Confirm the location specific SH&E Plan documents required hazard controls.
- Confirm Task Hazard Assessments (THAs) are conducted and hazards identified are eliminated through substitution, engineering, or administrative controls first before assigning PPE for hazard mitigation.
- Confirm appropriate subject matter experts, manufacturer's specifications, and regulatory requirements are consulted as necessary to assist with proper PPE selection.
- Match the appropriate PPE to those hazards that cannot be eliminated; support employees in exercising Stop Work Authority if the task is too hazardous to be mitigated
- Provide and document employee training on use and care of PPE.
- Determine which staff requires employee-issued PPE.

- Determine PPE requirements for visitors.
- If applicable, manage medical monitoring of employees using PPE (e.g. respirators, hearing protection, radiation, etc.).
- Approve the purchase of company-issued PPE.
- Confirm that appropriate PPE is utilized by employees when required or necessary. This may periodically be documented using *S3AM-208-FM2 Personal Protective Equipment Inspection*.
- Exercise Stop Work Authority if PPE is inadequate to address hazards.

4.1.2 **SH&E Managers**

- Provide guidance to Managers, Supervisors, and staff on the assessment of hazards and the selection of PPE.
- Provide training materials to Managers and Supervisors for employee training

4.1.3 **Employee**

- Review all relevant SH&E Plans, THAs and applicable SDS prior to commencing work.
- Exercise Stop Work Authority if the task is too hazardous.
- In accordance with training and instructions, utilize appropriate PPE that has been issued when required or necessary.
- Inspect PPE prior to and after use to confirm that it is functional, and maintain PPE in a clean and functional condition.
- Follow instructions and manufacturers' guidance on the care, use, and storage of PPE.
- Replace PPE when worn out, expired or damaged.
- Refrain from wearing PPE outside of the work area for which it is required if doing so would constitute a hazard.

4.2 Hazard Assessment

4.2.1 The location specific SH&E plan and THA shall assess the hazards and identify the necessary control measures. Refer to *S3AM-209-PR1Risk Assessment & Management.*

4.2.2 These control measures shall include direction and guidance concerning the appropriate PPE required as the last line of defense to the anticipated hazards of the specific operations and tasks. A PPE specific assessment may assist in identifying PPE requirements. *S3AM-208-FM1 Personal Protective Equipment Assessment* may be completed and included in the SH&E Plan.

4.2.3 Various tasks and operations, including but not limited to, demolition, remediation, spill response, asbestos abatement, and lead removal, may require additional direction concerning selection, use, care, and disposal of PPE from a subject matter expert (e.g. protector manufacturer, industrial hygienist, asbestos professional, etc.).

- Obtained direction shall be included in the SH&E Plan.
- Consultation with subject matters may be limited to the planning phase or they may be retained to provide technical assistance for a portion of or duration of the project.

4.3 Training

4.3.1 All employees shall be informed of their right to Stop Work if the task is too hazardous to mitigate through use of elimination, substitution, engineering controls, administrative controls, and PPE.

4.3.2 Staff will receive adequate instruction on the correct use, limitations, and assigned maintenance duties for the equipment to be used. The following information, at a minimum, will be covered during PPE training:

- What PPE is required.
- When it is required.
- Why it is required.
- How to properly don, doff, adjust, and wear the PPE described.
- The limitations of the PPE, including its expected useful life.
- How to properly care for, maintain, and dispose of the PPE.

4.3.3 Retraining may be required as applicable (e.g., observed non-compliance, changes in procedure, etc.).

4.3.4 Staff are responsible for confirming that they have reviewed the operation manual/instructions for the PPE before work commences.

4.3.5 All staff will receive a location specific orientation to the hazards on the job site as well as appropriate PPE requirements.

4.4 Determining the Need for PPE

4.4.1 Prior to beginning work, the SH&E plan shall be consulted and THAs developed to identify the PPE requirements.

4.4.2 After the hazard assessments have been completed, the manager and/or employee shall select the appropriate PPE for each job category or task, as necessary. PPE will be provided to each employee appropriate for the hazards present.

- All PPE selected, purchased and used by AECOM will meet or exceed the appropriate ANSI/CSA standards or other standards as determined by federal, provincial, territorial, or state legislation.

4.4.3 If the hazard can be mitigated through using appropriate PPE shall:

- Properly fit the employee's body. Reasonable attempts shall be made to procure gender-specific gear / sizing.
- Be selected and used in accordance with recognized standards and provide effective protection.
- Not in itself create a hazard to the wearer (e.g., scratched safety glasses which could cause impaired vision should be replaced with clear safety glasses).
- Be compatible so that one item of PPE does not interfere with other PPE.
- Be maintained in good working order and in a sanitary condition.
- Not be altered in any way.

4.4.4 Prior to entering any controlled or restricted work area, employees shall review the SH&E plan and corresponding THA(s) to confirm that they are equipped with the applicable ANSI/CSA-approved PPE, appropriate to the specific work area's hazards.

4.5 Eye and Face Protection

4.5.1 AECOM employees shall use appropriate eye and face protection when eye or face hazards are present or potential from flying particles, molten metal, liquid chemicals, acid and caustic liquids, chemical gases or vapors, or injurious light radiation.

4.5.2 Safety glasses with side protection is the minimum eye protection requirement. Additional eye protection shall be suitable to the anticipated hazards (e.g. goggles, safety glasses with a face-shield, welder's helmet, etc.). Refer to *S3AM-208-ATT1 Eye & Face Protection*.

4.6 Head Protection

4.6.1 Appropriate protective hardhats are required when employees are working in areas where there is any potential for injury to the head.

4.6.2 Head protection shall be suitable to the anticipated hazards (e.g. working near exposed electrical conductors requires hardhats designed to reduce electrical shock). Refer to *S3AM-208-ATT2 Head Protection.*

4.7 Foot Protection

4.7.1 AECOM employees shall use appropriate foot protection when hazards to feet are present or potential; including impact, puncture, cut, electrical, thermal or chemical hazards.

4.7.2 Refer to *S3AM-208-ATT3 Foot Protection.*

4.8 Hand Protection

4.8.1 Appropriate hand protection is required when employee's hands are exposed to hazards such as those from skin absorption of harmful substances, cuts and lacerations, abrasions, punctures, chemical burns, thermal burns, electricity, or harmful temperature extremes.

4.8.2 Refer to *S3AM-208-ATT4 Hand Protection* and *S3AM-317-PR1 Hand Safety*.

4.9 Chemically Resistant Clothing

4.9.1 Chemically resistant clothing is required when there is significant potential for the employee to come in direct contact with the chemicals being handled. Tasks that involve chemical handling will be evaluated for potential splashing or spilling. Refer to *S3AM-208-ATT5 Limb & Body Protection*.

4.9.2 The process for selecting chemical resistant clothing will be similar for the selection of chemical resistant gloves (refer to *S3AM-208-ATT4-Hand Protection* and *S3AM-317-PR1 Hand Safety*).

4.10 High-Visibility Apparel

4.10.1 “High visibility safety apparel” means personal protective safety clothing that is intended to provide conspicuity during both daytime and nighttime usage and that meets the Performance Class II or III requirements of ANSI/CSA standards. Refer to *S3AM-208-ATT6 High Visibility Safety Apparel.*

4.10.2 Color of apparel (orange or lime) may be client/project-specific. If there is a specific need to be visible to the passing public, to machine operators, or to other crew members, high visibility vests shall be worn (and retro-reflective striping on arms and legs at night).

4.10.3 Work conducted at night may require that the minimum level of apparel worn be, at minimum, ANSI/CSA Class III, and in accordance with the governing legislation.

4.11 Personal Clothing

4.11.1 Employees on a project site shall wear full length trousers and shirts that cover shoulders.

4.11.2 For personal safety on the job site, do not wear

- Loose or unsecured clothing or loose fitting cuffs;
- Greasy or oily clothing, gloves, or boots; or
- Torn or ragged clothing.
- Jewelry (e.g. rings, bracelets, neck chains) when working with moving parts or there is a risk or entanglement.

4.11.3 Long hair shall be tied back or otherwise confined when working with moving parts or there is a risk of entanglement.

4.11.4 Clothing made of synthetic fibers can be readily ignited and melted by electric flash or extreme heat sources. Cotton or wool fabrics are recommended for general use.

4.11.5 Footwear shall be suitable for the site conditions and task requirements. No athletic shoes, sandals, flip flops, permitted on active job sites.

4.11.6 It is recommended to use clothing with sun protection properties when working in high sun UV exposure

4.12 Specialized PPE

4.12.1 In addition to basic PPE, additional specialized PPE may be required to provide appropriate protection to the employee. Refer to applicable legislation and related SH&E procedures for additional information on PPE requirements.

- Fall Protection – Only full-body harnesses with shock-absorbing lanyards will be used for personal fall arrest. Refer to *S3AM-304-PR1 Fall Protection*.
- Respiratory Protection – Respiratory protection shall be selected based on the contaminant and concentration to which the employee will be exposed. Refer to *S3AM-123-PR1 Respiratory Protection*, the task- or project-specific hazard assessments and the applicable SDSs for specific requirements.
- Fire Resistant Clothing (FRC) – Approved fire-resistant outer clothing may be required at work locations with flammable or explosive materials or environments. Refer to *S3AM-208-ATT5 Limb & Body Protection.*
- Other Head Protection – Operators and passengers (if trained and permitted) of all-terrain vehicles and snowmobiles will wear approved helmets. Refer to *S3AM-208-ATT2 Head Protection.*
- Protection from Drowning – Appropriate personal floatation devices shall be worn when work working over and near water. Refer to *S3AM-315 Working On & Near Water*.
- Temperature Extremes – Work in cold environments may require additional layers and insulated clothing, gloves, boots and accessories such as balaclavas, hardhat liners. Confirm these items are approved and do not introduce additional unacceptable hazards (e.g. insufficient visibility, conductivity, etc.).
- Hearing Protection – Noise levels in the work environment that cannot be eliminated or reduced to acceptable levels requires worker be protected from exposure. Refer to *S3AM-118-PR1 Hearing Conservation.*
- Traction Devices – Traction devices applied to the base of work boots may be necessary if the employee may be walking on icy surfaces. Refer to *S3AM-208-ATT3 Foot Protection*.
- Rescue – Confined spaces hazards may necessitate the use of specific harnesses attached to retrieval lines to facilitate rescue. Refer to *S3AM-301-PR1 Confined Spaces*.

4.13 Maintaining PPE Supplies

4.13.1 Employees shall inspect their required PPE prior to use. Defective equipment shall be removed from service and replaced.

4.13.2 Each AECOM location will maintain a supply of safety equipment of appropriate types and sizes, including hard hats, high visibility vests, safety glasses, gloves, hearing protection and chemically resistant clothing based on the nature of their field activities. The Manager or designee will be responsible for maintaining this inventory.

4.13.3 Use of PPE by employees and adequacy of protection should be evaluated on a routine basis. This may periodically be documented using *S3AM-208-FM2 Personal Protective Equipment Inspection.*

4.13.4 At a minimum, locations will review their PPE program annually.

4.14 Obtaining Personalized Safety Gear

4.14.1 Employees are not expected to provide their own general PPE. Most basic PPE will be provided to the employee at no charge (e.g. safety glasses, hard hat, gloves, hearing protection, etc.) with the

exception of the below personalized safety equipment (prescription safety glasses, safety-toed boots, any washable coveralls).

4.14.2 Certain personalized safety gear such as prescription safety glasses, safety-toed (capped) boots, and any washable coveralls will be ordered and sized specifically by the user. A partial cost reimbursement to the employee may be made if their location provides a specialized PPE purchase program.

4.14.3 All specialized PPE (e.g. fall protection equipment, respirators, helmets, etc.) will be provided by AECOM for employee use at no charge to the employee, with the exception of the above personalized safety equipment (prescription safety glasses, safety-toed boots, any washable coveralls).

5.0 Records

5.1 Completed SH&E plans, THAs documenting PPE requirements, and as applicable, PPE assessments and PPE inspections, will be maintained in the location's safety files.

6.0 Attachments

6.1 S3AM-208-ATT1 Eye & Face Protection

6.2 S3AM-208-ATT2 Head Protection

6.3 S3AM-208-ATT3 Foot Protection

6.4 S3AM-208-ATT4 Hand Protection

6.5 S3AM-208-ATT5 Limb & Body Protection

6.6 S3AM-208-ATT6 High Visibility Safety Apparel

6.7 S3AM-208-FM1 Personal Protective Equipment Assessment

6.8 S3AM-208-FM2 Personal Protective Equipment Inspection

Americas

Personal Protective Equipment Assessment

S3AM-208-FM1

Location: _____ **Job No.:** _____

Date: _____ **Assessment conducted by:** _____

Specific tasks performed at this location: _____

If any of the indicated hazards are present, eliminate the hazard or use the indicated PPE. Include any additional guidance in the available section below each item.

Overhead Hazards

1.	Suspended/elevated loads, beams, or objects that could fall or strike head	☐ **Yes**	☐ **No**	Hard hat, ANSI Z89, Class G, E or C
2.	Flying objects that could strike head	☐ **Yes**	☐ **No**	Hard hat, ANSI Z89, Class G, E or C
3.	Energized wires or equipment that could strike head	☐ **Yes**	☐ **No**	Hard hat, ANZI Z89, Class G or E (dependent on potential voltage)
4.	Sharp objects or corners at head level	☐ **Yes**	☐ **No**	Hard hat, ANSI Z89, Class G, E or C

Eye Hazards

5.	Chemical splashes or irritating mists	☐ **Yes**	☐ **No**	Safety goggles
6.	Excessive dust	☐ **Yes**	☐ **No**	Safety glasses or goggles
7.	Smoke and/or fumes	☐ **Yes**	☐ **No**	Safety goggles
8.	Welding operations	☐ **Yes**	☐ **No**	Welding goggles
9.	Lasers/optical radiation	☐ **Yes**	☐ **No**	Consult subject matter expert for proper selection
10.	Projectiles	☐ **Yes**	☐ **No**	Dual eye protection
11.	Sawing, cutting, chipping, and/or grinding	☐ **Yes**	☐ **No**	Dual eye protection

Face Hazards

12.	Chemical splashes or irritating mists	☐ **Yes**	☐ **No**	Safety goggles
13.	Welding operations	☐ **Yes**	☐ **No**	Welding goggles or welding helmet
14.	Projectiles	☐ **Yes**	☐ **No**	Dual eye protection

If any of the indicated hazards are present, eliminate the hazard or use the indicated PPE. Include any additional guidance in the available section below each item.

Hand Hazards

15.	Chemical exposure	☐ **Yes** ☐ **No**	Use chemical-resistant gloves specific to hazard; consult SDS, subject matter expert, and/or Safety Representative
16.	Sharp edges, splinters, sharp tools, machine parts, etc.	☐ **Yes** ☐ **No**	Leather or Kevlar gloves
17.	Impact or crush hazards	☐ **Yes** ☐ **No**	Impact resistant gloves
18.	Temperature extremes – heat	☐ **Yes** ☐ **No**	Leather gloves, welder's gloves, hot mill gloves
19.	Temperature extremes – cold	☐ **Yes** ☐ **No**	Insulated gloves
20.	Blood, fungus, biological agents	☐ **Yes** ☐ **No**	Nitrile gloves
21.	Exposure to live electrical currents	☐ **Yes** ☐ **No**	Electrical gloves; consult Safety representative
22.	Vibrating tool operation	☐ **Yes** ☐ **No**	Anti-Vibration gloves
23.	Material handling	☐ **Yes** ☐ **No**	Leather, cotton, synthetic gloves

Foot Hazards

24.	Heavy materials (greater than 50 pounds) handled by employees	☐ **Yes** ☐ **No**	Safety shoes or boots
25.	Potential to crush or cut whole foot	☐ **Yes** ☐ **No**	Safety shoes or boots with metatarsal guard
26.	Sharp edges or points (puncture risk)	☐ **Yes** ☐ **No**	Safety shoes or boots
27.	Exposure to electrical hazards	☐ **Yes** ☐ **No**	Safety shoes or boots with: Conductive - Protects the wearer in an environment where the accumulation of static electricity on the body is a hazard. Static dissipative - Reduces accumulation of excess static electricity by conducting body charge to ground while maintaining a sufficiently high level of resistance. Electrical hazard - Provides a secondary source of protection against accidental contact with live electrical circuits, electrically energized conductors, parts or apparatus, and is manufactured with non-conductive electrical shock resistant soles and heels.

If any of the indicated hazards are present, eliminate the hazard or use the indicated PPE. Include any additional guidance in the available section below each item.

28.	Slippery conditions	☐ **Yes**	☐ **No**	Rubber-soled boots or grips
29.	Chemical contamination	☐ **Yes**	☐ **No**	Rubber, PVC, or polyurethane boots or boot covers with puncture and protective toe if task required
30.	Wet conditions	☐ **Yes**	☐ **No**	Rubber boots or boot covers
31.	Construction/demolition	☐ **Yes**	☐ **No**	Safety boots with metatarsal guard if foot-crushing hazard exists

Fall Hazards

32.	Elevations above 4 feet (general industry) or 6 feet (construction) without guardrails	☐ **Yes**	☐ **No**	ANSI A-10.14 Type 1 full-body harness
33.	Suspended scaffolds, boatswain's chairs, float scaffolds, or suspended staging	☐ **Yes**	☐ **No**	ANSI A-10.14 Type 1 full-body harness
34.	Working in trees	☐ **Yes**	☐ **No**	ANSI A-10.14 Type 1 full-body harness
35.	Working in vehicle-mounted elevating work platforms (e.g., bucket trucks, aerial lifts)	☐ **Yes**	☐ **No**	ANSI A-10.14 Type 1 full-body harness

Water Hazards

36.	Working on or above water where a risk of drowning exist	☐ **Yes**	☐ **No**	U.S. Coast Guard approved personal floatation device; Type I, II, or III

Excessive Heat or Flame

37.	Full body chemical protective clothing in temperatures greater than 80 °F	☐ **Yes**	☐ **No**	Cooling vest
38.	Work around molten metal or flame	☐ **Yes**	☐ **No**	Nomex or heat reflective clothing
39.	Welding activities	☐ **Yes**	☐ **No**	Welding leathers for those areas that are exposed to flame, spark, or molten metal

Respiratory Hazards

40.	Airborne particulates, gases, vapors, or mists in excess of established exposure limits	☐ **Yes**	☐ **No**	Refer to *S3AM-123-PR1 Respiratory Protection* for respirator selection guidance

Excessive Noise

41.	Exposure to noise	☐ **Yes**	☐ **No**	Ear plugs, muffs or both

If any of the indicated hazards are present, eliminate the hazard or use the indicated PPE. Include any additional guidance in the available section below each item.

Body and Leg Protection

42.	Chemical exposure	☐ **Yes** ☐ **No**	Contact SH&E Representative and/or subject matter expert for assistance in proper selection
43.	Using chainsaw, cutting brush	☐ **Yes** ☐ **No**	Chainsaw chaps
44.	Exposure to snakes	☐ **Yes** ☐ **No**	Snake chaps
45.	Exposure to vehicle traffic or heavy equipment	☐ **Yes** ☐ **No**	High visibility apparel

I certify that the above inspection was performed to the best of my knowledge and ability, based on the hazards present on: _____

Name _____ Signature _____

This document should be included in the location specific SH&E Plan.

Americas

Eye & Face Protection

S3AM-208-ATT1

1.0 Introduction

1.1 This fact sheet has been developed to inform employees about why eye and face protection is needed, when it should be worn, how to wear and adjust it properly, the limits of this type of PPE, and how to properly maintain and clean the eye and face protection issued.

1.2 AECOM will provide ANSI or CSA-approved (as appropriate to the jurisdiction) eye and face protection appropriate to the anticipated eye and face hazards and as required by client or site requirements. Employees shall wear the appropriate eye and face protection while engaged in activities where a risk of injury to the eyes or face may exist.

1.3 Safety glasses may be identified by the manufacturer or supplier logo, but shall contain the applicable standard marked (or etched) on all components (lenses, frames [front and temple], removable side shields, and any other parts of the glasses, goggles, or helmets).

1.4 Supervisors are responsible for ensuring that crews have access to the eye and face protection and confirming they are worn.

2.0 Types of Eye and Face Protection

2.1 There are three major types of eye and face protection:

2.1.1 Primary Protection

- Safety Glasses (side shields required)
- Safety goggles
  - Vented goggles—impact only
  - Indirectly vented—chemical splash and impact, dust
  - Non-vented—chemical fumes

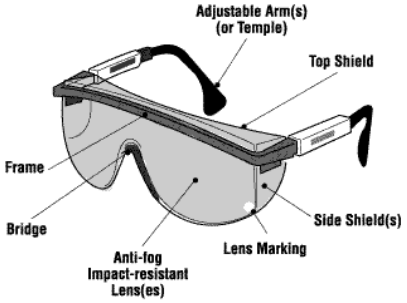
2.1.2 Faceshields

2.1.3 Radiation protection / welding helmets

2.2 Safety Glasses and Safety Goggles

2.2.1 The most widely used form of eye protection is safety glasses. To prevent lateral exposure to impact fragments, safety glasses are often equipped with side shields. Depending on the hazard, side shields can be either a cup-type or flat-folded. The cup-type provides more complete protection. At a minimum, AECOM will provide safety glasses with permanently attached side-shields or directly vented goggles to all employees whose work may present any eye or face hazard.

- In some cases such as moderate dust levels, safety glasses may include foam seals on frames to improve sealing against dust. If dust irritation of the eyes is an issue, the employee should contact the supervisor to evaluate the condition and provide more protective or better fitting safety eyewear (e.g. goggles).
- The frames of safety glasses are stronger than everyday eyewear frames, are often heat resistant, and designed to prevent the lenses from being pushed into the eyes.



- High impact eye protection utilizes plastic polycarbonate lenses which are stronger than regular lenses, are impact-resistant, and come in prescription and non-prescription forms.

2.2.2 Goggles form a complete seal around the eye area, providing more coverage than safety glasses and are more appropriate for chemical hazards and conducting tasks such as power washing. Goggles are required when working in an area or at a process that involves high dust or particulate concentrations.

- Direct vented goggles only provide impact resistance, but afford comfort due to air flow and reduction of fogging.
- Indirect vented goggles are also impact resistant, but have capped vents to allow air flow while also protecting against splashes or flying particles. Restricted air flow may result in fogging.
- Non-vented and indirectly vented goggles will be worn when employees are handling chemicals.

2.2.3 Manufacturers may apply anti-fogging and uv coatings to lenses of safety eyewear. Consider the use an anti-fogging agent if fogging of lenses is an issue.

2.3 Faceshields

2.3.1 Wear faceshields when there is a severe danger from impact from flying particles or chemical splash. Faceshields are secondary protectors and shall be worn over safety glasses or goggles.

2.3.2 Face shields providing impact protection shall be certified to the specifications of the applicable jurisdiction's standard (e.g., ANSI Z87+, CSA Z94.3, etc.).

2.3.3 Face shields shall be made available or installed whenever they may be required.

2.4 Radiation Protection / Welding Helmet

2.4.1 When welding or cutting, employees shall use equipment with filter lenses that has a shade number appropriate for protection against injurious light radiation.

2.4.2 When exposed to hazards such as lasers or beta radiation, employees shall use equipment with filter lenses that afford appropriate for protection against the laser or radiation hazard.

3.0 Prescription Glasses/Contact Lenses

3.1 If you wear corrective lenses, contact your SH&E coordinator for information about how to obtain prescription safety glasses. Prescription safety glasses shall be worn with appropriate side shields.

3.2 Regular prescription eyeglasses and sport glasses shall not be substituted for safety eyeglasses. Regular eyeglasses do not offer the same impact resistance of the lens and frame assembly as safety glasses and are not American National Standards Institute (ANSI) / Canadian Standards Association (CSA) approved.

3.3 Contact lenses are not recommended for any industrial job. Dust caught underneath the lens can cause painful abrasions. Some chemicals can react with your contacts to cause permanent injury.

3.3.1 When contact lenses are worn (and where a hazard exists), extra precautions are required to reduce the potential for injury. PPE for contact lens wearers includes splash or dust-resistant goggles, and safety glasses.

4.0 Cleaning and Maintaining Safety Eyewear

4.1 Clean lenses and frames regularly with mild soap and water and according to manufacturer's recommendations. Store protective eyewear in a clean, dry area.

4.2 Replace scratched, pitted, cracked, or broken safety eyewear immediately.

5.0 Proper Fit/Adjusting Glasses

5.1 PPE that fits poorly will not afford the necessary protection. When fitting devices for eye protection against dust and chemical splashes, be sure that the devices are sealed to the face. Confirm safety glasses fit properly. The arms or temples fit comfortably over the ears, the frame is as close to the face as possible and adequately supported by the bridge of the nose If the temple bars of the glasses are too long, the glasses will have a tendency to fall forward and slide down your nose. Check with your SH&E representative if you require glasses with adjustable temple bars. Standard safety glasses are 2 ¼ inches (58 millimeters); however, smaller sizes (2 ⅛ inches [2.54 millimeters]) are also available.

WHEN TO WEAR PROTECTION

Hazard	Concern	Glasses	Goggles	Faceshield
Impact	Flying fragments from front/sides.	Safety glasses with sideshields.	Vented goggles.	Severe danger from impact. Wear with glasses/goggles.
Chemicals	Splash.		Indirectly vented.	Severe splash. Wear with goggles.
Chemicals	Fumes.		Non-vented.	
Dust	Dust entering the eye.	Safety glasses with sideshields.	Vented goggles.	
Optical Radiation	Bright Light		Welding goggles with appropriate shaded lens.	Welding helmet with appropriate shaded lens.
	Ultra Violet			
	Infra-red (Heat)			
	Visible Light (Glare)			

Notes: Information provided by UVEX.

6.0 Guidelines

6.1 Dual eye protection – face shields shall be worn in addition to safety glasses or goggles when using chipping, grinding or buffing tools. Hazards associated with drilling or operations involving striking should be assessed for the need for dual eye protection.

6.2 Eye protection shall be worn when handling (e.g. transferring, spraying, applying, etc.) hazardous liquid or powder chemicals, and when draining or breaking joints on any pressure vessel, line, or equipment. In some situations, a face shield should be used in conjunction with goggles for additional eye and face protection.

6.2.1 Awkward positions, working overhead, or windy conditions may require retraining straps, mono-goggles or sealed eye wear.

6.2.2 Comfort and fit are very important in the selection of safety eyewear. Lens coatings, venting, or fittings may be needed to prevent fogging or to fit with regular prescription eyeglasses.

6.2.3 Safety sunglasses shall be worn when glare is a concern. Glare from sun and snow or water should be taken seriously as it can cause reduced vision and fatigue.

6.2.4 A combination of types of PPE may be necessary if more than one type of hazard exists. For example, where the potential hazards are chemical splashes and flying objects, chemical splash goggles used in combination with safety glasses may be required.

6.2.5 Lens color shall be appropriate to the environment and task. Use the below chart as a guideline only; always consult the manufacturer guidelines and specifications.

Safety Glasses Lens Color

	Clear Safety Glasses General indoor use
	Grey Safety Glasses Outdoor use where light and glare can cause eye strain and fatigue. Provides good color recognition.
	Clear with Slight Mirror Coating Safety Glasses Indoor / outdoor use. Serves same purpose as grey lens, but lets more visible light through. Reduces glare from artificial light.
	Gold, Blue, Silver Mirror Safety Glasses Outdoor use where light and glare can cause eye strain and fatigue. Provides good color recognition. Mirror reflects light, reducing the amount of light that passes through the lens.
	Dark Green Safety Glasses General purpose protection from glar and UV radiation.
	Brown/Espresso Safety Glasses Outdoor use where sunlight and glare cause eye strain and fatigue. Meets color traffic signal recognition requirements.
	Vermilion Safety Glasses Enhances contrast while reducing all color equality for best color recognition. Ideal for indoor inspection.
	Amber Safety Glasses Blocks blue portion of light spectrum while letting in red and green, creating high contrast. Hazardous at night when eye needs blue light to process visual information.
	SCT Safety Glasses (various tints) Spectrum control technology (SCT) lens is designed to absorb select wavelengths of light into the polycarbonate lens.
	Filter Shades (Glasses, Goggles, Helmets) Protects against ultraviolet and infrared radiation when working with molten metal, welding, cutting, soldering and brazing. (See Lens Shade Chart in Electric Arc Welding section of this document)

6.2.6 Brushing hair or removing clothing, eyewear, hard hats, etc. may release accumulated dust and/or metal particles. Bowing head and closing the eyes when removing these articles can prevent the particles from inadvertently entering the eyes.

6.2.7 Confirm an eyewash station is available in case flushing the eye becomes necessary

6.2.8 DO

- Replace pitted, scratched, bent, and poorly fitted PPE (damaged face/eye protection interferes with vision and will not provide the protection it was designed to deliver).
- Wear proper fitting eye protection (close to the face).
- Clean safety glasses daily, or more often if needed.
- Store safety glasses in a safe, clean, dry place when not in use.

6.2.9 DON'T

- Modify eye/face protection.
- Use eye/face protection that does not have ANSI/CSA certification.

Americas

Head Protection

S3AM-208-ATT2

1.0 Introduction

1.1 This fact sheet has been developed to inform employees about why head protection is needed, when it should be worn, how to wear and adjust it properly, the limits of this type of PPE, and how to properly maintain head protection issued.

1.2 Use hard hats in areas where there is the possible danger of head injury from the impact of falling or flying objects, striking against objects, electrical shock and/or burns, or any combination of these hazards. Hard hats will be worn when required by site safety procedures, client/site requirements, or when posted as an entry requirement.

1.3 The main type of head protector is the hardhat. Hardhats are designed to protect from impact and penetration caused by objects hitting your head and from limited electrical shock or burns. The shell of the hardhat is designed to absorb some of the impact. The suspension, which consists of a headband and strapping, not only holds the hardhat in place but is critical for absorbing and distributing impact shock loads. AECOM recommends ratchet style suspension for rapid adjustment during changing site conditions.

1.4 Helmets are required when operating or as a passenger of All-Terrain Vehicles, Snowmobiles or motorcycles. Helmets to be worn shall have a chinstrap that can affix snugly under the operators chin and the helmet shall be certified by the appropriate jurisdictional body. It is an offence in certain jurisdictions to not wear helmets for off-road vehicles.

1.5 Supervisors are responsible for confirming that employees have the appropriate ANSI/CSA -approved protective headwear necessary for their safety. This may include, as required by the specific job task and associated hazards:

1.5.1 Hard hat, or

1.5.2 Helmet.

2.0 Hard Hat Impact Types

2.1 Type I Hard Hats

2.1.1 Type I hard hats provide crown protection form penetration and impact. These hard hats are intended to reduce the force resulting from a blow only to the top (crown) of the head.

2.2 Type II Hard Hats

2.2.1 Type II hard hats provide crown and lateral penetration and impact protection. These hard hats are intended to reduce the force resulting from a blow that may be received off center or to the top of the head. A Type II hard hat typically is lined on the inside with thick, high-density foam.

2.3 Electrical Classes

2.3.1 Class G (General) – Class G hard hats are intended to reduce the danger of contact exposure to low voltage conductors. Test samples are proof-tested at 2,200 volts (phase to ground). However, this voltage is not intended as an indication of the voltage at which the hard hat protects the wearer. Please note: Class G hard hats were formerly known as Class A.

2.3.2 Class E (Electrical) – Class E hard hats are intended to reduce the danger of exposure to high voltage conductors. Test samples are proof-tested at 20,000 volts (phase to ground). However, this voltage is not intended as an indication of the voltage at which the hardhat protects the wearer. Please note: Class E hard hats were formerly known as Class B.

2.3.3 Class C (Conductive) – Class C hard hats are not intended to provide protection against contact with electrical conductors.

2.4 Do not use bump caps as protection against head injury, except when the only potential hazard is striking against objects and the use has been approved by a Manager.

2.5 No cowboy-style hard hats are permitted.

2.6 For tasks requiring face protection using face shields, hard hats designed for face shield attachment should be used. Some hard hats include attachment slots for hearing protection muffs.

3.0 Proper Fit / Maintenance

3.1 The suspension of the hard hat shall be adjusted to fit the wearer and to keep the shell a minimum distance of 1-1.5 inches (3 centimeters) above the wearer's head. Periodically inspect the suspension of your hard hat. Look for loose or torn cradle straps, loose rivets, broken sewing lines, or other defects. Replace the hat after a major impact.

3.2 Do not store materials in the suspension. Cold weather liners and perspiration control bands may be utilized within the hart hat unless specifically excluded by the manufacturer.

3.3 Any head covering worn under a hard hat should not contain any metal components, be close fitting, and not compromise the fit or stability of the hard hat in any manner. Baseball caps are prohibited from being worn under a hard hat.

3.4 Wear hard hats in the forward position unless written verification and instructions from the hard hat manufacturer indicate your hard hat model has been tested and found to be compliant when worn backwards.

4.0 Guidelines

4.1 On all construction projects and in the event that an overhead hazard exists, a four-point or six point suspension Type II, Class G or E hard hat will be provided to affected employees.

4.2 ANSI/CSA -approved industrial protective headwear that is appropriate to the hazards and meets applicable legislative requirements shall be worn by all personnel while engaged in construction, operation, maintenance, or other activities where there exists a foreseeable danger of injury to a worker’s head at a work site and/or a significant possibility of lateral impact to the head.

4.3 Visitors to areas where the above activities are being conducted shall comply with the hard hat requirement.

4.4 Hardhats, hard hats, and hard hat accessories (as required) shall be provided by AECOM and shall be appropriate to the anticipated hazards (e.g. fire resistant, arc rated, etc.)

4.5 Wear integral chinstraps when there is a risk of the hard hat dislodging, when working in high-wind conditions, working overhead or near helicopters.

4.6 Proper care is required for headgear to perform efficiently. The service life is affected by many factors including temperature, chemicals, sunlight, and ultraviolet radiation (welding). The usual maintenance for headgear is simply washing with a mild detergent and rinsing thoroughly.

4.7 Do not store a hard hat in direct sunlight (e.g. vehicle back window) as it will be subjected to unnecessary UV exposure. A hard hat with a chalky appearance rather than having a glossy finish or flaking of the shell indicates UV damage.

4.8 Some insect repellants can degrade hard hat materials. Consult the manufacturer’s recommendations and avoid any contact of the hard hat with insect repellant.

4.9 Do not alter hard hats in a way that will downgrade their efficiency. Typical prohibited alterations include painting, drilling holes in shell, application of metal jewelry, etc. Replace hats with these alterations or with excessive scratches.

4.10 Do not apply unapproved stickers to a hard hat. Placement of approved stickers on hardhats shall not hamper the ability to conduct a proper pre-use inspection. No stickers or reflective tape shall be placed within ¾ of an inch of the hard hat edge to prevent the risk of a decal acting as a conductor.

4.11 Inspect hard hats before use.

4.11.1 Remove from service if pitting, cracking, tearing, fraying, chalking, flaking, unapproved modifications or damaged suspension systems are observed.

4.11.2 Remove hard hats and their components from service and replace as recommended by the manufacturer. Hard hats shall be replaced after no more than 5 years.

4.11.3 Replacement suspensions are available for most hard hats. Note: Such things as hair oils, perspiration, hairspray and insect repellant can cause deterioration of the suspension.

4.11.4 DO

- Replace headgear that has been subjected to a blow even though damage cannot be seen.
- Remove from service any headgear if its serviceability is in doubt.
- Replace headgear and components according to manufacturers' instructions.
- Consult the Safety, Health and Environment team or your supplier for information on headgear.

4.11.5 DON'T

- Drill, remove peaks, or alter the shell or suspension in any way.
- Put chin straps over the brims of Class E headgear.
- Use any liner that contains metal or conductive material.
- Carry anything in the hard hat while wearing the hard hat.

Americas

Foot Protection

S3AM-208-ATT3

1.0 Introduction

1.1 AECOM employees shall use appropriate foot protection when hazards to feet are present or potential.

1.2 Foot injuries may occur if feet are unprotected, due to, but not limited to the following:

- Impact from heavy objects falling or rolling across the foot.
- Puncture or cuts – sharp objects falling, stepped on otherwise contacted.
- Puncture or cuts – high pressure water or equipment such as chainsaws, compacting equipment, snow blowers or ground brushing machines.
- Improper ankle support when walking on uneven surfaces.
- Electrical contact.
- Extreme heat or cold – immersion or contact with extremely hot or cold materials or substances.
- Chemical / hazardous substance contact - hazardous chemicals / products that can cause skin injury or irritation such as cement and petroleum products may contact feet and legs. Immersion in contaminated water.
- Snake bites.

2.0 Guidelines

2.1 ANSI/ASTM or CSA -approved (as appropriate to the given jurisdiction) safety-toed (steel or composite) boots with a minimum of 6 inch (15.2 centimeters) ankle support, an oil-resistant sole, and a distinctive heel (unless a heel presents additional hazard), shall be the minimum footwear requirement of all employees engaged in construction, operation, maintenance, or other activities where a risk of injury to the feet may exist.

2.1.1 Supervisors are responsible for confirming that employees have and additional foot protection necessary to ensure their safety. This may include the following types or combination thereof, as required by the specific job task:

- Caulk / Cork boots – spike-soled boots generally utilized in logging or timber operations.
- Boots providing metatarsal protection – provide above-the-toe protection from rolling or crushing hazards (e.g. railroad track work), as well as punctures or cuts from equipment such as chainsaws, compacting equipment, snow blowers or ground brushing machines.
- Acid and/or chemical-resistant boots – provide protection from chemicals or chemical products that could cause injury or irritation.
- Chemical-resistant boot covers – may be utilized for visitors, workers not routinely involved in the task or when potentially exposed to radiation hazards.
- Insulated boots – provide protection from extreme hot or cold.
- Rubber boots and non-slip wading boots – provide traction and immersion protection.
- Electric shock resistant – provide protection from electricity that may be conducted through the feet.

  Note: Electric shock resistant soles deteriorate with wear and in wet conditions. Static dissipative soles without toe protection are not certified by CSA.
- Traction devices – provide traction in icy conditions. Confirm the addition of ice cleats or other traction devices do not pose additional hazards (e.g. ice cleats made of conductive or sparking material in a flammable environment; loss of traction on concrete, etc.).

2.2 Employees assigned to field projects who are not required to wear specified protective footwear (e.g., steel-toed boots, metatarsal protection, rubber boots, chemical resistant boots, insulated boots, etc.) will wear substantial leather, high-sided work boots. Shoes (leather, canvas, tennis, deck, or other types of material), sandals, high-heeled shoes, etc., are not allowed on field project sites. In some cases protective over-boots may be required for specific-site access.

2.3 Employees are responsible for confirming their footwear is in good working condition and is appropriate to the conditions before work commences.

- Footwear must be, be fully laced and have adequate tread to maintain traction**.**
- Replace footwear that is defective (e.g. exposed toe-caps).
- Do not modify protective footwear.

3.0 Standards

3.1 Safety boots must meet the regulated standard.

- Safety boots are made with a steel or composite-reinforced box toe to protect the foot from being pierced or crushed by a falling object.
- Safety boots with flexible steel insoles provide puncture resistance. They will stop or deflect nails or other objects that have penetrated the sole of the boot.
- Oil-resistant soles provide the added safety feature of preventing slips and trips on slippery work floors.

3.2 The following standards apply to foot protection equipment:

3.2.1 Safety footwear may contain the following safety symbols denoting the protection offered:

- Green Triangle indicates that it is a class 1 toe cap with puncture resistant sole.
- Yellow Triangle indicates that it is a class 2 toe cap with puncture resistant sole.
- White Rectangle (with orange omega symbol) indicates electrical protection.
- Yellow Square (with green SD) indicates anti-static protection.
- Red Square (with black C) indicates electrically conductive.
- Fir Tree indicates protection against chain-saws.

3.2.2 ASTM footwear may be labeled in the following manner: ASTM F2413-05 M/I/75/C/75

- The ASTM F2413- 05 indicates compliance with the standard
- M stands for “Male” (or F for “Female”)
- I/75 indicates impact rating of 75 pounds
- C/75 indicates compression rating of 75 (75 = 2500lbs of pressure, 50 = 1750lbs of pressure)

3.2.3 Examples of symbols:



3.2.4 When required by the regulations or the client, AECOM will provide affected employees with safety-toed boots that meet the requirements of the applicable ANSI/CSA standard.

3.2.5 The purchase of normal footwear for work is the responsibility of the employee.

4.0 Proper Fit

4.1 With most PPE, the more comfortable it is to use, the more likely to be used. The fit of the safety boot is of the utmost importance. Try safety boots on before purchasing. When selecting boots, be sure that they are American National Standard (ANSI), American Society for Testing and Materials (ASTM), or Canadian Standards Association (CSA) approved, as appropriate to the jurisdiction. Consult with your supervisor about how to obtain safety boots.

4.2 The former ANSI standard for protective footwear has been replaced by ASTM standards. Footwear certified to the former ANSI Z41 1999 standard does not require replacement unless user inspection identifies safety deficiencies.

Americas

Hand Protection

S3AM-208-ATT4

1.0 Introduction

1.1 This fact sheet will inform employees about why and when hand protection is needed, the limits of gloves, and how to properly clean and dispose of gloves. Refer to *S3AM-317-PR1 Hand Safety* for additional information and guidance.

1.1.1 Gloves most commonly used in the construction industry are made from:

- Kevlar (or engineered fabrics).
- Leather.
- Cotton.
- Rubber.
- Synthetic rubbers and other manmade materials.

1.2 All personnel shall have gloves in their immediate possession 100% of the time when in a shop or on a work site. Appropriate gloves shall be worn when employees work with or near any materials or equipment that present the potential for hand injury due to sharp edges, corrosives, flammable and irritating materials, extreme temperatures, splinters, etc.

2.0 Types of Hand Protection

2.1 After physical guards, gloves provide the most common hand protection. There is no glove that protects against all hand hazards. The information below can assist the employee in selecting the appropriate glove for the hazardous condition. In all cases, the gloves should meet testing standards for the appropriate hazard they are protecting against.

2.2 As a general rule, always consult the manufacturer for specifications to ensure the gloves will provide the appropriate hand protection needed.

2.3 When selecting appropriate gloves, cuff design (open or closed) and glove length should also be considered.

2.4 Skin absorption of harmful substances

2.4.1 Nitrile offers good resistance to certain chemicals, but they tear and rip easily when sharp objects are handled.

2.4.2 The AECOM manager and employee shall consult the Safety Data Sheet (SDS) of the material being handled and, as appropriate, subject matter experts to appropriately select the chemical resistant glove.

2.4.3 The glove selection and any applicable liner gloves shall be based on proposed use and the manufacturer's chemical compatibility data, which indicates how each glove material performed in breakthrough time tests against certain chemicals. Examples:

- Butyl, polyethylene, or Silver Shield/4H gloves should be used for painting where significant potential for skin exposure to isocyanates exists.
- Porous painters or mechanics gloves should have butyl, polyethylene, or nitrile gloves worn underneath and are only appropriate for activities with incidental chemical contact and short-term use.
- Butyl or Silver Shield®/4H® gloves should be worn for adequate skin protection from acetone or methyl ethyl ketone (MEK). Nitrile gloves are not recommended.

2.4.4 In some cases, inner disposable chemical gloves (e.g., nitrile) will be required for protection of hands during removal of contaminated gloves.

2.4.5 Do not substitute another type of glove for the appropriately identified chemical resistant gloves that have been selected for the hazard; they may not offer adequate protection for the chemicals you handle.

2.4.6 Chemical gloves and chemical protective clothing often require taping the glove to the clothing to prevent gaps.

2.5 Severe cuts lacerations and punctures

2.5.1 Gloves providing cut resistance may be constructed of leather, synthetic materials (e.g. polyester, nylon), high performance materials (e.g. Kevlar), and metal mesh.

2.5.2 Leather gloves offer very little cut and puncture protection, however, they do offer some abrasion protection (see abrasion protection below). If cut or laceration hazards are present, an appropriate ANSI cut resistant rated glove should be used (Canada does not identify cut resistant ratings).

2.5.3 ANSI provides cut resistant ratings for various gloves to assist the user in selecting the right type of protection. The ratings are based upon how well the glove withstands ASTM testing methods.

2.5.4 Please note not all gloves that provide good cut/laceration resistance provide equal puncture resistance. When selecting a glove for puncture protection, please look at the manufacturer's specifications specific to puncturing. When selecting a glove for cut/laceration resistance, the information below can be used as a guide:

- **ANSI Level 1: Lowest cut hazard potential**. For example, paper cuts, parts assembly, light material handling, paper, assembling cardboard boxes, etc.
- **ANSI Level 2: Low cut hazard potential**. For example, packaging, light rope handling, moving office supplies, mechanical assembly work.
- **ANSI Level 3: Medium cut hazard potential.** For example, light glass handling, glass bottle/sample jar handling, light sheet metal handling, medium rope handling, and light utility knife handling.
- **ANSI Level 4: High cut hazard potential**. For example, thin sheet metal handling, rope handling, working around sharp edges, and medium utility knife handling.
- **ANSI Level 5: Highest cut hazard potential.** For example, thin sheet metal handling, working around sharp edges, heavy utility knife handling, and picking up broken glass.

2.6 Abrasions

2.6.1 Leather gloves offer some abrasion protection, but should only be selected for light abrasion protection. Appropriate activities for leather gloves may include moving light equipment where cut and lacerations are of minimal concern.

2.6.2 If cut or laceration hazards are present, an appropriate ANSI cut resistant rated glove should be selected. If medium to high abrasion protection is needed, select a glove that is approved to the appropriate level.

2.6.3 Gloves manufacturer with abrasion resistant surfaces in high contact areas (e.g. knuckles, palm) should be considered for tasks involving high potential for abrasion hazards (e.g. construction activities, mechanics, etc.).

2.7 Vibration

2.7.1 Gloves that meet the applicable ANSI standard for vibration reduction (also known as Anti-Vibration gloves) should be selected if performing activities that require handling vibrating tools (e.g. chainsaw, jackhammer, grinder, etc.).

2.7.2 Match the glove type to the hazard. Consult the glove manufacturer for guidance on selecting the right glove for the task. All Anti-Vibration gloves should completely cover the fingers.

2.8 Electrical Protection

2.8.1 Electrically insulated gloves used to protect from electrical hazards must be appropriately rated for the anticipated voltage.

- Insulated gloves and protectors must be inspected, tested and maintained according to manufacturer's specifications. Metal splinters, punctures or tears and cracking from ozone damage can all provide a path to conduct electricity
- Leather protectors must always be worn over insulated gloves worn for electrical protection. Never wear leather protectors without insulated gloves

2.8.2 Do not rely on glove color for identification of type and protection as color coding can be inconsistent. Ensure labels and manufacturer specifications are consulted to correctly identify glove type.

2.8.3 Do not wear hand PPE with metal parts near electrical equipment.

2.9 Temperature extremes and other hazards

2.9.1 Heat/flame resistant: depending on the activity and hazard, gloves or mittens that have been tested in accordance to ASTM standards should be selected when handling hot materials. Match the glove to the appropriate heat exposure level. The glove manufacturer may need to be contacted to help determine if the glove will meet and exceed hand protection.

2.9.2 Cold resistant: depending on the activity and hazard, insulated gloves or mittens should be used to protect the user's hands from cold conditions.

2.9.3 Wet gloves will diminish any insulating properties increasing the risk of frostbite in cold conditions. Conductivity is also increased when gloves become wet and pose a significant hazard in the presence of electricity.

2.9.4 Welding requires gloves that are fire resistant (e.g. leather) and extend up the forearm.

2.9.5 Employees subjected to radiation hazards may require lead-lined rubber, plastic or leather gloves.

2.10 Dexterity and Slip Resistance

2.10.1 Gloves should be selected according to the level of contact the user requires to conduct work tasks. Some work activities require more finger dexterity to safely do the work while other tasks or applications have a high risk/potential for cuts and abrasions to the hands. The protection selected must be appropriate to the type of hazard, but in the event of any discrepancies the protection required for the highest risk will prevail.

2.10.2 Gloves made of slip resistance of material may be required (e.g. climbing rung ladders, handling slippery objects).

2.10.3 Synthetic cut protection material such as Kevlar and Dyneema can be very slippery. A coating is often applied to provide grip.

3.0 Proper Fit/Cleaning Disposal

3.1 Use gloves that fit properly.

3.1.1 Tight-fitting gloves can cause fatigue while loose-fitting gloves can be hazardous. Always select the right size of glove**.**

3.1.2 Measure the circumference of your hand around the palm area. This measurement, in inches, is closest to your actual glove size. For example, 7" is equal to a size 7 glove. Always select the right size glove.

3.1.3 Form fitting gloves should be worn when working with moving machinery; bulky gloves can get caught or tangled in equipment.

3.2 When protective factors are not negatively impacted, glove liners or approved powder may be used to reduce friction that could be encountered.

3.3 Dispose of chemically resistant gloves in accordance with the established protocols at the site or office. The product SDS will need to be consulted if the glove is contaminated from chemical handling.

3.4 As applicable and appropriate to the glove type, wash all chemicals and fluids off gloves before removing hand PPE.

3.5 Gloves will deteriorate over time depending on the type of work and amount of chemicals gloves are exposed to. Remove excessive chemical residue that builds up on the glove. Replace cracked, ripped, or torn gloves or when breakthrough occurs. Breakthrough is the time between initial contact of the chemical on the glove surface and the detection of the chemical on the inside of the glove.

3.6 Follow manufacturer's instructions on the care and use of the hand PPE you are using.

4.0 Additional Points to Remember

4.1 Consult applicable SDSs, the SH&E Manager, and/or subject matter experts for questions related to the selection, use and maintenance of hand PPE.

4.2 Consideration must be given to allergies and alternatives shall be provided if necessary.

4.3 Always review performance characteristics as listed by the manufacturer.

4.4 The user shall inspect and test hand protection daily to determine if any deficiencies exist, such as holes, rips, excessive wear and tear, and saturation with water, oil or other substances that diminish the protection offered by the glove.

4.4.1 Effort must be made to keep gloves from becoming soiled with oil or other hydrocarbons. These can pose a fire hazard particularly when exposed to high concentrations of oxygen.

4.4.2 All rubber and synthetic gloves shall be tested for leaks prior to use. Inflate the glove by swinging it out a few times to trap air. Grasp the cuff to prevent the air from escaping and squeeze to cause the glove to expand allowing any escaping air to identify holes or tears.

Americas

Limb & Body Protection

S3AM-208-ATT5

1.0 Introduction

1.1 If there is a danger that a worker's hand, arm, leg or torso may be injured, the appropriate and properly fitting hand, arm, leg or body protection equipment is worn for the hazard identified.

1.2 Workers shall wear the appropriate chainsaw chaps when operating a chainsaw and snake chaps if potentially exposed to snake bites.

1.3 Limb and body protection should not be modified without manufacturer's approval as the protective qualities may be compromised (e.g. slits cut in coveralls or protective suits to access pockets can result in increased susceptibility to exposure; materials used for secondary stitching may conduct electricity or melt upon high temperature exposures).

2.0 Chemical Resistant Clothing

2.1 The need for chemical resistant clothing will be determined by the Manager after consulting the products SDS, any necessary subject matter experts, and the SH&E Manager. The Manager will issue the required clothing to the employee.

2.2 Like gloves, the objective of whole body protection is to separate the person from a contaminating or hazardous material. Disposable garments, such as Tyvek coveralls or aprons, provide this type of barrier.

- Uncoated Tyvek coveralls are made of a porous fabric and are designed to prevent contact with particulates.
- Coated Tyvek coveralls provide a nonporous barrier to protect the worker from chemical splash and vapors.
- Protective aprons are made from nitrile or neoprene rubber like that used to make chemical resistant gloves.

2.3 Whenever there is a potential for chemical splashing, disposable, chemical resistant clothing, such as a coated Tyvek coverall or apron will be worn. The following tasks are examples where chemical resistant clothing should be used:

- Cleaning of spills (large or small).
- Handling materials that are hazardous to skin.
- Sampling hazardous liquids/material.
- Equipment decontamination.
- Non-routine tasks involving the use of chemicals.
- The transfer of large quantities of chemicals from large containers to smaller ones.

3.0 Fire Retardant & Flame Resistant Clothing (FRC)

3.1 The terms 'Fire' and 'Flame', and 'Retardant' and 'Resistant', in reference to FRC are often used interchangeably and definitions can vary considerably. Regardless of the term used, it is important to know how the particular clothing provides protection.

3.2 Fabric used in FRC may be composed of fibers that resist ignition and withstand heat while other fabric may be treated with a chemical to provide flame resistance.

3.3 Some chemical treatments (such as Proban) can begin to lose effectiveness after 25 to 35 washes, whereas fabric composed of FRC fibers will not lose effectiveness due to washing.

3.4 If FRC is soiled the protection afforded is severely diminished. In some cases the residue, such as hydrocarbons, may be flammable.

3.5 Tears or holes in clothing can diminish its protective capacity and possibly pose a snagging hazard.

3.6 Do not roll up sleeves or pant legs, or neglect to fasten the front (zipper, snap) as intended.

3.7 Ensure the manufacturer's instructions and recommendations are followed when laundering or mending FR clothing.

3.8 Do not use fabric softener or bleach on FRC.

3.9 Wash on low temperature separately from other garments.

3.10 If a worker may be exposed to a flash fire or electrical equipment flashover, workers shall wear the appropriate rated outerwear and use other PPE appropriate to the hazard.

3.11 If FRC is to be worn, the clothing beneath the outerwear and against the skin shall be made of FRC fabrics or of natural fibers that will not melt when exposed to heat. Synthetic clothing is prohibited.

3.12 Situations requiring FRC include, but are not limited to:

- Risk of fire or explosion.
- Ground disturbance over or near live pressurized lines containing hydrocarbons.
- Work conducted within 165ft (50m) of a live facility.
- Jurisdictional requirements.
- Customer requirements.
- SDS or Task Hazard Assessments identify as necessary.

3.13 If static charge is an ignition concern work wear with anti-static properties may be required.

3.14 Clothing shall cover potentially exposed areas as completely as possible.

4.0 Arc Rated Clothing

4.1 Arc rated clothing has been tested for exposure to an electric arc. Note: If FRC does not have an arc rating it has not been tested for exposure to an electric arc.

4.2 Arc rated clothing is issued the lower value of either an ATPV or EBT value.

- ATPV – arc thermal performance value
- EBT – break open threshold

4.3 The arc rating is expressed in cal/cm2.

4.4 An arc flash hazard analysis shall be conducted by a competent person to determine the appropriate rating required for protective clothing and when it shall be worn. Refer to *S3AM-302-PR1 Electrical Safety*.

4.5 When arc rated clothing is worn it shall cover all affected parts of the body as well as any other clothing. The arc rated clothing shall be the outermost layer when arc protection is required.

4.6 Areas or electrical equipment may be labeled indicating the required PPE and the minimum arc rating for clothing.

4.7 Clothing that is not arc rated, but worn in conjunction with arc rated clothing shall not be used to increase the arc rating of the clothing system.

Americas

High Visibility Safety Apparel

S3AM-208-ATT6

1.0 Class 1 Safety Apparel

1.1 Class 1 safety apparel provides the minimum amount of required material to differentiate the wearer from the work environment.

1.2 At a minimum, this shall include 217 square inches (in^2), or 0.14 square meters (m^2), of fluorescent yellow-green, orange-red, or red background materials combined with 155 in^2 (0.10 m^2) retro-reflective material. As an alternative, the apparel can have 310 in^2 (0.20 m^2) of combined-performance material (i.e., materials that are both retro-reflective and fluorescent).

1.3 Class 1 safety apparel typically consists of a sleeveless traffic vest with retro-reflective bands no less than 0.98 inches (25 mm) in width.

1.4 Those occupational activities under which Class 1 safety apparel is typically used:

1.4.1 Permit full and undivided attention to approaching traffic;

1.4.2 Provide ample separation of the pedestrian worker from conflicting vehicle traffic; and

1.4.3 Permit optimum conspicuity in backgrounds that are not complex with vehicle and moving equipment speeds not exceeding 25 miles per hour (mph), or 40 kilometers per hour (kph).

1.5 Examples of pedestrian workers who could work in these situations may include:

1.5.1 Workers directing vehicle operators to parking/service locations;

1.5.2 Workers exposed to the hazards of warehouse equipment traffic;

1.5.3 Roadside “right-of-way” or sidewalk maintenance workers; and

1.5.4 Delivery vehicle drivers.

2.0 Class 2 Safety Apparel

2.1 Class 2 safety apparel provides superior visibility for the wearers by the additional coverage of the torso and is more conspicuous than Class 1.

2.2 At a minimum, this shall include 775 in^2 (0.50 m^2) of fluorescent yellow-green, orange-red, or red background materials combined with 201 in^2 (0.13 m^2) retro-reflective material. Combined-performance materials may not be used without background materials in Class 2.

2.3 Class 2 safety apparel typically consists of a full-torso sleeveless traffic vest with retro-reflective bands no less than 1.38 inches (35 mm) in width.

2.4 Those occupational activities under which Class 2 safety apparel is typically used:

2.4.1 Greater visibility is desired during inclement weather conditions;

2.4.2 Complex backgrounds are present;

2.4.3 Employees are performing tasks which divert attention from approaching vehicle traffic;

2.4.4 Work activities take place in close proximity to vehicle traffic; and

2.4.5 Vehicle and moving equipment speeds exceed 25 mph (40 kph).

2.5 Examples of pedestrian workers who could work in these situations may include:

2.5.1 Roadway construction workers;

2.5.2 Utility workers;

2.5.3 Survey crews;

2.5.4 Railway workers;

2.5.5 Forestry workers;

2.5.6 Parking and/or toll gate personnel;

2.5.7 Airport baggage handlers/ground crew;

2.5.8 Emergency response personnel;

2.5.9 Law enforcement personnel; and

2.5.10 Accident site investigators.

3.0 Class 3 Safety Apparel

3.1 Class 3 safety apparel offers greater visibility to the wearer in both complex backgrounds and through a full range of body movements. Visibility is enhanced beyond Class 2 by the enhancement of background and reflective materials to the arms and/or legs.

3.2 At a minimum, this shall include 1240 in2 (0.80 m2) of fluorescent yellow-green, orange-red, or red background materials combined with 310 in2 (0.20 m2) retro-reflective material. Combined-performance materials may not be used without background materials in Class 3.

3.3 Class 3 safety apparel typically consists of a coveralls, jumpsuits, long or short-sleeved jackets, or long-sleeved shirts with retro-reflective bands no less than 1.97 inches (50 mm) in width. A sleeveless garment or vest alone shall not be considered Class 3 apparel.

3.4 Those occupational activities under which Class 3 safety apparel is typically used:

3.4.1 Workers are exposed to significantly high vehicle speeds and/or reduced sight distances (note that several sources have interpreted the vehicle speed requirements as 50 mph (80 kph) or more);

3.4.2 The worker and vehicle operator have high task loads, clearly placing the worker in danger; or

3.4.3 The wearer must be conspicuous through a full range of body motions at a minimum of 1280 feet (390 m) and must be identifiable as a person.

3.5 Examples of pedestrian workers who could work in these situations may include:

3.5.1 Roadway construction personnel;

3.5.2 Utility workers;

3.5.3 Survey crews;

3.5.4 Emergency response personnel; and

3.5.5 Flagging crews.

4.0 Class E Safety Apparel

4.1 Class E apparel includes trousers or shorts which are part of a Class 3 apparel ensemble. Frequently a Class 2 vest is paired with Class E trousers, creating an overall ensemble which meets Class 3 apparel requirements. Class E garments are not intended to be worn without Class 2 or 3 garments.

4.2 At a minimum, Class E trousers shall have 465 in2 (0.30 m2) of fluorescent yellow-green, orange-red, or red background materials combined with 108 in2 (0.07 m2) retro-reflective material. Retro-reflective material shall encircle each leg (360° of visibility) and be placed not less than 1.97 inches (50 mm) above the bottom leg of the trouser.

4.3 At a minimum, Class E shorts shall have 465 in2 (0.30 m2) of fluorescent yellow-green, orange-red, or red background materials combined with 108 in2 (0.07 m2) retro-reflective material. Retro-reflective material shall encircle each leg.

5.0 Headwear

5.1 Headwear is considered an important accessory and compliments the overall visibility of the wearer. High-visibility headwear enhances visibility to the head of a moving worker in daylight and helps define the shape of the human form during nighttime exposures.

5.2 At a minimum, high-visibility headwear shall have 78 in2 (0.05 m2) of fluorescent yellow-green, orange-red, or red background materials combined with 10 in2 (0.0065 m2) retro-reflective material. As an alternative, the headwear can have 78 in2 (0.05 m2) of combined-performance material.

Americas

Risk Assessment & Management

S3AM-209-PR1

1.0 Purpose and Scope

1.1 This procedure requires hazard identification, risk evaluation, control measures, and documentation to manage safety, health and environment (SH&E) risks associated with work activities.

1.2 The objective is to establish and enhance SH&E performance, to mitigate and reduce losses due to injury, illness, property damage, or environmental impairment incident, and maintain regulatory compliance.

1.3 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 **Control Measure** - Actions that can be taken to reduce the potential of exposure to the hazard. The control measure could be to remove the hazard or to reduce the likelihood of the risk of the exposure to that hazard being realized.

2.2 **Hazard** - An object, condition or behavior that has the potential to cause human injury or illness, property damage, damage to the environment, business interruption, or a combination of these.

2.3 **Risk** – The possibility of loss or injury.

2.4 **Task Hazard Assessment (THA) –** A THA is a tool for evaluating work activities for the purpose of:

- Identifying the SH&E hazards and risks associated with the activity being performed;
- Identifying and implementing control measures to eliminate or reduce hazards and risks; and,
- Evaluating the effectiveness of control measures and making modifications as needed.

3.0 References

3.1 S2-001-ATT4 Catastrophic and Critical Consequences Guidance – AECOM Global

3.2 S3AM-002-PR1 Stop Work Authority

3.3 S3AM-004-PR1 Incident Reporting, Notifications & Investigation

3.4 S3AM-010-PR1 Emergency Response Planning

3.5 S3AM-204-PR1 Environmental Compliance

3.6 S3AM-216-PR1 Compliance Assurance

4.0 Procedure

4.1 Roles & Responsibilities

4.1.1 **SH&E Manager**

- Assisting management personnel to identify any required SH&E planning documentation.
- Assisting in the preparation of necessary SH&E risk assessment documentation.
- Reviewing and approving SH&E risk assessment documentation prior to its implementation for work activities.
- Providing SH&E technical and regulatory input as necessary.

4.1.2 **Manager**

- Confirming appropriate SH&E planning and risk assessment activities are undertaken in the proposal support and pre-award stages of a project.
- Confirming the completion of SH&E risk assessment documentation as required, that addresses the full range of work activities, SH&E risks and that all requirements and procedures are implemented and enforced post-award, during the work activities.
- Confirming SH&E requirements are implemented successfully, including but not limited to:
    - Subcontractor evaluations and performance monitoring
    - SH&E training
    - Personal protective equipment
    - First aid and emergency response
    - Client requirements
- Contacting the SH&E Manager to discuss SH&E risk assessment documentation needs/ requirements at the start of each new project involving AECOM and at designated intervals or:
    - When changes occur to the work operations or work location/ conditions
    - When work activities are modified/ changed, or
    - When additional tasks are added to the work scope.
- Confirming that the SH&E Plan has been reviewed and approved by the SH&E Manager prior to its use by AECOM personnel or prior to release to clients, outside agencies or organizations.
- Making appropriate resources available to protect the health and safety of AECOM employees, the environment and to comply with occupational health and safety, and environmental legislation and for the effective implementation of this procedure.
- Identifying and reporting to a Manager/Supervisor when changes occur to the work operations or work location/conditions.
- Identifying appropriate and applicable SH&E regulatory requirements and implement into respective SH&E Plan.
- Confirming appropriate SH&E review and assessment activities are undertaken in the close-out stage of a project.

4.1.3 **Employee**

- Obtaining necessary training identified in the SH&E Plan and associated documents.
- Understanding the potential hazards and controls of the task before work commences.
- Complying with all required controls as identified in the SH&E Plan and associated documents. Reporting any program, SH&E plan or regulatory variances to their Supervisor.

4.2 Risk Assessment Strategy

4.2.1 Hazard Identification

Hazard identification is the precursor to being able to assess risk. Before undertaking any activity, the hazards shall be identified by persons competent to recognize them using professional experience and training including the following:

a. Utilization of a formal hazard identification process;

b. Information from review and improvement processes;

c. Consideration of hazardous materials required for task(s);

d. Location of work and proximity to outside hazards or equipment;

e. Anticipation or possible change of conditions;

f. Consideration of risk of human error;

g. Identifying level of training required for task; and

h. Any other factors that can introduce hazard or risk into the activity.

4.2.2 Hazard identification should consider:

a. Routine and non-routine activities;

b. Activities of all persons having access to the workplace (including contractors and visitors);

c. Human behavior, capabilities and other human factors;

d. Identified hazards originating outside the workplace capable of adversely affecting the health and safety of persons under the control of AECOM within the workplace;

e. Hazards created in the vicinity of the workplace by work-related activities under the control of AECOM and neighboring activates not under AECOM control;

f. Infrastructure, equipment, materials at the workplace, whether provided by AECOM or others;

g. Changes or proposed changes in the organization of AECOM, its activities, or materials;

h. Modification to the SH&E management system, including temporary changes, and their impacts on operations, processes, and activities;

i. Applicable legal obligations relating to risk assessment; implementation of necessary controls;

j. The design of work areas, processes, installations, machinery/equipment, operating procedures, and work organization, including their adaptation to human capabilities; and

k. Driving and travel activities.

4.2.3 Risk Assessment

a. Evaluate work area for hazards as defined above (applies to field, office, and travel settings).

b. Determine whether identified hazards could affect employees, subcontractors, members of the public, visitors, or others.

c. Assess the severity and probability of any identified hazard occurring. This is generally based on experience, although incident statistics are available for most industries. The assessment of probability must also take into consideration the frequency with which exposure to a particular hazard will take place (e.g., the probability of occurrence is much greater if the activity is a daily event involving a number of individuals, compared with the same activity carried out twice a year by few individuals as part of a maintenance procedure).

d. Severity: Be realistic when considering how severe the result of exposure to a hazard could be. For example, it is remotely possible that someone tripping over a cable in an office may be killed, but the most probable result is bruising or a fractured bone. If, however, the cable is trailing across the top of a very busy stairway, a more severe injury is possible.

The following table shall be used to evaluate severity:

Severity – Potential Consequences				
	People	**Property Damage**	**Environmental Impact**	**Public Image/Reputation**
Catastrophic	Fatality, Multiple Major Incidents	>$1M USD, Structural collapse	Offsite impact requiring remediation	Government intervention
Critical	Permanent impairment, Long term injury/illness	>$250K to $1M USD	Onsite impact requiring remediation	Media intervention
Major	Lost Time /Restricted Work	> $10K to $250K USD	Release at/above reportable limit	Owner intervention
Moderate	Medical Treatment	> $1K to $10K USD	Release below reportable limit	Community or local attention
Minor	First Aid	</=$1K USD	Small chemical release contained onsite	Individual complaint

e. Probability: Determining the probability of a hazard actually causing harm can be much more difficult than determining the severity. The factors affecting the analysis of probability are:

- The number of times the situation occurs
- The position of the hazards
- Distractions
- The duration of exposure
- Quantities of materials involved
- Environmental conditions
- Competence of the people involved
- Condition of equipment.

In analyzing the probability of harm, it will be necessary to take into account the possibility of the control measures not being used because of human error, lack of maintenance, difficulty in compliance, complexity, etc.

The following table shall be used to determine probability:

Probability		
Frequent	Expected to occur during task/activity	9/10
Probable	Likely to occur during task/activity	1/10
Occasional	May occur during the task/activity	1/100
Remote	Unlikely to occur during task/activity	1/1,000
Improbable	Highly unlikely to occur, but possible during task/activity	1/10,000

4.2.4 Risk Matrix

A quantitative risk rating can be derived for each hazard using the following table.

Probability	**Severity**				
	5 - Catastrophic	4 – Critical	3 – Major	2 – Moderate	1 - Minor
5 – Frequent	**25**	**20**	**15**	**10**	**5**
4 – Probable	**20**	**16**	**12**	**8**	**4**
3 – Occasional	**15**	**12**	**9**	**6**	**3**
2 – Remote	**10**	**8**	**6**	**4**	**2**
1 - Improbable	**5**	**4**	**3**	**2**	**1**

Use of the quantitative risk table shown above can help to determine whether or not the level of risk is tolerable. This can assist in deciding priorities for action. In general, higher risks (yellow and red) may require the provision of considerable additional resources involving special equipment, training, high levels of supervision, and consideration of the most effective methods of eliminating or controlling hazards. Lower-level risks may be considered as acceptable, but actions should still be taken to try to reduce them further, if possible. The risk rating for a project should be revised if the scope of work changes and at a minimum, the risk rating should be re-assessed on an annually basis.

Risk Rating (Probability x Severity)	Risk Acceptance Authority
1 to 4 (Low)	Risk is tolerable, manage at local level
5 to 9 (Medium)	Risk requires approval by Operations Lead/Supervisor & SH&E Manager
10 to 25 (High)	Risk requires the approval of the Operations Manager & SH&E Director

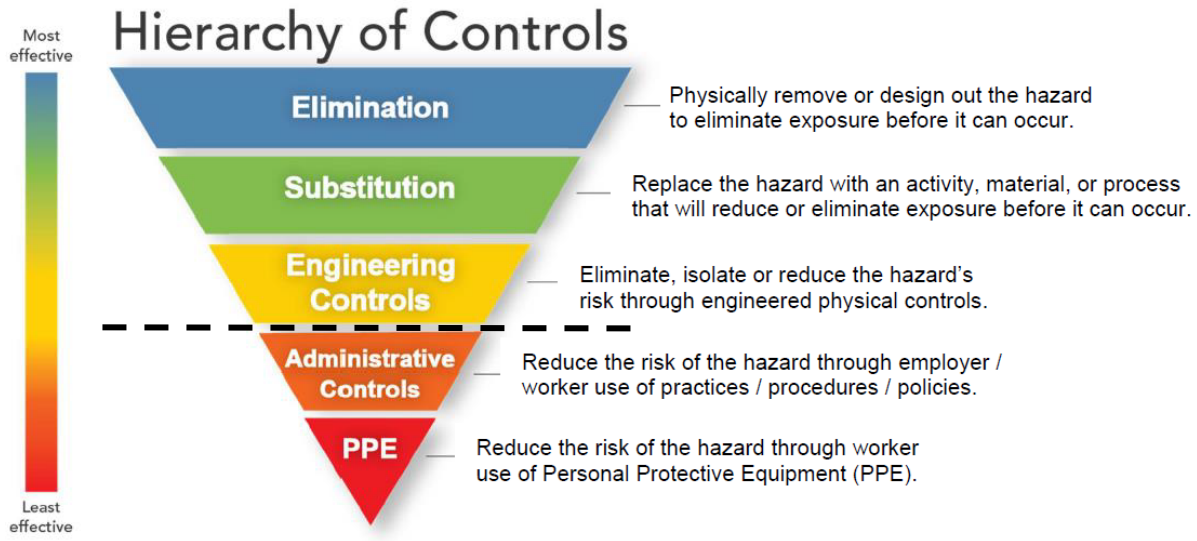
4.2.5 High Potential Risk

The hazards associated with all tasks will be assessed using the risk matrix. Tasks assessed with a risk rating of 10 to 25 are considered to be High Potential (HiPo) Risk tasks. In general, the following tasks are considered HiPo tasks (also identified in *S3AM-314-PR1 Working Alone)*. Depending upon the factors contributing to the severity and probability assessment of a hazard associated with a particular task, other HiPo tasks or activities could be added to this list.

- Working at heights > 4 ft. (1.22 m) (Including aerial lifts, snooper trucks, scaffolds, etc.).
- Working in a confined space.
- Working in a trench or excavation.
- Performing tasks requiring lock out/tag out.
- Work on energized equipment.
- Working with electricity.
- Working with hazardous substances or materials (including all HAZWOPER projects).
- Working with material under pressure.
- Working where there is a possible threat of violence, including civil unrest.
- Working in avalanche areas.
- Working on water or ice.
- Working in remote or wilderness isolation.
- Working in a controlled area.
- Extreme heat or cold stress environments.
- Working with power tools/equipment (drill, chainsaw, grinder, etc.).
- Working with/operating heavy equipment or machinery, including drill rigs.
- Working in isolation from first aid services or immediate/emergency assistance.
- Working around mobile equipment.
- Exposure to vehicular traffic (highways, roads, parking lots, etc.).
- All-terrain vehicle work.
- Working on railroads or within 25 ft. (7.62 m) of tracks.
- Any activity/task involving non-voluntary use of respiratory protection, including for site access.
- Working with people diagnosed with Coronavirus or other pandemic diseases.

4.2.6 Hierarchy of Controls

Controlling exposures to hazards is the fundamental method of protecting workers. Traditionally, a hierarchy of controls has been used as a means of determining how to implement feasible and effective control solutions.



Source: http://www.cdc.gov/niosh/topics/hierarchy/

When determining appropriate controls to mitigate the risk presented by each hazard, the most effective controls (ordered from the most effective at the top of the image above to the least effective at the bottom) shall be assessed and applied as is practicable, with PPE considered the last line of defense.

A minimum of one control above Administrative Controls (Elimination, Substitution, Engineering)

OR

Two controls below Engineering Controls (Administrative, PPE) is required to control any hazards that may contribute to a Catastrophic or Critical Consequence (see Risk Assessment Severity Table in this document).

Please consult *S2-001-ATT4 Catastrophic and Critical Consequences Guidance* for additional information.

Note: When engineering, administrative and PPE controls are used, and in many cases substitution, the **hazard is still present and can still cause harm.

- Layers of control or redundancy shall be established whenever possible (e.g., engineered control further supplemented by safe work practices and PPE).
- The use of interim controls may be necessary while longer-term solutions are developed and implemented.
- Elimination examples: entry into hazardous area unnecessary due to controls / sensors designed and constructed to be operated / monitored external to the area, fall hazard eliminated by lowering a workpiece to the ground, confined space hazards eliminated through use of remote cameras to inspect vaults, trip hazard removed, hazardous chemicals removed from the worksite, etc.
- Substitution examples: use of water-based paint in place of a solvent-based paint, use of an electric motor rather than a gas motor, use of a hand cart rather than manually moving materials, etc.
- Engineering Control examples: ventilation to reduce atmospheric hazards, enclosures to reduce machine noise, machine or equipment guards around pinch or crush points, interlocks to prevent inadvertent equipment operation, keyboard trays to enable proper posture, etc.

- Administrative Control examples: procedures (e.g., use of personal electronic devices prohibited while operating a vehicle, requirement to vacuum harmful dust rather than sweep, Task Hazard Assessments, etc.), training, job rotation, signage, or temporary barriers to warn of a hazard or describe safe procedures, etc.
- Personal Protective Equipment (PPE) examples: safety glasses, hardhats, gloves, hearing protection, etc. PPE is considered the least effective method of controlling a hazard, as the equipment only places a barrier between the worker and the hazard, but does not prevent the occurrence of the incident. PPE failure would expose workers to the hazard, and is dependent upon proper selection and fit, and employee compliance.

***Always assess the control measures taken for any hazards the control may create or introduce (e.g., heaters introducing exhaust hazards, electrical equipment presenting ignition hazards, bulky PPE reducing mobility, scheduling producing congested sites, etc.). These created or introduced hazards shall be properly assessed for risk, and may require an alternative control to be developed or additional controls developed for the created or introduced hazards.

4.3 Preplanning for Development of Risk Assessment Documentation

4.3.1 In order to adequately assess a proposed pursuit, SH&E impacts require assessment. If the project's scope review finds the project includes hazards or SH&E requirements that may have critical impact on AECOM personnel, the client, the environment, or financial outcomes, the hazards and impacts should be assessed further during the pre-bid and start-up stages of the project.

- Proposal teams and/or Managers should consult *S2-001-ATT4 Catastrophic and Critical Consequences Guidance* for additional information and may engage subject matter experts, such as SH&E personnel, to obtain an accurate pre-bid SH&E risk assessment and summary of potential impacts.
- This information may be used by the proposal team and/or manager to populate the SH&E sections of a prospective project's overall risk assessment, thereby informing go or no-go decisions and, when preparing a bid, budgetary and staffing for safety considerations.

4.3.2 Coordination must be made by management with representatives of the client, regulatory authorities (if needed), contractors as applicable, and other appropriate personnel to determine and coordinate such items as:

- Measures to protect the public and/or other persons exposed to the work operations.
- Client requirements and local, state, and/or federal laws and regulations that are applicable to the project.
- Procedures for handling and reporting incidents, property damage, and other emergencies.
- Disciplinary policies and management of restricted access for company employees and subcontractors/vendors.

4.3.3 As soon as possible, conduct an initial review of the work location and review the proposed work activity to determine, to the extent possible, existing or probable hazardous conditions and restricted areas.

4.4 Risk Assessment Documentation

Business Groups may approach risk assessment processes and documentation in different manners. As a minimum, risk assessment activities shall begin during the project planning stages, with hazards further assessed for risk and control development through start-up and execution.

- Project SH&E Plans shall be developed and include hazard identification and risk assessment documentation (risk registers / hazard assessments) applicable to the scope of work prior to project kickoff.

- Project execution activities shall ensure the Project SH&E Plan is reviewed and hazards are further assessed in light of current conditions.
- Field level hazard assessments (Task Hazard Assessment [THAs]) shall be developed or reviewed and updated immediately prior to initiating a task at the work location by those conducting the task.
- Risk assessment of potential severity and probability shall be completed for all incidents and near misses. Refer to *S3AM-004-PR1 Incident Reporting, Notifications & Investigation*.
- Hazard Assessment results shall be communicated to employees and subcontractors on-site. Copies of the Hazard Assessment documentation will be kept on-site for review.

4.4.1 **SH&E Plan** (equivalent terms may be used such as, Health and Safety Plan [HASP], Safe Work Method Statement [SWMS], SH&E Management Plan (SHEMP), etc.). The Safety, Health & Environment (SH&E) Plan addresses health and safety concerns associated with AECOM-managed activities. It defines the roles, responsibilities, requirements and authority of the SH&E program.

- Development of the Project SH&E Plan in the start-up stage allows for adequate preparation for the prevention of incidents.
- All AECOM office locations are required to prepare an SH&E Plan using *S3AM-209-FM1 Office SH&E Plan Template*.
- AECOM requires an SH&E Plan to be developed for work activities outside of an AECOM office. The SH&E Plan is also often required by regulation, insurance policy requirements, or client requirement. A template is provided in *S3AM-209-FM2 Industrial Site / Project SH&E Plan Template* and in *S3AM-209-FM2-A Short Term SH&E Plan Template*.
- *S3AM-209-FM2-A Short Visit SH&E Plan Template* is intended for low risk site visits only. It is only appropriate if the scope of work is limited to driving, walking, taking notes, and taking photographs, for a duration of time no longer than 3 days. It should not be used if the conditions at the site being visited are hazardous or high risk. Use at an active construction site is acceptable if escorted by the Client, or General Contractor (or similar).
- A typical SH&E Plan includes, but is not limited to, the following components:
  - Descriptions of roles and responsibilities for the activity.
  - Risk registers / hazard assessments for each task and operation found in the work plan (documented using *S3AM-209-FM4 Pre-Job Hazard Assessment* or equivalent).
  - Attached AECOM procedures applicable to the scope of work. Utilize *S3AM-209-FM3 Procedure Checklist* to assist in determining which AECOM procedures apply.
  - Supplementary information to the attached procedures (e.g., jurisdiction-specific requirements, client requirements, etc.)
  - Supervision.
  - Training requirements.
  - Personal protective equipment requirements for the separate tasks or operating areas.
  - Medical surveillance requirements (for chemical exposure, noise, radiation, etc.).
  - Frequency and types of monitoring for physical and chemical hazards.
  - Pre-entry briefings requirements for visitors and workers.
  - Location-specific Emergency Response Plan. Refer to *S3AM-010-PR1 Emergency Response Planning*.
  - Client requirements that are more stringent than AECOM's SH&E requirements.
  - In California, the SH&E Plan must also address the Injury Illness Prevention Program. Refer to *S3AM-209-ATT1* for additional information.
- A SH&E Plan for hazardous waste operations may also include, but not be limited to:

- Site access and control measures.
- Site specific information on chemical, biological or radiation hazards.
- Decontamination procedures.
- Confined Space Entry plan.
- Spill containment plan.
- Waste management.

- An SH&E Plan for construction activities may also include, but not be limited to:
  - Traffic plan and site access controls.
  - Electrical and machinery protective measures.
  - Trench and excavation safety.
  - Fall protection and rescue plans.
  - Storage for combustible and flammable materials.
  - Sediment and community noise control plans.
- An SH&E Plan for a demolition project may also include, but not be limited to:
  - Materials movement plan.
  - Critical task sequencing.
  - Explosives safety.
  - Dust control measures.
  - Removal of asbestos and lead-containing materials.
- The Project SH&E Plan is reviewed and hazards are further assessed in light of current conditions and based on lessons learned during the course of project execution.

4.4.2 **Pre-Job Hazard Assessment.** The principle activities associated with the scope of work to be performed, the inherent risks, and the control measures for those risks shall be assessed and documented in order to properly plan the project work. This is accomplished through risk registers / hazard assessments contained in the project SH&E Plan. The business group process may also establish a process using Pre-Job Hazard Assessments.

- Pre-Job Hazard Assessments, or equivalent documentation, shall be completed before the work activities commence and are updated based on lessons learned. Refer to *S3AM-209-FM4 Pre-Job Hazard Assessment*.
- Workers involved in the anticipated activities should participate in the hazard assessment process so that best practices are shared and all possible hazards of the activities are identified.
- Pre-job Hazard Assessments are performed by:
  - Identifying the principle activities of the scope of work to be performed.
  - Potential hazards are identified for each activity and the initial risk rating is determined using the Risk Matrix.
  - Control measures are then identified for each activity using the hierarchy of controls, and may include reference to applicable procedures or plans.
  - Each hazard is then re-evaluated and assigned a final risk rating using the Risk Matrix.
  - If the final risk rating is a 5-9 (medium risk) or 10-25 (high risk), additional hazard controls shall be identified and applied until the final risk rating is reduced to 4 or below. If the final risk rating cannot be reduced to 4 or lower, additional approvals are needed before the activity can begin.
- A Pre-Job Hazard Assessment, or equivalent document, may be completed as a stand-alone

document, or may be incorporated into an SH&E Plan. Developed Pre-Job Hazard Assessments should be consulted when completing applicable field level hazard assessment (THA) activities.

4.4.3 **Daily Tailgate Meeting.** A tailgate meeting for all project personnel shall be held daily (excluding fixed-facility locations where AECOM employees permanently work full time). A record of the meetings shall include the name of all attendees, items discussed, and date/time of meeting. *S3AM-209-FM5 Daily Tailgate Meeting Form* may be used to document the meeting (DCSA may replace this form with the electronic Daily Tailgate Meeting Tool available on the Ecosystem Daily Tailgate Meeting App Site).

At a minimum, the meeting will involve representatives from all organizations with a direct contractual relationship with AECOM on the project site (e.g., AECOM employees, subcontractors, client representatives, etc.). Other contractors working in the area of AECOM's activities should also be invited to the meeting when possible. All members of the meeting should be engaged and encouraged to participate and provide input and feedback. Objectives for the meeting should include:

- Eliminating injuries, illnesses, and damage to the environment or property.
- Review planned work activities.
- Clarify roles and responsibilities.
- Confirm work crew is fit-for-duty.
- Assess, identify and mitigate hazards.
- Share lessons learned and observations.
- Review simultaneous operations with other non-AECOM controlled activities (e.g., other contractors performing work in the vicinity of AECOM's operations, fuel delivery at the location, utility company working near AECOM operations).

4.4.4 **Task Hazard Assessment (THA).** A THA is the most important element in an effective hazard identification and risk reduction program. *S3AM-209-FM6 Task Hazard Assessment* (or *S3AM-209-FM6-ES or equivalent approved Business Group specific form*) shall be completed before every assigned task at the work location. The THA is to be completed at the worksite by the individual(s) who is intended to conduct the task immediately prior to initiating the associated task. The intent of the THA is to engage the end-user in actively assessing the hazards associated with their task, as well as identify changes and capture nuances or specifics immediately present that may otherwise remain unacknowledged in the project's pre-planning hazard assessment documentation (risk registers, hazard assessments, etc.).

The focus of the analysis shall be on the specific assigned task and the evaluation of risks and assignment of control measures based on actual work conditions. THA is a portion of the overall job scope, focused at the specific foreman and/or crew level. Task Hazard Assessments must be completed prior to the start of work. Re-assessment must also be completed when a significant change of scope occurs or if conflicting work is being done. Completion of the THA involves both the site supervision and employees involved in the work.

Task Hazard Assessment steps:

- Assemble employees involved in the work.
- Review the scope of work being performed.
- Review the risk registers / hazard assessments obtained from the Project SH&E Plan for content applicable to the immediate task.
- As necessary, review the associated procedure.
- The THA shall:
    - Break the task into individual steps.

- Identify actual and potential hazards.
- Rank the risk using the Risk Matrix.
- Develop appropriate controls measures for each hazard.
- Rank the post control measure risk using the Risk Matrix.

- Review the THA for any additions or edits.
- Confirm communication of the THA to all affected employees.
- Confirm the THA is reviewed by any visitors or additional or new personnel brought on to perform the task.

If the final risk rating is a 5-9 (medium risk) or 10-25 (high risk), additional hazard controls shall be identified and applied until the final risk rating is reduced to 4 or below. If the final risk rating cannot be reduced to 4 or lower, additional approvals are required before the activity can begin.

Employees shall monitor the activities for compliance with the THA. Workers should stop any work on a task if conditions change from the planned and agreed approach to the work. The THA should be updated to reflect new conditions or changes in task methods.

Business Group Task Hazard Assessment processes may vary from the above description; however comprehensive hazard identification associated with the task, identification of appropriate controls, and effective communication between all involved and affected shall be incorporated into the Business Group process.

4.5 Key Elements in Risk Management at a Site

4.5.1 Regularly, or at least once per month, conduct safety meetings for supervisory personnel, including those of other contractors and subcontractors. Suggested action items for these meetings include:

- Reviewing of THAs, safety procedures and policies applicable to the project.
- Identifying responsibilities of the various parties, including contractor(s) and subcontractor(s) obligations.
- Reviewing noted and anticipated hazards, and plan methods to eliminate or control them.
- Discussing incidents and near misses to determine causes and steps necessary to prevent reoccurrence.
- Discussing suggestions and ideas for improving the project's safety program.
- Maintaining a record of these meetings; this will be done by the safety representative or supervisor.

4.5.2 Regular inspections of active work areas will be made by the project supervisors and the site SH&E representative. Refer also to *S3AM-216-PR1 Compliance Assurance* for additional guidance.

- To be effective, such inspections should occur on all shifts, should be unannounced, and should occur at varied intervals.
- Imminent danger situations must be stopped and corrected immediately. Refer to *S3AM-002-PR1 Stop Work Authority.*
- Inadequate or deficient protective measures and unsafe or unhealthy work practices must be brought to the immediate attention of the appropriate supervisor and/or manager for correction and disciplinary action, as required.
- Inform the manager of all deficiencies not immediately correctable, and/or that may result in damage to facilities, equipment, or work in progress, or that create hazardous exposures to employees or the public.
- Projects that exhibit unsatisfactory SH&E performance present risk to AECOM personnel, the client, the public, property or the environment.

- Further evaluation may be required and a risk reduction plan, including monitoring activities may be determined as necessary.
- Considerable additional resources may be required involving personnel, special equipment, training, high levels of oversight, and consideration of the most effective resources and methods of improving safety program performance.

4.5.3 Signs and posters of appropriate size and design, and bearing standard pertinent regulations, will be used to convey warnings, directions, and instructions to personnel and the public, as required by the client and other applicable regulations. The observance of such safety and incident prevention signs will be strictly required of company employees and visitors while on the project site.

4.5.4 Consideration must be given to make the project environmental protection plan effective.

- The type and extent of the measures needed for pollution control, hazardous materials handling, hazardous waste control and disposal, and for relating occupational health issues will depend upon the contract stipulations, hazard involved, type of operation, and the mandatory requirements of regulatory authorities.
- Such measures will include appropriate control methods necessary to prevent or reduce to safe levels exposure to hazardous substances.
- Refer also to *S3AM-204-PR1 Environmental Compliance* for additional guidance.

4.5.5 It is the practice of AECOM to commend and reward employees and their supervisors for achieving excellence in their field of work, particularly when that work is performed safely. Project management is encouraged to promote and participate in safety recognition programs by developing project-specific safety goals and including safety incentive programs in project budgets. Project goals should include proactive goals such as training participation and training support, safety observations conducted, and management participation in safety reviews (e.g., safety walk-downs).

4.5.6 Concerning worksites in which other employers control concurrent operations and SH&E issues related to the worksite, the manager shall coordinate with those conducting concurrent operations to confirm appropriate control measures are in place to protect employees from the hazards associated with activities to be performed.

- Coordination shall occur prior to work commencing, periodically thereafter, and as necessary given changes in scope and/or working conditions.
- Affected employees (including managers and supervisors) shall seek to participate in all site SH&E meetings related to concurrent operations.

4.5.7 All employees are empowered and expected to stop work or not start work when it is unsafe. Employees will be trained on stop work authority upon initial assignment. Refer to *S3AM-002-PR1 Stop Work Authority*.

4.6 Other Requirements

4.6.1 The following requirements apply to SH&E risk assessment documentation:

- Preparation of the SH&E documentation may be performed by a member of the project team or SH&E.
- SH&E documentation (including draft versions of documents) will be reviewed by a SH&E Manager prior to release for outside agency review (e.g., clients, regulatory agencies, etc.) and prior to its field implementation.
- Changes to approved SH&E documentation require concurrence from a SH&E Manager (or designee). This includes those made in response to changing field conditions or operational requirements and those made in response to regulator/client comments. Any written responses made to regulator/client comments also must be reviewed by the SH&E Manager.
- The SH&E documentation for any project lasting twelve (12) months or longer will be reviewed

at periodic intervals, but at least annually. The SH&E Manager will review the changes and determine whether modifications are required to the existing SH&E planning documentation. This confirms that the documentation continues to reflect the current scope of work and knowledge of site conditions, and that any revised regulatory requirements are properly addressed. The Manager will provide a master copy of the SH&E documentation to be maintained on site for reference by personnel, together with copies of any required SH&E-related records or operational documentation. The master copy must be current in all respects, and will include any changes or modifications made as work progresses.

- Managers will confirm that SH&E documents have been reviewed with affected personnel prior to implementation of field work. Sign-off and concurrence is mandatory and to be kept in the project records.

5.0 Records

5.1 Completed SH&E Plans, risk registers / hazard assessments, Tailgate Meeting Forms, and Task Hazard Assessments will be filed in the appropriate project file.

6.0 Attachments

All Business Groups

6.1	S3AM-209-ATT1	California Injury & Illness Prevention Program
6.2	S3AM-209-FM1	Office SH&E Plan Template
6.3	S3AM-209-FM2	Industrial Site / Project SH&E Plan Template
6.4	S3AM-209-FM2-A	Short Term SH&E Plan Template
6.5	S3AM-209-FM3	Procedure Checklist
6.6	S3AM-209-FM4	Pre-Job Hazard Assessment
6.7	S3AM-209-FM5	Daily Tailgate Meeting Form
6.8	S3AM-209-FM6	Task Hazard Assessment
6.9	S3AM-209-FM6(ES)	Evaluación de Riesgos de las Tareas (THA – Spanish)
6.10	S3AM-209-FM7	Office Relocation Plan

Supplementary Business Group Specific

6.11	S4[CS]AM-209-FM6-A	Task Hazard Assessment – Focus 4 Plus 2 – CS-BC Group
6.12	S4[DCS]AM-209-FM2-A	Safe Work Plan Template - DCS Group
6.13	S4[DCS]AM-209-FM2-A[ES]	Plan de Trabajo Seguro – (SWP Spanish) DCS Group
6.14	S4[DCS]AM-209-FM2-B	Short Visit Safe Work Plan Template - DCSA Group
6.15	S4[DCS]AM-209-FM2-C	Universal Health & Safety Plan Template - DCSA Group
6.16	S4[DCS]AM-209-FM2-D	Disaster Recovery Health & Safety Plan Template - DCSA Group
6.17	S4[DCS]AM-209-FM2-F	Safety Work Plan Template – Short Duration Work Zone – DCSA Group
6.18	S4[DCS]AM-209-FM2-G	Safety Work Plan Template – Highway Work Zone – DCSA Group
6.19	S4[DCS]AM-209-FM4-A	Risk Register – DCSA Group
6.20	S4[DCS]AM-209-FM6-A	Task Hazard Assessment – DCSA Group
6.21	S4[DCS]AM-209-FM6-A(ES)	Evaluación de Riesgos de Tareas (THA Spanish) – DCSA Group
6.22	S4[DCS]AM-209-FM6-A(FR)	Évaluation des Dangers de la Tâche (THA French) – DCSA Group

Americas

Regulatory Inspections

S3AM-211-PR1

1.0 Purpose and Scope

1.1 The purpose of this procedure is to outline the process for local management to follow in response to any regulatory agency inspection at their location.

1.2 This procedure applies to all Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 **Regulatory Inspection** – Any non-routine announced or unannounced inspection of an AECOM office or project site by a regulatory agency involved with Occupational Health and Safety and Environmental laws and regulations. Periodic visits from service or local agencies to project sites to approve certain activities such as utility hook-up, utility clearance, etc. are not considered regulatory inspections.

2.2 **Regulatory Agency** – Any agency that has the authority to regulate and enforce Occupational Health and Safety or Environmental laws and regulations. Examples include Ministry of Environment, Ministry of Labor, Occupational Safety and Health Administration, the Environmental Protection Agency, the Nuclear Regulatory Commission, the Department of Transportation, or state and local agencies.

2.3 **Citation** – A written notice of violation identified by a regulatory agency. Examples include notices of violation, warning letters, complaints, official statements of observations, or other formal actions.

2.4 **Fine** – A written or other monetary penalty paid or anticipated for non-compliance.

3.0 References

3.1 S3AM-004-PR1 Incident Reporting, Notifications & Investigations

4.0 Procedure

4.1 Roles & Responsibilities

4.1.1 **Individual First Contacted**

- Serve as the initial point of contact for the inspector.
- Notify the AECOM Site Supervisor of the presence of inspection personnel.

4.1.2 **Site Supervisor**

- Make all initial notifications that an inspection is in progress at the location.
- Serve as the primary contact for the inspector in the absence of a management representative.
- Confirm that the regulatory visit is fully documented.
- Verify that any cited activity was immediately stopped and not resumed until the appropriate corrective actions are implemented.

4.1.3 **Manager**

- Notifying, or designating an individual to notify, the VP of SH&E and the SH&E Manager that a regulatory inspection is in progress and submitting a report according to the *S3AM-004-PR1 Incident Reporting, Notifications & Investigation* following the inspection.
- Notifying the client of an Agency inspection that is occurring on their project site so that the client may have representation during the inspection, at their discretion.
- Forwarding any correspondence from the inspector, as well as any notes taken by local staff during the inspection to the Counsel and the VP of SH&E within 24 hours.

- Where a citation was issued, direction will be given to the local staff to stop the performance of the cited activity until the appropriate corrective actions are implemented.
- Directing the Site Supervisor to post any regulatory citation in accordance with the directions outlined in the issued citation.
- Confirming a formal response is submitted to the citing agency and facilitating payment of any associated monetary fine after approval from Counsel.
- As applicable, serve, or designate an appropriate individual to serve, as AECOM's informal and formal agency negotiation meeting representative to discuss the citation.

4.1.4 **Employees**

- Answer all questions succinctly and truthfully.
- Where an employee is represented by a union, the employee may request his/her representative to be present.

4.1.5 **VP of SH&E and SH&E Manager**

- Assisting management, as applicable, during the course of the inspection.
- Supporting management with guidance on appropriate corrective actions to address any cited activity.
- Supporting management and the Counsel with responses to any citation, including participation in informal or formal agency negotiation meetings regarding the citation.
- As applicable, serve, or designate an appropriate individual to serve, as AECOM's informal and formal agency negotiation meeting representative to discuss the citation.

4.1.6 **Counsel**

- Authorizing the release of AECOM documentation to an inspector or the associated agency.
- Providing guidance to the Manager regarding the decision to contest the citation, including reviewing and approving any AECOM-issued response to the citation.
- Assisting employees in preparation for inspector interviews by providing guidance and direction.
- Providing, or designating, representation during informal and formal agency negotiation meetings regarding the citation.
- Authorizing payment of any monetary fine associated with a non-compliance citation.

4.2 General Requirements

4.2.1 It is the policy of AECOM to have a management representative on site to interface with a regulatory agency inspector during an inspection for work activities that AECOM controls.

4.2.2 If an inspection involves AECOM, the lead AECOM staff member will notify the regulatory agency employee that it is the policy of AECOM to inform management first before the inspection proceeds and provide the time (typically one hour is granted) needed for a management representative to participate in a conference call and/or arrive on site.

4.2.3 The Manager will assess the need for notifying the client of inspections that may occur on client property and will notify the on-site AECOM staff member if the client will be sending a representative to participate in the site inspection.

- As applicable, contact Counsel prior to any staff interviews by the inspector so that Counsel may have an opportunity to provide guidance and direction.

4.2.4 It is not the policy of AECOM to request a search warrant or seek to delay an inspection from any regulatory agency unless specifically so advised by Counsel.

4.2.5 Answer all questions succinctly and truthfully; all discussions will be kept on the topic of inquiry.

4.2.6 Never admit responsibility for an apparent violation.

4.2.7 Where AECOM is in an oversight or observation role, we will participate in the opening conference, inspection tour, and closing conference in the capacity of an observer.

4.3 Before the Inspection Starts

4.3.1 Verify the inspector's credentials, ask what the reason for the inspection is, and ask for an opening conference between the inspector and management staff.

4.3.2 Determine the intended scope and duration of the inspection. If the inspection will be lengthy, provide office space, equipment, and clerical support for the inspection team (as available).

4.3.3 If the inspection is the result of an employee complaint, insist that the inspection be limited to only the location associated with the complaint.

4.4 During the Inspection

4.4.1 Ensure that each inspector or inspection team is accompanied by a management team representative at all times.

4.4.2 Determine if any industrial hygiene sampling or other monitoring will be completed. Arrange for side-by-side testing. Note that inspectors will usually provide 24-hour advance notice regarding sampling or monitoring activities during an inspection.

4.4.3 Allowing the inspector to view any requested documentation, electronic or printed; however, the inspector must submit a formal (written) request to AECOM before documentation can be turned over.

4.4.4 Upon receipt of an agency's formal request for documentation, immediately notify the Manager and Counsel; do not provide any documentation to the agency without the approval of the Counsel.

4.4.5 Any photos or video taken by an inspector shall be similarly captured from the same vantage point by the AECOM representative.

4.4.6 Document all inspections, interviews, discussions, and actions taken. Take thorough and detailed notes; include exact locations, names, equipment, etc. that the inspector observes or otherwise records.

4.5 Post Inspection

4.5.1 Request and participate with the inspector in the closing conference; take notes of any referenced apparent violations or recommended corrective actions.

4.5.2 For any activity associated with an apparent violation, stop that activity until the appropriate corrective action can be implemented.

4.5.3 Forward all associated paperwork to both the Counsel and VP of SH&E.

5.0 Records

5.1 None

6.0 Attachments

6.1 None

Americas

Subcontractor Management

S3AM-213-PR1

1.0 Purpose and Scope

1.1 This procedure applies to all AECOM Americas based employees and operations and to subcontractors of any tier. A subcontractor is a person or business which has a contract (and is not an employee) with AECOM to provide some portion of the work or services on a project which AECOM has agreed to perform for the client.

1.2 This procedure does not apply to vendors. For the purposes of this procedure, a vendor is a service provider and, is a person or business which performs services. Examples of a vendor could be a food machine vendor supplier for a site canteen; a portable toilet delivery company; an office equipment repair service; etc.

1.3 This procedure does not apply to third-party contractor operations where there is no subcontract relationship between the contractor and AECOM. Safety issues regarding third-party contractor operations are governed by project-specific contracts, and are not covered by this procedure.

1.4 This procedure provides requirements on the evaluation of subcontractor safety, health, and environmental programs; contractual risk management; subcontractor safety performance on the job site; and the responsibilities of the Manager with respect to subcontractor jobsite performance.

1.5 Each AECOM subcontractor must be evaluated at least annually using *S3AM-213-FM1 Subcontractor SH&E Evaluation Form*, or equivalent process (e.g., third-party qualification vendor, internal pre-qualification databases), in order to perform work on any AECOM projects.

2.0 Terms and Definitions

2.1 Subcontractor - For the purposes of this procedure, a person or business which has a contract directly with AECOM to provide work or services related to AECOM or client work scopes beyond delivery or basic repairs. Examples of a subcontractor could be an engineer; a sign installer; a welding company; an office renovation company; etc. A person or business with a contract directly with AECOM that does not fall clearly within this definition may also be required by the applicable business group to comply with this procedure.

3.0 References

3.1 S3AM-015-PR1 Newly Hired or Transferred Employees

3.2 S3AM-209-PR1 Risk Assessment & Management

4.0 Procedure

4.1 Implementation of this procedure is the responsibility of the AECOM manager (Manager) directing activities of the facility, site, or project location.

4.2 The AECOM manager shall ensure appropriate training of AECOM personnel responsible for overseeing subcontractor work.

4.3 Subcontractors shall be appropriately trained, competent, and capable to perform their activities in a safe, healthful, and environmentally responsible manner.

- As applicable, verification of subcontractor training or competency, or medical clearance may be required.

4.4 AECOM direction shall be provided to the subcontractor's management (foreman, supervisor, Site Safety Representative, etc.). Direction of subcontractor employees shall be the responsibility of the subcontractor's management.

4.5 Pre-qualification of Subcontractor – The Manager shall complete the following procedures for all subcontractors proposed for projects covered by this procedure unless an equivalent process (e.g., third-party prequalification vendor, internal pre-qualification databases and procurement processes, etc.) is used. The Manager shall also require subcontractors to follow these procedures with respect to pre-qualification of sub-subcontractors of any tier.

4.5.1 Request all subcontractor candidates to complete the attached *S3AM-213-FM1 Subcontractor SH&E Evaluation Form* or equivalent (e.g., third-party prequalification vendors, internal pre-qualification databases).

4.5.2 Conduct an assessment of each subcontractor's qualifications with respect to the Subcontractor Evaluation Criteria contained in *S3AM-213-ATT1 Subcontractor Evaluation Criteria.*

4.5.3 If the subcontractor does not meet criteria outlined in *S3AM-213-ATT1 Subcontractor Evaluation Criteria*, the decision shall be that the subcontractor shall not be used. However, if a unique business need exists (e.g., subcontractor is a specialty subcontractor, only bid, client required, small business/minority set asides), the Manager shall initiate *S3AM-213-FM2 Subcontractor Variance Form* (or equivalent vendor/database approval).

- Subcontractor Variance documentation shall clearly identify how the risk of the unmet criteria will be managed, including expectations and requirements of the subcontractor in managing the risk. Examples may include, but are not limited to requiring the subcontractor to:
  - Submit a detailed safety mitigation plan associated with the unmet criteria.
  - Utilize the AECOM Safety Management System in place of the subcontractor system.
  - Utilize specific programs associated with the AECOM Safety Management system.
  - Provide disclosures of specific criteria or engage in inspections at greater frequency.
- Potential risk and liability impact of variance content can vary considerably based on contract, type of subcontractor, and workplace activities. Legal counsel should be consulted to ensure that the proposed variance for the subcontractor does not impose undue risk and liability for AECOM.
- Variance requirements shall be acknowledged and agreed to by the subcontractor prior to work commencing and compliance with the variance requirements shall be monitored by the Manager.
- Failure to comply with the variance requirements shall be grounds for termination (this shall be specified in the subcontract).

4.5.4 If the subcontractor has been successfully evaluated within the last 12 months, the successful evaluation may be substituted for the pre-qualification evaluation.

4.5.5 For long-term operations, update this evaluation within 12 months of the previous evaluation.

4.6 Contractual and Risk Management Requirements of Subcontractors

4.6.1 Ensure that the subcontractor is contractually bound to comply with applicable client and AECOM SH&E Program requirements (e.g. alcohol and drug policies, procedures, insurance, licenses, registrations, etc.).

4.6.2 The AECOM SH&E Plan does not, nor is it intended to, address procedures of subcontractors during their site activities.

4.6.3 The subcontractor shall maintain appropriate SH&E procedures, that at a minimum comply with client and AECOM requirements and those procedures applicable to work that is exclusive to their activities on the site, and for which they may have superior knowledge.

- Depending upon the contractual agreement between AECOM and the subcontractor, the subcontractor may be required to develop a project SH&E Plan. Subcontractors' SH&E Plans shall, at a minimum, conform to the requirements of the AECOM SH&E Plan
- AECOM's scope of work under the client contract and the contract with the subcontractor can determine to what extent AECOM is required to review subcontractor plans and procedures. If in doubt consult legal counsel. In general, concerning subcontractors contracted to AECOM:
    - AECOM can be expected to review subcontractor plans and/or procedures in which AECOM can reasonably be expected to have adequate knowledge (e.g., Fitness for Duty, Hazard Assessment & Risk Management, Stop Work Authority, etc.).
    - AECOM can be expected to verify documentation and general adequacy of relevant subcontractor SH&E plans and/or procedures for which the subcontractor has superior knowledge.

4.6.4 Ensure that AECOM has the right in its subcontract, without liability to AECOM, to stop the subcontractor's work in the event of any violations of the applicable safety requirements.

4.6.5 Managers shall require subcontractors to follow pre-qualification procedures for lower-tiered subcontractors.

4.7 Subcontractor Safety Representative

4.7.1 Require each subcontractor to appoint a Subcontractor Safety Representative (SSR) who:

- Is knowledgeable of the subcontractor's activities.
- Understands the safety requirements of the subcontractor's activities.
- Has the ability to recognize and the authority to correct safety deficiencies and execute a stop work order should an imminent danger arise.
- Has the responsibility for the administration of the subcontractor safety program.
- Will serve as the direct contact with AECOM regarding resolution of SH&E issues
- Will report work-related injuries/illnesses/incidents, environmental incidents and regulatory inspections/violations to AECOM according to AECOM procedures and/or client requirements.

4.8 Communication

4.8.1 Provide the SSR with information regarding site safety program including but not limited to:

- Client Requirements
- Project SH&E Plan
- AECOM SH&E Program
- Site Hazard Communication Program
- Site Emergency Plan
- Any additional safety information from other contractors or subcontractors working on the site.

4.8.2 Subcontractors and their employees shall engage in a hazard assessment and risk management process equivalent to or exceeding that of AECOM. Refer to *S3AM-209-PR1 Risk Assessment & Management*.

- If the subcontractor process is deficient, the subcontractor management shall utilize AECOM's process to supplement for the deficiency and train their employees appropriately.

4.8.3 Subcontractors shall participate in site safety briefings including, and as applicable, orientations, project kick-off meetings, hazard assessments, inspections, tailgate / toolbox meetings, and post-job meetings.

4.8.4 Subcontractors shall comply with all safety directives and/or stop work orders issued by the AECOM representatives.

4.8.5 Subcontractors shall notify the AECOM manager when they will utilize short service employees (SSE) to perform on-site activities. The AECOM manager approval of any SSE shall be obtained by the subcontractor prior to mobilization. Subcontractor site management will interact with the short service employee to verify their level of competency and manage the subcontractor SSE in accordance with *S3AM-015-PR1 Newly Hired or Transferred Employees* or an equivalent process.

4.8.6 Prior to the start of work, roles, responsibilities, communication chain-of-command, and emergency preparedness procedures shall be established.

4.9 Subcontractor Performance

4.9.1 To the extent reasonable in light of AECOM's scope of work under the client contract, the AECOM Manager (or designee) should visit the site and periodically observe subcontractor's operations (e.g., conduct spot checks) to assess whether subcontractor appears to be conducting their operations in accordance with applicable safety requirements. Periodically review any required subcontractor health and safety performance and written documentation for compliance with applicable requirements. *S3AM-213-FM4 Subcontractor SH&E Data Submission* may be used to obtain monthly SH&E metrics from the subcontractor.

4.9.2 Information shall be compiled and subcontractor performance assessment should be documented using *S3AM-FM3 Subcontractor SH&E Performance Assessment* or equivalent.

4.9.3 In the event that unsafe acts or unsafe conditions are observed, immediately stop work, and bring them to the attention of the SSR for resolution.

4.9.4 The AECOM Manager shall ensure incidents and significant near misses related to subcontractor operations are investigated to identify causes and corrective actions.

4.9.5 In the event of serious and/or continuing subcontractor breaches of applicable requirements, contact legal counsel to assess whether formal contractual action is appropriate under the subcontract.

4.9.6 Once a job is completed, a subcontractor's performance should be reviewed and feedback provided to subcontractor management. This should be documented using *S3AM-FM3 Subcontractor SH&E Performance Assessment* or equivalent.

5.0 Records

The following documentation will be maintained in the project file:

5.1 S3AM-213-FM1 Subcontractor SH&E Evaluation Form or equivalent.

5.2 S3AM-213-FM2 Subcontractor Variance Form or equivalent, if applicable.

5.3 S3AM-213-FM3 Subcontractor SH&E Performance Assessment or equivalent.

5.4 S3AM-213-FM4 Subcontractor SH&E Data Submission, if applicable.

5.5 Identified safety deficiencies as applicable for subcontractors and verification of correction of conditions.

5.6 All other safety-related subcontractor documentation (e.g., training certifications, incident reports, etc.

6.0 Attachments

6.1 S3AM-213-ATT1 Subcontractor Evaluation Criteria

6.2 S3AM-213-FM1 Subcontractor SH&E Evaluation Form

6.3 S3AM-213-FM2 Subcontractor Variance Form

6.4 S3AM-213-FM3 Subcontractor SH&E Performance Assessment

6.5 S3AM-213-FM4 Subcontractor SH&E Data Submission

Americas

Compliance Assurance

S3AM-216-PR1

1.0 Purpose and Scope

1.1 This procedure establishes the protocol for assessment and audits of the Safety, Health and Environment (SH&E) program and its application, as well as the process to identify and monitor corrective actions.

1.2 This procedure provides direction for AECOM employees to perform, document and track workplace Safety, Health and Environment (SH&E) inspections, reviews, and assessments, and to implement appropriate corrective actions designed to minimize risk and enhance operational SH&E performance. The goal is to minimize risk and enhance operational SH&E performance.

1.3 This procedure applies to all Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

1.4 This procedure does not supersede AECOM client SH&E requirements provided they meet or exceed this procedure, however projects/sites are still subject to the compliance assurance requirements of this procedure as determined by AECOM management.

2.0 Terms and Definitions

2.1 **Certificate of Recognition (COR)** – In Canada, a program established by a provincial or territorial government authority which certifies that a company has an established and functioning SH&E program meeting specific criteria (as determined by an audit). COR provides financial incentives in the form of workers compensation rebates; it is also a client requirement in most jurisdictions.

2.2 **Corrective Action Plan** – A document that lists items requiring correction and establishes a timeline and necessary priorities for resolving the identified issues. It also lists completion dates for each item.

2.3 **Program SH&E Review** – A systematic review conducted by Senior Management of a project's or program's field activities and the application of AECOM's Safety, Health and Environment Management System. The review is comprised of a Program SH&E Review Assessment, Program SH&E Review Summary and a Program SH&E Review Presentation.

2.4 **SH&E Program Evaluation** – An evaluation of the general implementation of the SH&E program. The assessment is based on the knowledge, expertise, and opinion of the individual completing the assessment (whereas an audit also assesses completed documentation and formal interviews).

2.5 **SH&E Audit** – A systematic review of operations, procedures, equipment, and records in order to identify, evaluate, document, and report actual or potential safety, health, and/or environmental risks or hazards. An audit includes site observations, document review, and formal interviews or consultations with affected personnel.

2.6 **SH&E Audit Report** – A document outlining the results of the audit. A corrective action plan will be a part of the audit report.

2.7 **SH&E Inspection** – A systematic review of operations, procedures, equipment, and records in order to identify, evaluate, document, and report actual or potential safety, health and/or environmental risks or hazards. An inspection is normally less formal and less consuming from a time and resources standpoint to conduct than is an audit. This does not apply to government inspections (see *S3AM-211-PR1 Regulatory Inspections*).

2.8 **SH&E Records** – Information and documentation related to SH&E aspects of the program, project, or other operations unit including but not limited to SH&E Plan personnel acknowledgement sheets, Job Safety Analyses /Task Hazard Assessment sign-off sheets, Pre-Job or Pre-Entry Briefing sign-off sheets, SH&E training attendance and course completion records, medical surveillance records, exposure monitoring results, and equipment calibration records.

2.9 **SH&E Self-Inspection (Walkthrough)** – Informal walkthrough by Managers and/or designated SH&E staff of work areas, offices, storage areas, and other operations. Depending on the scope of work, pace of operations, and types and severity of physical and/or chemical hazards, self-inspections will be conducted on a frequent but not less than weekly basis.

3.0 Reference

3.1 S3AM-211-PR1 Regulatory Inspections

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager**

- Provide the resources needed to complete, document, and report audits in their location where an audit program is established and provide the resources for effective corrective action implementation.
- Schedule workplace inspections, and confirm results are reported in accordance with this procedure.
- Actively participate in the SH&E inspection, audit and program SH&E review processes at their sites and will provide those conducting the processes access to SH&E records, equipment, work areas, and personnel as appropriate.

4.1.2 **SH&E Manager**

- Provide training and technical guidance to operations in support of the requirements of this procedure.
- Schedule Program Safety Reviews as required.
- Confirm that a viable SH&E audit program is implemented within the Business Group / Business Unit where it is required either by AECOM, its clients, or local legislation.
- Assist with the implementation of Corrective Actions which are within their realm of responsibility.

4.1.3 **Employees**

- Cooperate with SH&E Department and audit, review, or inspection team personnel.
- Participate in the workplace inspections, reviews, audits, and/or corrective actions, if requested.

4.2 SH&E Inspections

4.2.1 Active, ongoing AECOM project sites and workplaces, including offices, shall be inspected monthly or at a frequency determined by the Manager and/or SH&E Manager to meet the local regulations.

- Refer to *S3AM-216-FM1 Site Inspection* or *S3AM-216-FM2 Office Inspection*.
- Alternately, *S3AM-216-FM4 Monthly Inspection Checklist* may be utilized with the approval of the Manager and SH&E Manager.

4.2.2 On oversight projects where AECOM has or shares the responsibility for project safety, the AECOM supervisor will coordinate with the Contractor's SH&E inspection program and provide observations to the Contractor.

4.2.3 Unscheduled inspections may be requested by the SH&E Manager in response to incidents such as a work-related injury, illness, or significant near miss; regulatory agency inquiry or inspection; or SH&E-related employee report of unsafe condition or similar issue.

4.2.4 Self-inspections include identifying and correcting SH&E compliance issues, housekeeping or material storage issues, life and fire safety violations, deficiencies with mobile equipment, or other adverse conditions or unsafe behaviors.

- Use of *S3AM-216-FM1 Site Inspection* or *S3AM-216-FM2 Office Inspection* is not required for these walkthroughs. However, issues will be documented by the inspector and corrective actions taken by the location's Supervisor or SH&E representative (on the spot, where feasible) when hazards, compliance violations, and/or other deficiencies are observed.

4.3 SH&E Program Evaluations and Program SH&E Reviews

4.3.1 The **SH&E Manager** shall schedule a Program SH&E Review at the request of Senior Management.

- The Program SH&E Review shall commence with an assessment of the program or project's active application of the SH&E Management System. The order of the assessment is in accordance with AECOM's Life Preserving Principles.
    - The assessment findings are recorded and scored as detailed within *S3AM-216-FM5 Program SH&E Review Assessment*. The assessment shall include a summary of findings, corrective actions, and assignment of responsible parties.
- The Program SH&E Review Assessment shall be used to complete *S3AM-216-FM6 Program SH&E Review Summary* and *S3AM-216-FM7 Program SH&E Review Presentation*. The summary and presentation are intended to provide the Program SH&E Review findings and recommendations to program or project management and any other relevant stakeholders.

4.3.2 SH&E Program Evaluations are conducted by the program or project's management and do not require Senior Management request.

- SH&E Program Evaluation requirements, such as frequency, may be established by the Business Group, Business Unit, or project or program management.
- Refer to *S3AM-216-FM3 SH&E Program Evaluation*.

4.4 Audits

4.4.1 Annual audits shall be implemented in AECOM locations, including worksites and/or offices where required by AECOM, its clients, or local legislation.

4.4.2 Audits may be conducted as a part of an accreditation process, such as Certificate of Recognition (COR) in Canadian jurisdictions, or as part of a third-party pre-qualification process.

- The format of the audit will be dictated by the requirement for the audit; for example, Canadian COR audits will follow the mandated audit structure of the province/territory.
- External auditors shall be escorted when present on any AECOM location.
- Key AECOM personnel shall be identified to coordinate, prepare for and support this audit process. This may include, but not be limited to:
    - Liaising with external auditor personnel.
    - Collecting documentation required for review.
    - Coordinating location visits and any preparation required of the external auditor personnel for the location visit(s).
    - Informing AECOM personnel of audit processes in preparation.
    - Arranging any required pre- or post-audit meetings.
    - Accompanying and supporting auditor as necessary during the audit process.

4.4.3 Internal or self-assessment audits may be ongoing requirements associated with external or third party audit processes or may be established by an AECOM Business Group or Business Unit as an internal requirement.

- Internal or self-assessment audits associated with an external or third party shall be submitted to the appropriate agency or body according to the requesting entity's requirements.
- Internal or self-assessment audits may be conducted by worksite or office employees, but shall be augmented by the supporting SH&E Manager, the project site safety representative, or designee (e.g. local SH&E Coordinator) as appropriate.
- Internal or self-assessment audits established as an internal requirement shall follow audit protocols identified by the appropriate AECOM Business Group or Business Unit.

4.4.4 Auditors should conduct a courtesy pre-audit briefing with personnel affected by the audit (e.g. site management team, project workers) to explain how the audit will be conducted and their expected level of participation, if any. Auditors should avoid disrupting routine work activities as far as practical.

4.4.5 Auditors will confirm that appropriate SH&E records pertaining to the project, location, or business unit are thoroughly reviewed. Original documentation will remain at the audit site so as not to be misplaced or lost.

4.4.6 Auditors should plan to have access to, and interview, a cross-section of AECOM employees at the audit location in order to engage employees in the audit process and to verify/validate audit questions and criteria as needed.

4.4.7 Audit documents should specifically identify the location or locations encompassed by the audit.

4.4.8 The audit will conclude after the auditor(s) has conducted a closing conference with the location's management team to review the results and document any required corrective actions.

4.4.9 Prior to formal audit issuance, draft audit findings shall be reviewed by local management.

4.5 Corrective Actions / Corrective Action Plans

4.5.1 All discrepancies noted during an inspection, evaluation, review, or audit shall be documented and tracked in the appropriate online management system (e.g. IndustrySafe).

4.5.2 All action items identified shall be corrected in a timely manner by local operations management. On-the-spot corrective action will be taken for imminent danger issues, life and fire safety deficiencies, and SH&E compliance violations. Other problem issues will be corrected on-the-spot when feasible.

4.5.3 For issues that cannot be corrected the same day (e.g. findings such as employee training or knowledge deficiencies, missing SH&E records, management failure to document procedures, etc.), the appropriate management team will document necessary follow-up action and assign accountability for corrective actions. These shall be additionally documented in the appropriate online management system (e.g. IndustrySafe) to assist with tracking.

4.5.4 If corrective actions will take more than 30 calendar days to complete, interim actions shall be implemented to prevent injury, illness, property loss, or impairment to the environment until planned/long-term corrective measures are put in place. The SH&E Manager shall be consulted as appropriate.

4.5.5 The management teams associated with the inspected, evaluated, reviewed or audited location and the related corrective actions will inform the SH&E Manager on the status of open corrective action plan items on a quarterly basis at a minimum.

5.0 Records

5.1 Copies of the most recently conducted inspections, evaluations, reviews, audits and attached corrective action plans shall be posted on the location's safety bulletin board to enable access for all employees.

5.2 Copies of all inspections, evaluations, reviews, audits and attached corrective action plans will be provided to the SH&E Manager and maintained in the applicable files (e.g. office, program, project, etc.).

5.3 Management teams associated with the inspected, evaluated, reviewed, or audited location and the related corrective actions are responsible for recording, reporting, and tracking results.

6.0 Attachments

6.1 S3AM-216-FM1 Site Inspection

6.2 S3AM-216-FM2 Office Inspection

6.3 S3AM-216-FM3 SH&E Program Evaluation

6.4 S3AM-216-FM4 Monthly Inspection Checklist

6.5 S3AM-216-FM5 Program SH&E Review - Assessment

6.6 S3AM-216-FM6 Program SH&E Review - Summary

6.7 S3AM-216-FM7 Program SH&E Review – Presentation

Americas

Permit to Work

S3AM-218-PR1

1. Purpose and Scope

This procedure establishes the process to issue safe work permits as applicable to the field work to be conducted on AECOM projects and when required by regulation, AECOM, or the client. Permit to Work requirements include assessment of tasks to determine if and when a safe work permit (SWP) is required, establishing of authority to issue safe work permits, the process to issue a safe work permit, responsibilities to work in accordance with the issued permit, and process for closure of the permit.

This procedure also identifies and supplements other AECOM procedures that contain task specific permit requirements. This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2. Procedure

2.1 Roles and Responsibilities

Role	Responsibility
Manager	1. Ensure the project or industrial site's SH&E Plan identifies any applicable Permit to Work requirements. 2. Ensure this Permit to Work system is adhered to along with any other applicable safe work systems. 3. Confirm work associated with permit requirements does not commence until Safe Work Permit(s) (SWPs) are issued, approved and understood 4. Ensure the system is adequately resourced including appointment of Permit Issuer (Authorised Person). 5. Confirm employees involved in work associated with Permit to Work requirements are familiar with this procedure, SWPs, and have appropriate training. 6. Ensure the system is audited in line with documented requirements.
SH&E Manager	1. Provide guidance to Managers, Supervisors, and staff on the assessment of hazards and the selection of appropriate control measures. 2. Provide training materials to Managers and Supervisors for employee training. 3. Assist as necessary in the preparation of necessary SWPs. 4. Providing SH&E technical and regulatory input as necessary.
Permit Issuer / Approver (Authorized Person)	1. Exercise direct operating control over the scope of a SWP. 2. Participate in the development of the Pre-Job Hazard Assessment, Job Safety Analysis or equivalent and SWP. 3. Provide notification of work as required to client and/or any regulatory agencies. 4. Confirm Permit Receiver(s) have the necessary skills, training and competency to do the permitted work safely, including full orientation to project and company requirements. 5. Ensure the work site has been verified as being safe for the work prior to activity. 6. Ensure all identified controls are in place, (e.g., barricades, isolations in place, tagged and where appropriate locked, etc.). 7. Issue the SWP face-to-face with the Receiver(s), discuss and ensure that requirements (scope, location, duration, controls, etc.) are understood. 8. Ensure required inspections of the work area is conducted to review the scope of work with the permit receiver. 9. Revalidate permits whenever changes occur (e.g. to scope, shift, conditions, etc.) and ensure Permit Receiver is notified of any changes to the permit or requirements. 10. Cancel the SWP if the safe working conditions are not maintained. 11. Confirm any necessary actions are completed in order to close the SWP (e.g., de-

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isolation, owner notification, etc.).

12. Close the SWP face-to-face with the Receiver.

Permit Receiver(s)

1. Have the necessary skills, training and competency to do the permitted work safely.
2. Maintain a copy of the SWP in a designated, centralized location.
3. As applicable, participate in the development of the Pre-Job Hazard Assessment, Job Safety Analysis or equivalent and SWP.
4. Accept a SWP face-to-face with the Permit Issuer / Approver after discussion of all requirements and when requirements are fully understood.
5. Understand, observe and implement the identified precautions / control measures, and carry out the work activity as per the documented requirements in the SWP and supporting documentation.
6. Stop work where there is a work scope change, changes to the permit conditions or if a hazardous situation arises and reporting to the Permit Issuer / Approver.
7. Raise any SH&E concerns or improvement suggestions directly at the time with the Permit Issuer / Approver.
8. Inspect the work area with the Permit Issuer / Approver (or designee).
9. Ensure hand-back and permit closure is carried out correctly. Ensure the workplace has been left in a safe and tidy state upon completion or suspension of work.

2.2 General

The overall procedure is summarized in the numbered list below.

1. Determine the need for a Safe Work Permit (SWP)
2. Determine the Permit to Work Authority & identify Permit Issuer(s) / Approver(s)
3. Identify the designated Permit Issuer(s) / Approver(s) for the project
4. Complete the initial onsite inspection
5. Complete the SWP
6. Verify SWP understanding
7. Final site inspection
8. Closure of the SWP

2.2.1 Determine the Need for a SWP

Proper planning of the scope of work for a given project or industrial site should consider if Permit to Work requirements apply.

- Assess regulatory requirements, AECOM requirements, client requirements and level of risk associated with the proposed tasks to determine Permit to Work applicability.
  - The following AECOM procedures provide task specific permit requirements and shall be consulted if applicable to the scope of work:
    - S3AM-120-PR Radiation
    - S3AM-209-PR1 Risk Assessment & Management - Americas
    - S3AM-301-PR1 Confined Spaces – Americas
    - S3AM-302-PR1 Electrical Safety - Americas
    - S3AM-303-PR1 Excavation - Americas

  - S3AM-304-PR1 Fall Protection - Americas
  - S3AM-310-PR1 Cranes & Lifting Devices - Americas
  - S3AM-325-PR1 Lockout Tagout - Americas
  - S3AM-330-PR1 Underground Work - Americas
  - S3AM-332-PR1 Hot Work – Americas
- The absence of permit requirements in any other AECOM procedures does not necessarily indicate a SWP is not required. The tasks associated with such procedures should be assessed based on risk, regulatory requirements and client requirements to determine whether Permit to Work requirements should be established. The form *S3AM-218-FM1 Safe Work Permit (Non-Task Specific)* is designed to be used when a permit is determined to be required and in the absence of a task specific permit.

- If SWPs are required, the project or industrial site SH&E Plan should detail the specific Permit to Work requirements.
- Refer to *S3AM-209-PR1 Risk Assessment & Management* for further information associated with SH&E Plan development.

2.2.2 Determine the Permit to Work Authority

Project or industrial sites will vary as to which entity is authorized to issue SWPs for the location or the specific given scope of work. The Permit to Work Authority may be AECOM, the client, or a third party (e.g., site owner, utility owner, agency, etc.).

- If work is being performed at an active client location that has a location-specific Permit to Work system in place, the client's site authorized Permit Issuers / Approvers are the Permit to Work authority.
- If the work is on a third party's active operating site or associated with third party owned equipment or systems that has an equivalent site Permit to Work system in place, the third party's site authorized Permit Issuers / Approvers are the Permit to Work authority.
  - Where non-AECOM permits are proposed to be used on an AECOM-controlled project, an assessment (gap analysis) shall be undertaken to verify that the third-party permit system meets the minimum requirements of the AECOM standard. Where gaps are identified, the higher standard of the two systems shall be adopted and application confirmed as part of the project or industrial site SH&E Plan.
- AECOM is performing work at a site that has no active Permit to Work system in place or the site does not have a Permit to Work system that is equivalent to that of AECOM. In this scenario, AECOM Permit Issuers / Approvers are the Permit to Work authority.
  - AECOM shall designate competent and appropriately trained Permit Issuer(s).

2.2.3 Initial Onsite Inspection

Prior to issuing the SWP, the Permit Issuer / Approver shall visually inspect the area where the work is to be performed. The inspection shall include but not be limited to the following:

- Simultaneous operations which could impact the work.
- Potential environmental impacts and procedures for addressing them (spill containment, absorbent pads, etc.).
- Location of appropriate assembly areas and emergency equipment (e.g., wind socks, fire extinguishers, emergency alarms, etc.).
- Site facilities (e.g., break areas, rest rooms, cafeteria, etc.).
- Location of available utilities such as potable water.
- Hazards and mitigation measures associated with the work location.

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2.2.4 Complete the Permit

After the initial onsite inspection, the Permit Issuer / Approver shall complete the SWP for the work.

- Confirm the appropriate permit is utilized for the given scope of work. If a task specific permit is not applicable, utilize *S3AM-218-FM1 Safe Work Permit (Non-Task Specific)* or equivalent.
- The Permit Issuer / Approver should engage the work team throughout the form completion to verify that the Permit Issuer / Approver and the Permit Receiver(s) have a good understanding of the scope of work, the potential hazards and mitigation measures involved.

2.2.5 Verify Permit Understanding

Once Permit Receivers have accepted a permit, he/she/they shall verify understanding:

- Understand the hazards of the area, equipment and work and the safeguards in place.
- Understand potential environmental impact and procedures for addressing.
- Understand and follow Personal Protective Equipment requirements.
- Have the necessary skills and knowledge to do the permitted work safely.
- Know emergency procedures, alarms and assembly points.
- Know the location of and how to use emergency equipment.
- Know the scope of other work that could impact the work.
- Understand the scope of the permitted work.

2.2.6 Final Site Inspection

After the work has been completed or when the time permitted on the SWP has been reached, an on-site inspection will be completed to verify that:

- The scope of work has been completed and the job site has been left in a safe and orderly manner; or
- The job is not complete, but a review of the area was performed to determine if the conditions are safe until the job is completed.

2.2.7 Closure of the SWP

A permit will be closed when the work is complete. Under certain circumstances, the Permit will be withdrawn or cancelled by the Permit Issuer / Approver, also considered closure of the permit. The permit will be withdrawn or cancelled whenever there has been a change in work conditions or scope and this has resulted in a change in hazards and safeguards, there is a complete change in the work crew, work was stopped due to an emergency, or the work activity has taken longer than permitted by the SWP. When a permit has been closed, withdrawn or cancelled, work shall stop until a new SWP can be issued.

The permit will be closed out by signing the bottom of the SWP by the Permit Issuer / Approver and depending upon the type of Permit, may include signature of the Permit Receiver(s). These signatures indicate that SWP is no longer active due to one of the following circumstances:

- The scope of work is complete, the final site inspection has been performed, and the job site has been left in a safe and orderly manner; OR
- The job is not complete, but a review of the area was performed to determine if the conditions are safe until the job is completed (withdrawal); OR

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- The job is not completed, but the SWP was cancelled because of site emergency and a final site inspection was not performed (cancelled).

3. Help & Training (Optional)

All persons involved in Permit to Work activities shall be trained in this procedure, the applicable Project or Industrial Site SH&E Plan, and shall be competent in the task(s) outlined in the permit scope and risk assessment.

- Competency may be achieved through a combination of training, education, experience, acquired knowledge and skills.
- Permit Issuers / Approvers and Receivers shall be trained in accordance with AECOM, client and regulatory requirements for work permitting.
  - In addition, Issuers and Receivers shall hold any pre-requisite core training for the particular type of work being permitted (e.g. confined space, work at height, etc.).
  - Contractors shall be able to show evidence of current competency for the task they are undertaking, or where they are adopting a supervisory role or as the Permit Issuer.

4. Terms and Definitions

a.	Safe Work Permit (SWP)	A documented means of communicating and authorizing the scope and schedule for work requiring a permit, identifying the applicable control measures, including the equipment and materials needed, identifying any affected systems areas or equipment, facilitate recognition of changes, and provide a process for safely managing the hazards posed by the work. This term includes any task specific permits contained in other AECOM SH&E procedures (e.g., Confined Space, Lockout Tagout, etc.) as well as *S3AM-218-FM1 Safe Work Permit (Non-Task Specific)* associated with this procedure, designed to be used when a permit is required and in the absence of a task specific permit.
b.	Permit to Work Authority	The entity authorized to issue SWPs applicable to the project or industrial site or the specific given scope of work. The Permit to Work Authority may be AECOM, the client, or a third party (e.g., site owner, utility owner, agency, etc.).
c.	Closure of Permit	The action taken by the Permit Issuer / Approver when the work is complete. Closure of the permit will also occur whenever there has been a change in work conditions or scope resulting in previously unassessed hazards, complete change in the work crew, a work stoppage due to an emergency, or if the work activity has taken longer than the time indicated on the SWP.
d.	Permit Issuer / Approver (Authorized Person)	An individual who has been trained to issue SWPs in accordance with this procedure.
e.	Permit Receiver	The individual or individuals who accept a work permit and agree to conduct work in accordance with the provisions specified in that permit.
f.	Permit Register	A method of recording the permits issued for the particular project or industrial site. In situations where very few permits are generated on a project a register may not be necessary.

5. References

The following AECOM Americas procedures are referenced in this document.

a. S3AM-120-PR1 Radiation

b. S3AM-209-PR1 Risk Assessment & Management - Americas

c. S3AM-301-PR1 Confined Spaces – Americas

d. S3AM-302-PR1 Electrical Safety - Americas

e. S3AM-303-PR1 Excavation - Americas

f. S3AM-304-PR1 Fall Protection - Americas

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g. S3AM-310-PR1 Cranes & Lifting Devices - Americas

h. S3AM-325-PR1 Lockout Tagout - Americas

i. S3AM-330-PR1 Underground Work - Americas

j. S3AM-332-PR1 Hot Work – Americas

6. Records

Records shall be maintained in a readily accessible manner, and include:

a. Records of training of Permit Issuers and Permit Receivers.

b. Permit Registers as applicable.

c. Copies of SWPs and supporting documentation in accordance with project document management requirements. Retention shall be retained for a minimum of 12 months after job completion.

7. Appendices

a. S3AM-218-FM1 Safe Work Permit (Non-Task Specific)

8. Change Log

List the change history pertaining to this document including if it was identified differently throughout its life-cycle:

Rev #	Change Date	Description of Change	Location of Change
0	June 22, 2018	New Document	
1	July 31, 2019	Revised Scope to include ‘any other entity…’	Section 1.0
2	September 30, 2020	Added content to Manager, Permit Issuer, and Permit Receiver Responsibilities	Section 2.1

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Safe Work Permit (Non-Specified Task)

S3AM-218-FM1

Project Name:		**Project No.:**	
Project Work Area:		**Permit to Work No.:**	
Permit Issuer (print):		**Permit Issuer (sign):**	
Permit Receiver (print):		**Permit Receiver (sign):**	
Emergency Contact:		**Number:**	

This Safe Work Permit is limited to the following job description and valid for the below time period:

From Date:		**Time 24hr:**		**To Date:**		**Time 24hr:**	

JOB DESCRIPTION (Include Scope/Description/Tasks & Area/Equipment & Boundaries):

PRECAUTIONS AND PREPARATION FOR WORK

All people working under this Safe Work Permit have the necessary site indoctrinations / orientations, and training as per the SH&E Plan?	☐ **Yes** ☐ **No**
Emergency response plan in place and known (incl. procedures, warning systems, assembly points, evacuation routes, emergency equipment, emergency contacts)?	☐ **Yes** ☐ **No**
The procedures applicable to scope of work covered by this Safe Work Permit have been reviewed and are understood by all involved?	☐ **Yes** ☐ **No**
The scope and boundaries of any other work in the area that could impact this permitted work has been reviewed and is understood?	☐ **Yes** ☐ **No**
Have other workers in the area have been notified if this permitted work could impact their work? Consider traffic control, barricades, noise, chemical exposure, etc.	☐ **Yes** ☐ **No**
All equipment to be used is in good condition, inspected, properly maintained, and ready to operate?	☐ **Yes** ☐ **No**
The work area been inspected for additional hazards (e.g., chemical, physical, biological, etc.)?	☐ **Yes** ☐ **No**
Other:	

Supporting Docs Attached:	
Contractor(s) (if applicable):	
Client Coordinator:	

HAZARDS & REQUIRED CONTROLS

Hazard	Control Required

REQUIRED PERSONAL PROTECTIVE EQUIPMENT (check applicable and provide detail)

☐ Head Protection Detail	☐ Hand Protection Detail	☐ Eye Protection Detail
☐ Foot Protection Detail	☐ Respiratory Protection Detail	☐ Fall Protection Attach Fall Protection Plan
☐ Hearing Protection Detail	☐ Protective Clothing Detail	☐ Other Detail

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ISOLATIONS		
☐ NIL REQUIRED	☐ AS PER ATTACHED LOCKOUT TAGOUT PERMIT	☐ OWN ISOLATION AS REQUIRED WITH PERSONAL DANGER TAG/LOCK

PERMIT ACCEPTANCE
(This Permit is only valid when all above parts have been completed)

Permit Issuer (Authorised Person):

The building or plant item described above is in my opinion in a safe condition for the job to be done provided all the conditions above are fully observed. These conditions have been discussed with, and understood by, the persons involved.

Name (Permit Issuer)	Signature	Date	Time	Valid Until	Time

Permit Receiver (Responsible Person or Persons Taking Permit to Work)

I have read this Permit to Work and have had the hazards and precautions explained to me. I undertake to comply with these provisions. Should there be a change in conditions which introduce new hazards to the task, I, or the work party will stop work and notify the Permit Issuer (Authorised Person). Work will only proceed upon authorization of the Permit Issuer. I shall vacate area on request or alarm.

Name (Permit Receiver)	Signature	Org	Date	Time (24hr)

Permit Receiver (Responsible Person or Persons Handing Back Job Site)

Permit Receiver (Responsible Person or Persons Handing Back Plant)
I or my work party have withdrawn from the job. Unless the job is incomplete all tools, materials and equipment from the immediate vicinity of the work area, are removed, all flange guards replaced, all Personal Danger tags and/or locks removed and the area cleaned.

The scope of work has been completed and the job site has been left in a safe and orderly manner (closure). OR	☐ **Yes** ☐ **No** **OR**
The job is not complete, but a review of the area was performed and verified the conditions are safe until the job is completed (withdrawal). OR	☐ **Yes** ☐ **No** **OR**
The job is not completed, but the SWP was cancelled because of site emergency and a final site inspection was not performed (cancelled).	☐ **Yes** ☐ **No**

Name (Permit Receiver)	Signature	Org	Date	Time (24hr)

Permit Issuer (Authorized Person)

The scope of work has been completed, the final site inspection has been performed, and the job site has been left in a safe and orderly manner (closure). OR	☐ **Yes** ☐ **No** **OR**
The job is not complete, but a review of the area was performed and verified the conditions are safe until the job is completed (withdrawal). OR	☐ **Yes** ☐ **No** **OR**
The job is not completed, but the SWP was cancelled because of site emergency and a final site inspection was not performed (cancelled).	☐ **Yes** ☐ **No**
Comments:	
This Permit to Work is now withdrawn.	

Name (Permit Issuer)	Signature	Org	Date	Time (24hr)

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Hand & Power Tools

S3AM-305-PR1

1.0 Purpose and Scope

1.1 This procedure provides the AECOM requirements for all manually operated hand and power tools and associated use, handling and storage. These requirements apply to tools provided by AECOM for employee use as well as tools provided by employees for use on AECOM work sites.

1.2 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 None

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-118-PR1 Hearing Conservation

3.3 S3AM-208-PR1 Personal Protective Equipment

3.4 S3AM-302-PR1 Electrical Safety

3.5 S3AM-325-PR1 Lockout Tagout

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Managers/Supervisors**

- Ensure that all aspects of this procedure are followed and adhered to on all AECOM projects, sites and locations.
- If a specific tool is not included in the work instructions related to this procedure, appropriate guidelines shall be established prior to work associated with that tool, including following manufacturer's recommendations.
- Ensure compliance with applicable client requirements and restrictions regarding hand or power tools.

4.1.2 **Safety, Health and Environment (SH&E) Manager**

- Provide technical guidance and support as to this procedure and associated work instructions.

4.1.3 **Employees**

- Work only with tools for which they are appropriately trained and familiar with.
- Follow manufacturer's recommendations for its use and never modify the equipment without first obtaining authorization from the manufacturer.
- Comply with applicable client requirements and restrictions regarding hand or power tools.

4.2 Requirements

4.2.1 Always conduct a task hazard assessment (THA) prior to work commencing and include the identified hazards associated with the anticipated tool use.

4.2.2 No employee shall use any hand or power tool, unless they are familiar with the use and operation of the equipment or have received specific instruction on its use and operation.

4.2.3 All tools will be used for which they were designed and in accordance with manufacturer's specifications. Do not use tools for jobs they are not intended for. For example, do not use a slot screw driver as a chisel, pry bar, wedge or punch or wrenches as hammers.

4.2.4 Use approved tools only. Never modify or use makeshift tools.

4.2.5 Do not apply excessive force or pressure on tools unless permitted by the manufacturer's specifications. This includes additional force by hammering with body weight, foot or other tools.

4.2.6 Keep surfaces and handles clean and free of excess oil and grease to prevent slipping.

4.2.7 Do not carry sharp tools (e.g. knife, chisel, screwdriver, etc.) in pockets; this practice may cause puncture wounds.

4.2.8 All tools shall be properly maintained. Clean, dry, lubricate and repair tools as applicable, and return to a suitable toolbox, room, rack, or other storage area upon completion of a job.

4.2.9 Ensure proper ergonomics principles are observed when using hand and power tools, such as but not limited to:

- Avoid static and awkward positions when possible.
    - Move at intervals to reduce muscle fatigue.
    - Consider tools with a trigger strip, rather than a trigger button. This strip will allow the exertion of more force over a greater area of the hand that, in turn, will reduce muscle fatigue
- Do not apply excessive force or pressure on tools.
- If possible use tools with comfortable grips that are designed to allow the wrist to stay straight. Avoid using a bent wrist.
- Choose hand tools that have a centre of gravity within or close to the handle.
- Frequently used tools that weigh more than 1 pound (0.45 kilograms) should be counter-balanced.
- Ensure proper body positioning when using a tool to prevent slips or falls in the event of unanticipated tool behaviour (slip, kickback, etc.). Avoid over-reaching.
- Pull on tools such as a wrench or pliers whenever possible. Loss of balance is more likely when pushing if the tool slips. If pushing is necessary, hold the tool with an open palm.
- Hand-arm vibration exposure is associated with the use of hand tools.
    - Reduce power to the lowest setting that can complete the job safely. This action reduces tool vibration at the source.
    - Consider the need for controls such as limiting time of use.
    - If safe to do so, adjust to a looser but stable grip, and use anti-vibration gloves.
- Use of heavy tools such as jackhammers can cause fatigue and strains. Heavy rubber grips can reduce these effects by providing a secure handhold.
- Do not increase a tool's leverage by adding sleeved additions (e.g. a pipe or snipe) to increase tool handle length.

4.2.10 Avoid placing fingers and hands in danger zones:

- Ensure hands and fingers have sufficient clearance in the event the tool slips.
- Ensure stability of the work-piece. Use work-piece holders (e.g. vise, chisel holder, etc.) whenever possible to prevent injury to hands or deflection of tool or work-piece.

- Use push sticks or guides when cutting or machining smaller material.

4.2.11 Secure tools when working from heights to prevent them from falling. Never leave tools on ladders, scaffolds, or overhead work areas when they are not in use.

4.2.12 Utilize good housekeeping practices to ensure tools do not present a tripping hazard.

4.2.13 Ensure no part of a tool extends over the edge of the bench top. Place sharp tools (e.g., saws, chisels, knives) on benches so that sharp points or edges face away from the edge.

4.2.14 When using saw blades, knives, or other tools, if possible direct the tools away from aisle areas and away from other employees working in close proximity.

4.2.15 Do not throw tools from place to place or from person to person, or drop tools from heights. Hand them, handle first, directly to other workers.

4.2.16 Use non-sparking and intrinsically safe tools in atmospheres with flammable or explosive characteristics and where highly volatile liquids, and other explosive substances are stored or used.

- Iron or steel hand tools may produce sparks that can be an ignition source around flammable substances. Where this hazard exists, spark-resistant tools made of non-ferrous materials shall be used.
- Electrical tools shall be identified as intrinsically safe.

4.2.17 If the task presents electrical hazards, worker must be competent and use the appropriate insulated tools to perform work that includes the risk of electrical shock. Cushioned grip handles do not protect against electrical shock.

4.2.18 The fluid used in hydraulic power tools must be an approved fire-resistant fluid and must retain its operating characteristics at the most extreme temperatures to which it will be exposed. The exception to fire-resistant fluid involves all hydraulic fluids used for the insulated sections of derrick trucks, aerial lifts, and hydraulic tools that are used on or around energized lines. This hydraulic fluid shall be of the insulating type.

4.2.19 All tools designed to accommodate guards must have the guard(s) in place when the tool is in use. Do not modify, remove, or disable any machine guards.

4.2.20 Do not allow loose clothing, long hair, loose jewelry, rings, and chains to be worn while working with power tools.

4.2.21 Make provisions to prevent tools from automatically restarting upon restoration of power. Refer to *S3AM-325-PR Lockout Tagout*.

4.3 Training

4.3.1 Instruction in the proper use, safe handling, and maintenance of tools will be provided to employees unfamiliar with the tool.

- Assess the employee's training needs as per *S3AM-003-PR1 SH&E Training* procedure.
- Refer to the applicable work instructions associated with this procedure for any additional training specifics.
- Training shall include applicable manufacturer's recommendations and guidelines.

4.3.2 Employees shall demonstrate knowledge and competency in the use, safe handling and maintenance of the applicable tool prior to operation.

4.4 Personal Protective Equipment (PPE)

4.4.1 Utilize basic PPE appropriate to the task; gloves, safety-toed boots, hard hats and safety glasses with side shields. Refer to *S3AM-208-PR1 Personal Protective Equipment*.

4.4.2 Ensure lockout devices (padlocks, multiple lock hasps, tags) are utilized as necessary. Refer to *S3AM-325-PR Lockout Tagout*.

4.4.3 Ensure PPE is appropriate to the work and use additional PPE as required (e.g. mono-goggles, hearing protection, respiratory protection, etc.).

- Dual eye protection is required to be worn by any employee undertaking or within 3 ½ feet (1 meter) of a task that produces projected particles or material.
- Head and face protection is recommended for employees working with pneumatic tools.
- Noise hazard is associated with pneumatic and many other tools. Working with noisy tools such as jackhammers requires proper, effective use of appropriate hearing protection.

4.4.4 Screens shall also be set up to protect nearby workers from being struck by flying fragments around chippers, riveting guns, staplers, or air drills.

4.4.5 Refer to the applicable work instructions associated with this procedure for any additional specialized PPE.

4.5 Inspections

4.5.1 All tools must be inspected prior to each use.

- Any tool that is defective or has missing parts must not be used.
- Every broken or defective tool must be tagged ‘out of service’ or ‘do not use’ and immediately removed from service.
- Tagged tools will be returned to the supervisor for repair or replacement.

4.5.2 All tools must be inspected to manufacture’s specifications and according to tool rests and guard adjustment tolerances. All tools will be inspected to ascertain that all safety devices are present and functioning properly. Refer to *S3AM-305-FM1 Hand & Power Tool Maintenance Inventory* and *S3AM-305-FM2 Hand & Power Tool Inspection Report*.

5.0 Records

5.1 None

6.0 Attachments

6.1 S3AM-305-ATT1 Chainsaw

6.2 S3AM-305-ATT2 Circular Saw

6.3 S3AM-305-ATT3 Cut Off Saw

6.4 S3AM-305-ATT4 Handheld Grinder

6.5 S3AM-305-ATT5 Impact Wrench

6.6 S3AM-305-ATT6 Nail Gun

6.7 S3AM-305-ATT7 Dustless Vacuum

6.8 S3AM-305-ATT8 Power Drill

6.9 S3AM-305-ATT9 Pressure Washer

6.10 S3AM-305-ATT10 Reciprocating Saw

6.11 S3AM-305-ATT11 Sander

6.12 S3AM-305-ATT12 Knives

6.13 S3AM-305-ATT13 Clearing & Grubbing Equipment

6.14 S3AM-305-ATT14 Pneumatic Tools

6.15 S3AM-305-ATT15 Manual Hand Tools

6.16 S3AM-305-ATT16 Small Engines

6.17 S3AM-305-ATT17 Electric & Battery Hand Tools

6.18 S3AM-305-FM1 Hand & Power Tool Maintenance Inventory

6.19 S3AM-305-FM2 Hand & Power Tool Inspection Report

Americas

Hand & Power Tool Maintenance Inventory

S3AM-305-FM1

Equipment (*Make, Model, Serial #*)	Equipment Owner	Equipment Status (*On Hire, Active, Decommissioned*)	Frequency of service	Service Type	Manufacturer's Standards	Industry Standards	Legislated Requirements	Location of Equipment

Americas

Hand & Power Tool Inspection Report

S3AM-305-FM2

TOOL	DATE	INSPECTED BY	RESULTS	ACTION REQUIRED	ACTION COMPLETED (DATE)

Americas

Chainsaw

S3AM-305-ATT1

1.0 Objective / Overview

1.1 Available in a variety of types and capacities, chainsaws are one of the most powerful, yet dangerous cutting tools available.

1.2 Working safely with a chain saw includes proper training, good body mechanics and felling technique, well-maintained equipment, and protective clothing.

2.0 Hazards

2.1 Improper operation (kickback – sudden and violent reverse movement of the saw)

2.2 Hand/arm vibration

2.3 Noise

2.4 Flying/falling debris

2.5 Sharp, moving blade

2.6 Defective tool

3.0 Safe Operating Guidelines

3.1 Only approved operators are permitted to operate a chainsaw.

3.2 Review manufacturer's operating manual, *S3AM-305-PR1 Hand & Power Tools*, and *S3AM-305-ATT16 Small Engines* for additional guidelines.

3.3 Inspect saws prior to use and periodically during use:

- 3.3.1 A sharp chainsaw is safer than a dull one. Worn chains shall be replaced immediately.
- 3.3.2 Keep the saw clean, lubricated, and adjusted.
- 3.3.3 Inspect and test the chain brake, chain catch, throttle lock, handles and guards, all nuts and bolts, spark arrestor, and muffler and air filter.
- 3.3.4 The chain tension should be properly adjusted and the carburetor tuned. The idle must be correctly adjusted; the chain should not move when the saw is in the idle mode.
- 3.3.5 Ensure the saw is fitted with an inertia break and hand guard.
- 3.3.6 Ensure the saw is fueled with the appropriate fuel type.
- 3.3.7 Do not operate a chain saw that is damaged or improperly adjusted, or is not completely and securely assembled**.** If a chainsaw is defective, remove it from service, and tag it clearly "Out of service for repair" or "Do Not Use". Replace damaged equipment immediately – do not use defective tools "temporarily." DO NOT ATTEMPT FIELD REPAIRS.

3.4 Never "drop start" the saw (the saw is held in the air with one hand on the handlebar and the other on the pull cord) as no control is provided to prevent rotation of the saw back toward the user.

3.5 Ensure an appropriately sized fire extinguisher or fire-fighting equipment is readily available.

3.6 A chainsaw is not only dangerous to the operator but also to surrounding persons. Do not allow others in the area when chainsaws are operated.

3.7 Never operate a chain saw when fatigued.

3.8 Make sure there are no nails, wire, or other imbedded material in the material to be cut that can cause flying particles or kickback.

3.9 Keep all parts of the body away from the saw chain when the engine is running.

3.9.1 Keep the saw close to the body.

3.9.2 Bend from the knees, not the waist. Improper lifting techniques and poor posture contribute to injuries.

3.9.3 Always avoid standing on the log and making cuts with the saw between your legs; always cut with the saw to the outside of your legs.

3.9.4 Always stand to one side of the limb to be cut, never straddle it.

3.9.5 Never cut above chest height.

3.10 Determine where the tree/limb will fall prior to cutting.

3.10.1 Start cutting only after a clear escape path has been made.

3.10.2 Always ensure that personnel and equipment are not in the path of the falling tree/log, and that you have time to move away.

3.10.3 If necessary, flag/or fence off the area to prevent entry.



Blade nose strikes another object



Improper starting of bore



Top or blade nose touches bottom or side of kerf during reinsertion

3.11 Always keep in mind where the chain will go if it breaks; never position body or allow others in line with the chain.

3.12 Avoid operations that could result in kickback of the saw towards the operator.

3.13 Keep the chain out of the dirt, debris will fly, the teeth will be dulled and the chain life shortened.

3.14 Shut the saw off when carrying through brush or on slippery surfaces. The saw may be carried no more than 50 feet (15 meters) while idling.

4.0 Personal Protective Equipment

4.1 Dual eye protection – safety glasses with side shields and a face shield

4.2 Chainsaw Chaps

4.3 Wear appropriate apparel. Long hair, loose or baggy clothing, ties, or jewellery can become caught in moving parts.

4.4 Safety toe work boots

4.5 Hardhat with lateral impact protection

4.6 Gloves providing impact, abrasion, cut, tear, & puncture resistance

4.7 Hearing Protection

Americas

Circular Saw

S3AM-305-ATT2

1.0 Objective / Overview

1.1 The circular saw is used in cutting wood products (e.g. plywood, construction lumber, etc.).

1.2 Safe measures for use include proper training, good body mechanics and operating technique, well-maintained equipment, and protective equipment.



2.0 Hazards

2.1 Kickback – Sudden and violent reverse movement of the saw

2.2 Noise

2.3 Flying debris

2.4 Sharp, moving blade (severe cuts)

2.5 Defective tool

2.6 Improper operation

3.0 Safe Operating Guidelines

3.1 Review manufacturer's operating manual, *S3AM-305-PR1 Hand & Power Tools*, and *S3AM-305-ATT17 Electric & Battery Hand Tools* for additional guidelines.

3.2 Use sharp blades and ensure cracked and dull blades are removed from service. Dull blades cause binding, stalling and possible kickback.

3.3 Use the correct blade for the application and check for proper operation before each cut.

3.4 Check often to ensure that guards return to their normal position quickly. Never defeat the guard to expose the blade.

3.5 Portable circular saws having a blade greater than 2 inches (5.08 centimeters) in diameter must be equipped at all times with guards. An upper guard must cover the entire blade of the saw.

3.6 A retractable lower guard must cover the teeth of the saw, except where it makes contact with the work material. The lower guard must automatically return to the covering position when the tool is withdrawn from the work position.

3.7 Before starting a circular saw, be sure the power cord and extension cords are out of the blade path and are long enough to freely complete the cut. A sudden jerk or pulling on the cord can cause loss of control of the saw and a serious accident.

3.8 Secure the work being cut to avoid movement.

3.9 For maximum control, hold the saw firmly with both hands after securing the work piece.

3.10 Keep the upper and retracting lower blade guard and the motor free from dust.

3.11 Do not hold or force the retracting lower guard in the open position.

3.12 Do not over tighten the blade-locking nut.

3.13 Do not twist the saw to change, cut or check alignment.

3.14 Do not use a saw that vibrates or appears unsafe in any way.

3.15 Do not force the saw during cutting.

3.16 Do not cut materials without first checking for obstructions or other objects such as nails and screws.

3.17 Check frequently to be sure clamps remain secure.

3.18 Avoid cutting small pieces that can't be properly secured and material on which the saw shoe can't properly rest. Use a push stick or guide when cutting operation requires the hands of the operator to come close to the blade.

3.19 Do not overreach. Keep proper footing and balance.

3.20 When starting the saw, allow the blade to reach full speed before contacting the work piece.

3.21 Circular saws are designed for right-hand operation; left-handed operation will demand more care to operate safely.

3.22 Never place hand under or in front of the shoe or guard of the saw when operating.

3.23 Cut at the proper depth (¼ inch / 0.64 centimeters) below work surface. Set the depth of the blade prior to use, when the saw is unplugged.

4.0 Personal Protective Equipment

4.1 Wear proper apparel for the task. Long hair, loose or baggy clothing, ties, or jewelry can become caught in moving parts.

4.2 Gloves that provide cut, abrasion and impact resistance.

4.3 Kickback apron as necessary.

4.4 Safety toed boots.

4.5 Safety glasses with side shields and faceshield.

4.6 Hearing Protection.

Americas

Cut Off Saw

S3AM-305-ATT3

1.0 Objective / Overview

1.1 Cut-off saws are high-speed cutting tools and very dangerous to operate. Therefore, it is very important to review the general safety rules, training, Personal Protective Equipment and procedures for working with portable cut off saws.

1.2 Cut off saws are used in a variety of activities (i.e. concrete, piping, metal, etc.).

2.0 Hazards

2.1 Noise

2.2 Flying debris

2.3 Sharp, moving blades (severe cuts)

2.4 Ignition sources (hot engine, sparks)

2.5 Hand/arm vibration

2.6 Kickback – Sudden and violent reverse movement of the saw

3.0 Safe Operating Guidelines

3.1 Review manufacturer's operating manual, *S3AM-305-PR1 Hand & Power Tools*, and *S3AM-305-ATT17 Electric & Battery Hand Tools* or *S3AM-305-ATT16 Small Engines* for additional guidelines

3.2 In addition to inspecting the general tool prior to operation, inspect the abrasive wheel for cracks and chips and appropriate wheel type.

- 3.2.1 If cracked or chipped, replace wheel before use.
- 3.2.2 Do not use abrasive-type wheels for rough grinding.

3.3 Ensure the saw is started in accordance with manufacturer's specifications:

- 3.3.1 Start the saw on firm ground or other solid surface in an open area.
- 3.3.2 Never "drop start" the saw as in the above picture (the saw is held in the air with one hand on the handlebar and the other on the pull cord) as no control is provided to prevent rotation of the saw back toward the user.

3.4 Handling

- 3.4.1 Hold the saw firmly with two hands when the engine is running, and whenever the blade is rotating until it comes to a complete stop.
- 3.4.2 Carry the saw with engine stopped, muffler away from your body, while protecting the cutting wheel from striking the ground or other objects.

3.5 Cutting

- 3.5.1 Clear the working area.
- 3.5.2 Begin cutting at full throttle and continue at full throttle until the cut is finished.
- 3.5.3 Avoid standing in a direct line with the cutting wheel.
- 3.5.4 Use only downward pressure on the saw, as lateral pressure may cause the blade to break and shatter.

3.5.5 Do not change the direction of the cut once started, as this can also cause the blade to break and shatter.

3.5.6 Do not cut above shoulder height.

3.5.7 Avoid operating the saw if the terrain is wet and/or frozen.

3.5.8 Keep flammable and combustible materials away from saw while cutting.

3.5.9 Ensure an appropriate fire extinguisher or fire-fighting equipment is readily available.

3.6 Maintenance

3.6.1 Shut off the engine and remove the spark plug wire before adjusting or working on the saw.

4.0 Personal Protective Equipment

4.1 Safety glasses with side shields and faceshield.

4.2 Chainsaw chaps.

4.3 Safety toe work boots.

4.4 Gloves that provide cut abrasion and impact resistance.

4.5 Hearing protection: earplugs and/or earmuffs.

4.6 Respirator if required (concrete operations).

Americas

Handheld Grinder

S3AM-305-ATT4

1.0 Objective / Overview

1.1 Handheld grinders are high-speed electric- or pneumatic-powered grinding tools used to shape or cut metal, and can be dangerous to operate.

1.2 Grinders are used in a variety of activities (i.e., piping installation/repair, metal, restoring, polishing, sharpening, etc.).

2.0 Potential Hazards

2.1 Kickback – Sudden and violent reverse movement of the grinder

2.2 Electric shock

2.3 Flying debris

2.4 An improperly installed or incompatible wheel can break or explode and cause injury.

2.5 Moving parts (severe cuts)

2.6 Fire hazard from sparks igniting nearby debris or objects

2.7 Noise

2.8 Hand/arm vibration

3.0 Safe Operating Guidelines



3.1 Review manufacturer's operating manual, *S3AM-305-PR1 Hand & Power Tools*, and *S3AM-305-ATT17 Electric & Battery Hand Tools* for additional guidelines.

3.2 Inspect the tool before every use. Damaged tools must be removed from use and tagged "DO NOT USE".

3.3 Grinder guards are to be used at all times and must not be altered.



3.3.1 US requirements specify a maximum of 180° of the grinding wheel to be exposed.

3.3.2 While 120° coverage may be permissible in certain jurisdictions, guards that are greater are not to be cut down.

3.3.3 Replace damaged or defective guards immediately

3.4 Grinders must be used with an unmodified manufacturer supplied handle at all times. If removal of the handle is required the reason must be appropriately documented and approved by project / location manager and SH&E manager or designee. Client approval may also be required.

3.5 Trigger locks are not permitted. If a grinder is found with a trigger lock, the lock shall be disabled.

3.6 Never use the grinder for jobs for which it is not designed (e.g. cutting with a grinding wheel vs. cutting disc).

3.7 Grinders must be permanently marked with the manufacturer's established maximum RPM (revolutions per minute).

3.8 Inspect the disk or wheel prior to operation:

3.8.1 Wire wheels must be inspected for loose and broken wires.

3.8.2 Ensure the RPM (as posted on the wheel) is equal to or greater than that posted on the grinder, the disk / wheel is the correct size for the grinder, and the type of wheel is compatible with the material being ground or cut.

3.8.3 Wheels must be replaced as specified by the manufacturer. In the absence of specifications a wheel shall not be worn down to a size which would allow the mounting flange assembly to contact the work-piece or work-piece holding fixture.

3.8.4 Ensure the disk or wheel is checked for cracks or other damage. A ring test can be conducted on clean, dry, unmounted wheels greater than 4" (10.16 centimeters) in diameter:

- Suspend the wheel by its arbor hole;
- Use a non-metallic tool (wood, plastic) to gently tap the wheel at 45° from the vertical center line on either side of the wheel, approximately 1 to 2 inches (2.5 – 5 centimeters) from the edge;
- Rotate the wheel 45° and repeat the process until the entire wheel has been tested;
- A wheel that emits a metallic ring indicates absence of damage, whereas a dull sound means the wheel should be removed from service.

3.8.5 If cracked, chipped, or there is any other evidence of damage, remove from service and replace wheel before use.

3.9 When mounting the wheels:

3.9.1 Grinders must be unplugged before changing wheels, discs or positioning guards.

3.9.2 Follow manufacturer's specifications (e.g. stamp facing grinder, mount up, mount down, etc.)

3.9.3 Ensure that the mounting flanges are clean and the mounting blotters are used.

3.9.4 Do not over tighten the mounting nut.

3.9.5 Before grinding or cutting, run newly mounted wheels at operating speed to check for vibrations.

3.10 General Safety Provisions

3.10.1 Ensure abrasive wheels are stored according to manufacturer specifications (absence of temperature extremes and solvents, dry area protected from impact, first in first out).

3.10.2 Keep the work area clean. Do not grind near flammable and combustible materials. Sparks can ignite debris and flammable vapors. A fully charged fire extinguisher must be located nearby. Use of a fire blanket may be necessary.

3.10.3 All observers should be kept at a safe distance from the work area to ensure they are protected from flying debris / sparks. Whenever practicable, use screens or shields.

3.10.4 Always secure work with clamps or a vise, freeing both hands to operate the tool. Never clamp a handheld grinder in a vice.

3.10.5 Use grinding wheels only at their rated speed.

3.10.6 Ensure safety guard(s) is positioned properly prior to start-up.

3.10.7 Allow the grinder to come to full operating speed before beginning grinding operation.

3.10.8 Do not use the side of a grinding wheel unless the wheel is designed for side grinding.

3.10.9 Always stand to the side of the wheel, never directly behind it.

- Be sure to keep your footing and maintain proper balance. Keep hands, fingers, and other body parts from coming into contact with the revolving wheel.
- While in operation, grinder shall be held with a firm grip using both hands. One engaging the trigger, and the second holding the handle.

3.10.10 Grinding aluminum is prohibited.

3.10.11 Tools shall be maintained with care. They should be kept clean and sharp for the best performance. Follow instructions in the user's manual for lubricating and care instructions.

4.0 Personal Protective Equipment (PPE)

4.1 Please refer to *S3AM-208-PR1 Personal Protective Equipment* for further information.

4.2 Gloves providing appropriate heat, impact, abrasion, cut, tear, & puncture resistance.

4.3 Wear appropriate apparel. Long-sleeved shirts and pants are required; clothing shall be made of natural fibers. Synthetics are not permitted. Note: Long hair, loose or baggy clothing, hoodie strings, ties, or jewelry can become caught in moving parts.

4.4 Dual eye protection required - Safety glasses with sideshields and properly impact-rated face shield. Welding helmets used as a face shield shall be verified as approved by CSA / ANSI for protection against impact.

4.5 Safety toe work boots.

4.6 Hearing protection: earplugs and/or earmuffs.

4.7 Other PPE as necessary for the work site/activity (e.g., hard hat, respiratory protection).

Americas

Impact Wrench

S3AM-305-ATT5

1.0 Objective / Overview

1.1 Impact wrenches are mainly used for tire changing but that does not limit their use. They can be used in all applications when a certain amount of torque is needed to loosen or tighten nuts and bolts.

1.2 The danger comes in to play when employees try to use the wrong sockets with an air wrench. Employees using air wrenches must have a general understanding of how to use them.

2.0 Potential Hazards

2.1 Flying debris

2.2 Noise

2.3 Cuts

2.4 Hand/arm vibration

3.0 Safe Operating Guidelines

3.1 Review manufacturer's operating manual, *S3AM-305-PR1 Hand & Power Tools*, and *S3AM-305-ATT14 Pneumatic Tools* for additional guidelines.

3.2 Impact wrench sockets and accessories must be used with this tool. Do not use hand sockets and accessories.

3.3 The proper fastening torque may differ depending upon the kind or size of the bolt.

3.4 Check the torque with a torque wrench.

3.5 Connect tool to air hose of recommended size.

3.6 Never use a wire, soft pin, or nail to hold the socket onto the square spindle of the impact wrench.

3.7 If the proper retaining device on the tool is broken, the tool shall be removed from service to be repaired.

3.8 On applications where a low or critical level of torque is required, it is recommended that each fastener is impacted lightly. Then perform the final tightening with a hand torque wrench.

4.0 Personal Protective Equipment

4.1 Safety toed boots

4.2 Anti-vibration gloves with impact and abrasion and cut resistance.

4.3 Safety glasses with side shields.

4.4 Hearing protection.

Americas

Nail Gun & Stapling Tool

S3AM-305-ATT6

1.0 Objective / Overview

1.1 Nail guns and stapling tools (pneumatic power-fastening devices) are useful, but must be handled with care.

1.2 Nail guns and stapling tools have been shown to be the cause of unnecessary injuries when the design of the gun places emphasis on speed, rather than safety.

2.0 Potential Hazards

2.1 Flying debris/nails

2.2 Imbedded object

2.3 Puncture wounds

2.4 Noise

3.0 Safe Operating Guidelines

3.1 Review manufacturer's operating manual, *S3AM-305-PR1 Hand &Power Tools*, and *S3AM-305-ATT14 Pneumatic Tool* for additional guidelines.

3.2 Permit only experienced and trained persons to operate pneumatic nailing and stapling tools. Never let an inexperienced worker use a nail gun without supervised training.

3.3 Never point a nail gun or stapling tool toward the body or any other personnel.

- 3.3.1 Never rest the gun against any part of your body, or try to climb a ladder with the gun cradled against your body.
- 3.3.2 Be aware of other workers in the work area.
- 3.3.3 Be aware of what is located behind the nailing surface. Never place hands or other body parts directly behind the nailing surface.
- 3.3.4 Ensure no one is in the line of fire should an incorrectly selected fastener eject out the other side of the material.

3.4 Inspect a tool before connecting it to air supply:

- 3.4.1 Check tool safety mechanisms if applicable. Never disable a safety tip on a nail gun or stapling tool.
- 3.4.2 Tighten securely all screws and cylinder caps.
- 3.4.3 Pneumatic power-fastening devices that shoot nails, rivets, staples, or similar fasteners and operate at pressures more than 100 pounds per square inch (6,890 kPa), must be equipped with a safety interlock to keep fasteners from being ejected, unless the muzzle is pressed against the work surface.

3.5 Check correct air supply and pressure before connecting a tool.

3.6 Check that the tool is correctly and securely connected to the air supply hose and that it is in good working order, with the safety mechanism operative, before using.

3.7 Always handle a tool as if it loaded with fasteners (nails, staples, etc.). Do not carry a tool with a finger on the trigger or with the trigger depressed.

3.8 Equip tools with a work-contacting element that limits the contact area to one that is as small as practical.

3.9 Make sure that the mechanical linkage between the work-contacting element and trigger is enclosed.

3.10 Disconnect a tool from the air supply and ensure the air is completely exhausted from the tool when the tool is unattended, when loading with fasteners (nails, staples), and during cleaning or adjustment.

3.11 Before clearing a blockage, be sure that depressing the trigger exhausts all air from the tool and the tool is disconnected from the air supply.

3.12 Use only fasteners recommended by the manufacturer. Ensure fasteners are appropriate to the work surface to ensure fastener does not eject completely through the material.

3.13 Avoid nailing into knots as nail can splinter wood.

3.14 Permit only properly trained people to carry out tool maintenance.

3.15 Do not depress the trigger unless the nosepiece of tool is directed onto a safe work surface and properly aligned both vertically and horizontally with the surface

3.16 Do not overreach. Keep proper footing and balance.

3.17 Ensure the hand not holding the nail gun or stapling tool is a minimum of12 inches (30cm) away from the nosepiece of the tool.

3.18 Keep the gun properly aligned with your work both vertically and horizontally.

4.0 Personal Protective Equipment

4.1 Gloves providing appropriate protection to the task (e.g. impact, puncture, chemical, etc.).

4.2 Safety toed boots.

4.3 Use hearing protection, where required.

4.4 Wear safety glasses with side shields at all times and face shield if flying debris may be encountered.

Americas

Dustless Vacuum

S3AM-305-ATT7

1.0 Objective / Overview

1.1 Dustless decontamination system (also refered to as Pentek brand name) removes and packages surface contamination from concrete and steel structures.

1.2 The Pentek integrated suite of manually operated equipment (e.g., squirrel III, corner cutter, roto-peen, and crack chaser) is designed for the safe removal of radioactive materials, lead-based paints, polychlorinated biphenyls, pesticides, chemical residues, and other contaminated coatings.

1.3 The Pentek system incorporates a high-performance vacuum and waste packaging unit, the VAC-PAC, in conjunction with pneumatically operated equipment to remove contaminated material. Dust and debris are captured at the cutting tool surface. Supporting equipment required to operate the unit includes a 60 kilowatt generator and an air compressor (minimum 350 cubic feet capacity), as well as a drum grappler for drum handling activities.

2.0 Hazards

2.1 Noise

2.2 Vibration

2.3 Tripping

2.4 Hot surfaces (vacuum unit)

2.5 Electrical (high voltage)

2.6 Pinch

2.7 Back strain

2.8 High pressure air

3.0 Safe Operating Guidelines

3.1 Review manufacturer's operating manual, *S3AM-305-PR1 Hand &Power Tools*, and *S3AM-305-ATT14 Pneumatic Tool* for additional guidelines.

3.2 Prior to use, a pre-operation inspection must be completed to determine if the unit is in safe working condition.

3.3 The vacuum unit should be placed a minimum of 50 feet (15.2 meters) away from the work area.

3.4 Once in position to begin work, apply the brake to stabilize the unit. When raising the VAC-PAC to insert/remove a drum, do not place your body or any extremity under the VAC-PAC while it is in the raised position.

3.5 Two workers should be used to maneuver the unit into place.

3.6 A minimum 10 feet (3 meters) clearance will be established around the unit while in operation.

3.7 Workers should be aware of their position in relation to the hoses and cable to minimize tripping hazards.

3.8 A competent person will train each worker in the operation of the unit.

3.9 Maintenance in excess of preventive maintenance activities (e.g., lubrication) will be performed by manufacturer personnel ONLY. Always know where the emergency stop is located.

3.10 Operators of a motorized drum grappler must be trained in agreement with the powered industrial truck

standard. Refer to *S3AM-324-PR1 Powered Industrial Trucks*.

3.11 Review *S3AM-302-PR1 Electrical Safety* prior to refueling the electrical generator and/or compressor.

4.0 Personal Protective Equipment

4.1 Leather gloves (maintenance).

4.2 As applicable, Tyvek suit (with hood).

4.3 Anti-vibration gloves (operation).

4.4 Hearing protection (plugs or muffs).

Americas

Power Drill

S3AM-305-ATT8

1.0 Objective / Overview

1.1 Available in a variety of types and capacities, portable power drills are undoubtedly the most used power tools.

1.2 Because of their handiness and application to a wide range of jobs, drills often receive heavy use. For this reason, you will need to carefully check your drill's capacity limitations and accessory recommendations.

2.0 Hazards

2.1 Electricity

2.2 Flying debris

2.3 Rotating and sharp parts

2.4 Burns (hot bits)

2.5 Manual handling (sprains/strains - wrist)

3.0 Safe Operating Guidelines

3.1 Review manufacturer's operating manual, *S3AM-305-PR1 Hand & Power Tools*, and *S3AM-305-ATT17 Electric & Battery Hand Tools* for additional guidelines.

3.2 Always keep drill bits sharp.

3.3 Disconnect the power supply before changing or adjusting bit or attachments,

3.4 Do not use high speed steel (HSS) bits without cooling or using lubrication.

3.5 Be sure the chuck is tightly secured to the spindle. This is especially important on reversible-type drills. Tighten the bit securely as described by the owner/operators manual.

3.6 The chuck key must be removed from the chuck before starting the drill. A flying key can be an injury-inflicting missile.

3.7 Secure workpiece being drilled to prevent movement.

3.8 If the bit is long enough to pass through the material, select a shorter drill bit or provide against damage and injury.

3.8.1 Prevent other workers from accessing the area.

3.8.2 Remove or provide coverage for material that could be damaged by the drill bit.

3.9 Secure magnetic drills with a chain or rope to prevent falling. Label cord connections to prevent unplugging.

3.10 Check auxiliary handles, if part of the tool. Be sure they are securely installed.

3.11 Always use the auxiliary drill handle when provided. It gives you more control of the drill, especially if stalled conditions occur.

3.12 Grasp the drill firmly by insulated surfaces.

3.13 Always hold or brace the tool securely. Brace against stationary objects for maximum control. If drilling in a clockwise -- forward -- direction, brace the drill to prevent a counter-clockwise reaction.

3.14 Do not overreach. Always keep proper footing and balance.

3.15 Don't force a drill. Apply enough pressure to keep the drill bit cutting smoothly. If the drill slows down, relieve

the pressure. Forcing the drill can cause the motor to overheat, damage the bit and reduce operator control.

4.0 Personal Protective Equipment

4.1 Wear proper apparel for the task. Long hair, loose or baggy clothing, ties, or jewellery can become caught in moving parts.

4.2 Gloves that provide cut, abrasion and impact resistance.

4.3 Safety toed boots.

4.4 Safety glasses with side shields and face shield.

4.5 Hearing protection.

Americas

Pressure Washer

S3AM-305-ATT9

1.0 Objective / Overview

1.1 Pressure washing can be divided into three categories based on the water pressure the equipment is capable of producing:

- Ultra high pressure jetting – greater than 30,000 psi
- High pressure washing – 5,000 to 30,000 psi
- Pressure washing – less than 5,000 psi

1.2 Generally, light duty portable pressure washing equipment and car washes produce less than 5,000 psi. High pressure washing equipment is often used for such tasks as cleaning vessels and process piping. Ultra high pressure jetting is also often employed to clean vessels and to remove coatings and scaling of production equipment. If not used correctly and safely, pressure washers can be dangerous piece of work equipment.

1.3 AECOM only allows trained, authorized personnel to operate the high pressure washers. Along with training, other safety measures include: reviewing the manufacturers instructional booklet, proper maintenance of equipment, and personal protective equipment.

2.0 Hazards

2.1 Kickback – Sudden and violent reverse movement of the gun

2.2 Flying debris

2.3 Slips and trips on wet surfaces and hoses

2.4 Noise

2.5 Manual handling

2.6 Exhaust fumes/carbon monoxide (CO) in enclosed spaces

2.7 Contact with high pressure / high temperature fluids

3.0 Safe Operating Guidelines

3.1 Review manufacturer's operating manual, *S3AM-305-PR1 Hand & Power Tools*, *S3AM-305-ATT17 Electric & Battery Hand Tools* or *S3AM-305-ATT16 Small Engines* for additional guidelines.

3.2 Ensure area is properly flagged with tags identifying work being performed and hazards. Keep all unauthorized workers out of area while job in progress.

3.3 Inspect all hoses, fittings, wands, cords and hose reel for damage or defects.

3.3.1 Equipment is complete and assembled correctly (i.e. nozzle tip correctly connected to the wand and not directly to hose).

3.3.2 Ensure trigger mechanism is functioning properly.

3.3.3 Fittings are securely attached.

3.3.4 Insulated components are in place.

3.4 Check fuel connections and hoses for signs of leaks, defects or damage.

3.5 Confirm nozzle / jets are clear by turning on water, without pump pressure.

3.6 Check pressure pump oil level before use. Hold the wand firmly with the trigger released when turning the pump on.

3.7 Recheck hoses once the system is pressurized.

3.8 Never service equipment while energized or pressurized.

3.9 Ensure other personnel are clear of area while pressure washer is pressurized. Non-operators must remain a minimum of 25 feet (7.6m) from the operator.

3.10 Do not wash at a 90 degree angle to minimize spray and flying debris.

3.11 Never point a pressure washer at yourself or others. Contact with high pressure fluid can result in serious cut or injection injuries.

3.12 Increase pressure slowly during operation to prevent hose kick-back.

3.13 Do not drive over, pull on, or kink the high pressure hose. Damage to the hose may compromise the wire braiding inside and cause the hose to burst.

3.14 Whip checks must be used for all high pressure connections.

3.15 High-pressure washing equipment should be cleaned often to avoid dirt buildup, especially around the trigger and guard area.

3.16 Always set the trigger safety lock when the gun valve is not in use.

3.17 Relieve the pressure in the system before coupling and uncoupling hoses.

3.18 Visually inspect the full length of high pressure discharge hose and inspect other high pressure fluid-handling components for abrasions or cuts, damage caused by exposure to chemicals and for damage caused by kinks in the hose.

3.19 High pressure washers shall be used to clean or decontaminate equipment, surfaces or structures only.

3.20 High pressure washers WILL NOT be used to clean or decontaminate workers or personal protective equipment while it is being worn.

3.21 Maintain a distance from the spray contact point to reduce noise exposure and risk of being struck by flying debris. Avoid overreaching and maintain a stable stance.

3.22 When shutting down a pressure washer, turn the pump off before turning the water supply off.

3.23 After turning off pressure washer, ensure all residual pressure is released from system by squeezing the trigger. Consult the operator’s manual for any other procedures specific to the equipment for shut-down.

3.24 Protect unit from freezing, when applicable.

4.0 Personal Protective Equipment

4.1 Hardhat.

4.2 Safety glasses with side shields and a face shield.

4.3 Gloves providing appropriate protection (rubber, chemical).

4.4 Hearing protection.

4.5 PVC (or equivalent) rain suit.

4.6 Safety toed boots with metatarsal protection.

Americas

Reciprocating Saw

S3AM-305-ATT10

1.0 Objective / Overview

1.1 The versatility of the reciprocating saw, in cutting metal, pipe, wood and other materials have made it a widely used tool.

1.2 By design, it is a simple tool to handle. Its demands for safe use, however, are very important.

2.0 Potential Hazards

2.1 Flying debris

2.2 Noise

2.3 Sharp, moving parts (cuts)

2.4 Hand/arm vibration

2.5 Electricity

3.0 Safe Operating Guidelines

3.1 Review manufacturer's operating manual, *S3AM-305-PR1 Hand & Power Tools*, and *S3AM-305-ATT17 Electric & Battery Hand Tools* for additional guidelines.

3.2 Use sharp blades. Dull blades can produce excessive heat, make sawing difficult, result in forcing the tool, and possibly cause an accident.

3.3 Ensure appropriate blade selection. Different work surfaces demand different blades

3.4 Position yourself to maintain full control of the tool, and avoid cutting above shoulder height. Always use two hands to operate the saw.

3.5 To minimize blade flexing and provide a smooth cut, use the shortest blade that will do the job.

3.6 The work piece must be clamped securely, and the shoe of the saw held firmly against the work to prevent operator injury and blade breakage.

3.7 Maintain firm contact between the saw's shoe and the material being cut.

3.8 When making a "blind" cut (cannot see behind what is being cut), be sure that hidden electrical wiring, or water pipes are not in the path of the cut.

3.9 If wires are present, they must be disconnected at their power source by a qualified person or avoided, to prevent the possibility of lethal shock or fire.

3.10 Water pipes must be drained and capped.

3.11 Always hold the tool by the insulated grouping surfaces. When making anything other than a through cut, allow the tool to come to a complete stop before removing the blade from the work piece. This prevents breakage of the blade, and possible loss of tool control. Do not operate reciprocating saw in explosive atmospheres.

3.12 Do not overreach. Keep proper footing and balance at all times.

3.13 Check for misalignment or binding of moving parts, breakage or parts and any other condition that may affect the tool's operation.

4.0 Personal Protective Equipment

4.1 Wear proper apparel for the task. Long hair, loose or baggy clothing, ties, or jewelry can become caught in moving parts.

4.2 Gloves that provide cut abrasion and impact resistance.

4.3 Kickback apron, as necessary.

4.4 Safety toed boots.

4.5 Safety glasses with side shields and face shield.

4.6 Hearing protection.

Americas

Sander

S3AM-305-ATT11

1.0 Objective / Overview

1.1 Sanders are commonly used at project sites for a variety of tasks.

1.2 Often times the hazards associated with sanders are overlooked; they don't appear threatening because they don't have sharp blades or bits. These misconceptions can be prevented through proper training and personal protective equipment (PPE) selection.

2.0 Potential Hazards

2.1 Kickback – Sudden and violent reverse of the sander

2.2 Noise

2.3 Hand/arm vibration

2.4 Dust exposure

2.5 Flying debris

2.6 Severe abrasive parts

2.7 Electricity

2.8 Fuel (fine dust) and ignition sources (electricity, friction)

3.0 Safe Operating Guidelines

3.1 Review manufacturer's operating manual, *S3AM-305-PR1 Hand & Power Tools*, and *S3AM-305-ATT17 Electric & Battery Hand Tools* for additional guidelines.

3.2 Disconnect power supply before changing a sanding belt, making adjustments, or emptying dust collector.

3.3 Inspect sanding belts before use. Replace those belts that are worn or frayed.

3.4 Install sanding belts that are the same widths as the pulley drum.

3.5 Adjust sanding belt tension to keep the belt running true and at the same speed as pulley drum.

3.6 Secure the sanding belt in the direction shown on the belt and the machine. Keep hands away from the sanding belt.

3.7 Before starting a sander, be sure the power cord and extension cords are out of the belt path and are long enough to freely complete the task. The sander must be either double insulated or connected to a ground fault circuit interrupter.

3.8 Use two hands to operate sanders – one on the trigger and the other on the front handle knob. Move sanders away from the body.

3.9 Clean dust from the motor and vents at regular intervals.

3.10 Do not use a sander without an exhaust system or dust collector present that is in good working order. The dust created when sanding can be a fire and explosion hazard. Proper ventilation is essential as well as guarding against open flame and sparks.

3.11 Empty the collector when ¼ full. Minimise dust disturbance when emptying the collector.

3.12 Do not exert excessive pressure on a moving sander. The weight of the sander provides adequate pressure for the job.

3.13 Do not work on unsecured stock unless it is heavy enough to stay in place. Clamp the stop into place or use a ‘stop block’ to prevent movement.

3.14 Do not overreach. Always keep proper footing and balance.

3.15 Do not cover air vents of the sander.

3.16 Check often to ensure that guards are in their normal position.

4.0 Personal Protective Equipment

4.1 Wear proper apparel for the task. Long hair, loose or baggy clothing, ties, or jewellery can become caught in moving parts.

4.2 Gloves that provide cut, abrasion and impact resistance.

4.3 Safety toed boots.

4.4 Safety goggles and faceshield.

4.5 Hearing protection.

4.6 Respiratory protection, as necessary.

Americas

Knives

S3AM-305-ATT12

1.0 Objective / Overview

1.1 Knives serve a variety of purposes at work sites, and can be a useful tool, when used safely and correctly.

1.2 Learning proper positioning and correct usafe of a knife will drastically reduce the potential of cut-related injuries.

2.0 Hazards

2.1 Improper body positioning

2.2 Improper knife selection

2.3 Defective knife

2.4 Improper knife operation (including storage)

3.0 Safe Operating Guidelines

3.1 Select the appropriate knife for the task. Consider using a rounded tip blade if the task allows.

3.2 Always be sure that knives are sharp and not dull. A dull blade will require more force to cut, increasing the likelihood injury (e.g. hand slipping, knife breaking, etc.). Replace dull blades – A knife that tears rather than cuts, generally indicates the blade is dull.

3.3 Be sure the blade is seated in the frame of the knife correctly, closed, and fastened together properly.

3.4 Always direct the cut away from yourself and others

- 3.4.1 Keep body parts away from the cut line, (e.g., fingers, leg, etc.)
- 3.4.2 Ensure that the material being cut is stabilized and not against a body part (e.g. cutting rope against your leg).
- 3.4.3 Always pull the knife, never push the knife (the blade may break, and momentum could cause the body to come into contact with broken blade).

3.5 Ensure knife blades are protected or retracted when not in use.

- 3.5.1 Never carry a knife with an exposed blade in your pocket.

3.6 Use of razor and break away utility knives is prohibited.

- 3.6.1 Purchase safety-equipped utility knives with guarding or automatically retracting blades.

3.7 When using a knife to cut thicker materials, use several passes. Increased force on the blade can cause it to stray from the intended cut path, or break the blade.

3.8 When changing blades, always handle from the non-sharp side. Cover blade with duct tape and dispose.

3.9 Use an alternate tool when possible (scissors, wire cutters, etc.).

3.10 Let a falling knife fall.

4.0 Personal Protective Equipment

4.1 Cut resistant gloves are mandatory when using knives (Kevlar, thick leather, etc.).

Americas

Clearing & Grubbing Equipment

S3AM-305-ATT13

The following safety precautions will be followed during site clearing and tree falling.

1.0 General

1.1 Refer to *S3AM-305-PR1 Hand & Power Tools* for additional guidance.

1.2 As applicable, refer also to *S3AM-305-ATT15 Manual Hand Tools, S3AM-305-ATT16 Small Engines,* and *S3AM-305-ATT17 Electric & Battery Hand Tools* for additional guidance.

1.3 All clearing activities shall terminate during electrical storms and periods of high winds.

1.4 Dead, broken or rotted limbs or trees (widow makers) shall be felled first.

1.5 Be aware of the presence of other personnel when using any tool, especially picks or axes.

2.0 Machete, Pick and Axe Use

2.1 A machetes, picks and axes will only be used for their designated purpose; do not carelessly swing the tool when it is not needed.

2.2 To prevent lacerations, employees will wear Kevlar gloves and Kevlar chain saw chaps.

2.3 Machetes, picks and axes shall not be used when other employees are in the immediate work area.

3.0 Use of Weed Whips

3.1 Weed whips may be used to clear vegetation such as grass, light brush, briars and tree seedlings. The L-shaped weed whip cuts grass and weeds but is unstable for use on larger growth; the triangular-frame weed whip cuts briars and woody stems up to a half-inch in diameter. A “Suwannee” sling is a heavy duty weed whip that also has an axe blade. It does the same work as a weed whip, but can also cut through large materials. The heavier weight of this tool allows it to more easily cut off larger material than a weed whip.

3.2 When using weed whips, employees should follow these safety procedures:

3.2.1 Select the correct tool for the types and size of vegetation present across the landfill.

3.2.2 Employees will wear gloves that provide impact, abrasion, cut, tear, and puncture resistance when using weed whips.

3.2.3 Weed whips are meant to be swung back and forth with both hands. Avoid using a golf swing. The tool should be swung no higher than an employee’s side.

3.2.4 Strong swings should be made to prevent the blade from bouncing or glancing off springy growth.

3.2.5 Screws hold the serrated double-edge blade in place. These screws can work loose so check them before each use.

3.2.6 At the end of the day, inspect the whips for damage. Clean, sharpen, and oil as necessary and store with a sheath in place.

4.0 Chain Saws

4.1 Refer to *S3AM-305-ATT1 Chainsaw.*

5.0 Felling Trees Manually

5.1 Before cutting begins, survey the work area for dead limbs, the lean of the tree to be cut, wind conditions and the location of other trees.

5.2 Remove lodged trees (tree has not fallen to the ground after being separated from its stump) as soon as possible. Never work under a lodged tree.

5.3 The distance between workers should be maintained at twice the height of the trees being felled.

6.0 Chipping Operations

6.1 Prior to use, make sure all safety devices and controls, such as emergency shut-off devices, are tested and verified to be functioning properly.

6.2 Access covers and doors shall not be opened until the drum or disk is at a complete stop.

6.3 Infeed and discharge ports shall be designed to prevent employee contact with disc, knives and blower blades.

6.4 The operator must be completely familiar with the controls and proper use of the equipment.

6.5 Workers feeding material into self-feeding wood chippers are at risk of being fed through the chipper if they reach or fall into the infeed hopper or become entangled in branches feeding into the machine.

6.5.1 Make sure two workers (buddy system) are in close contact with each other when operating the chipper.

6.5.2 Stand to the side of the chipper while inserting limbs into chipper, never stand directly in front.

6.5.3 Insert trunk portion of tree/limb first. This will prevent the branches from getting entangled with clothing, etc. and pulling you in with the tree/limb.

6.5.4 Bystanders should be kept at least 25 feet (7.6m) away when in operation.

6.5.5 Keep the area around the wood chipper free of tripping hazards.

6.6 Never wear loose clothing that may get caught on feed material or moving parts.

7.0 Personal Protective Equipment

7.1 Wear proper apparel for the task.

7.1.1 Long hair, loose or baggy clothing, ties, or jewellery can become caught in moving parts.

7.1.2 Wear clothing with long sleeves and full length pants of durable material.

7.2 Use gloves that provide impact, abrasion, cut, tear and puncture resistance.

7.3 Safety toed boots with ankle support.

7.4 Safety glasses with side shields and face shield.

7.5 Hearing protection as necessary.

Americas

Pneumatic Tools

S3AM-305-ATT14

1.0 Objective / Overview

1.1 Pneumatic tools utilize air pressure to perform the tool's task.

1.2 Safe measures for use include proper training, good body mechanics and operating technique, well-maintained equipment, and protective equipment.

1.3 There are several dangers associated with the use of pneumatic tools. First and foremost is the danger of getting hit by one of the tool's attachments or by some kind of fastener the worker is using with the tool.

2.0 Hazards

2.1 Improperly secured air hoses

2.2 Noise

2.3 Flying debris

2.4 Defective tool

2.5 Improper operation

3.0 Safe Operating Guidelines

3.1 Review the manufacturer's operating manual, *S3AM-305-PR1 Hand & Power Tools*, and *S3AM-305-ATT17 Electric & Battery Hand Tools* for additional guidelines.

3.2 Never use bottled gas as a power source for pneumatic tools.

3.3 Drain water from air compressor tank and condensation from air lines.

3.3.1 Blow out the air line before connecting a tool. Hold hose firmly and blow away from yourself and others.

3.4 Pneumatic tools must be checked to see that the tools are fastened securely to the air hose to prevent them from becoming disconnected. Pneumatic tools must have the air supply controlled according to manufacturer's specifications.

3.5 Make sure that hose connections fit properly and are equipped with a mechanical means of securing the connection between tool/hose/compressor to prevent whipping in case of disconnection or failure (e.g. chains, tie wires, whip checks or equivalent retaining devices).

3.6 Safety clips or tool retainers must be in place on pneumatic impact tools to prevent accessories (e.g. chisel on a chipping hammer) or attachments from being ejected.

3.7 If an air hose is more than 1/2-inch (12.7 mm) in diameter, a safety excess flow valve must be installed at the source of the air supply to reduce pressure in case of hose failure.

3.8 In general, the same precautions should be taken with an air hose that are recommended for electric cords, as the hose is subject to the same kind of damage or accidental striking, and because it also presents tripping hazards. Avoid creating trip hazards caused by hoses laid across walkways, curled underfoot, on ladders.

3.9 Airless spray guns that atomize paints and fluids at pressures of 1,000 pounds or more per square inch (6,890 kPa) must be equipped with automatic or visible manual safety devices that will prevent pulling the trigger until the safety device is manually released.

3.10 Ensure that the compressed air supplied to the tool is clean and dry. Dust, moisture, and corrosive fumes can damage a tool. An in-line regulator filter and lubricator increases tool life.

3.11 Keep tools clean and lubricated, and maintain them according to the manufacturers' instructions.

3.12 Use only the attachments that the manufacturer recommends for the tools in use.

3.13 Use the proper hose and fittings of the correct diameter and type for the pneumatic or hydraulic application.

3.13.1 The manufacturer’s recommended safe operating pressure for hoses, valves, pipes, filters, and other fittings must not be exceeded.

3.13.2 Use hoses specifically designed to resist abrasion, cutting, crushing and failure from continuous flexing.

3.13.3 Choose air supply hoses that have a minimum working pressure rating of 150 pounds per square inch gauge or 150 percent of the maximum pressure produced in the system, whichever is higher.

3.13.4 Check hoses regularly for cuts, bulges and abrasions. Tag and replace, if defective.

3.14 Install quick disconnects of a pressure-release type rather than a disengagement type. Attach the male end of the connector to the tool, NOT the hose.

3.15 Reduce physical fatigue by supporting heavy tools with a counter-balance wherever possible.

3.16 Do not operate the tool at a pressure above the manufacturer's rating.

3.17 Turn off the air pressure to the hose, exhaust the airliine and disconnect the tool from the air supply when not in use, before servicing or when changing power tools or attachments.

3.18 Do not carry a pneumatic tool by its hose.

3.19 Do not use compressed air for cleaning purposes unless the pressure is reduced to 30 pounds per square inch (psi) or less. This rule does not apply for concrete form, mill scale, green cutting, and similar cleaning operations. Proper respiratory, hand, eye, and ear protection must be worn.

3.20 Compressed air guns shall never be pointed toward anyone.

3.20.1 Employees shall never “dead-end” them against themselves or anyone else.

3.20.2 A chip guard shall be used when compressed air is used for cleaning.

3.20.3 Never use compressed air to blow debris or to clean dirt from clothes or body.

4.0 Personal Protective Equipment

4.1 Gloves providing appropriate protection to the task (e.g. impact, puncture, chemical, etc.)

4.2 Safety toed boots

4.3 Use hearing protection, where required.

4.4 Wear safety glasses with side shields at all times and face shield if flying debris may be encountered.

Americas

Manual Hand Tools

S3AM-305-ATT15

1.0 General

1.1 Review manufacturer's operating manual and *S3AM-305-PR1 Hand & Power Tools* for additional guidelines.

1.2 Carry tools using a heavy belt or apron and hang tools at your sides.

1.3 Never carry tools in your pockets or hanging behind your back.

2.0 Hammers

2.1 Hammers are designed according to the intended purpose. Select a hammer that is comfortable for you and that is the proper size and weight for the job. Misuse can cause the striking face to chip, possibly causing a serious injury.

2.2 Choose a hammer with a striking face diameter approximately ½ inch (1.3 centimeters) larger than the face of the tool being struck (e.g., chisels, punches, wedges, etc.).

2.3 Strike a hammer blow squarely with the striking face parallel to the surface being struck. Always avoid glancing blows and over and under strikes. (Hammers with beveled faces are less likely to chip or spall).

2.4 Look behind and above you before swinging the hammer.

2.5 Watch the object you are hitting.

2.6 Hold the hammer with your wrist straight and your hand firmly wrapped around the handle.

2.7 Do not use handles that are rough, cracked, broken, splintered, sharp-edged or loosely attached to the head. Remove from service and replace the handle if possible.

2.8 Do not use any hammer head with dents, cracks, chips, mushrooming, or excessive wear.

2.9 Do not use a hammer for any purpose for which it was not designed or intended.

2.10 Do not use one hammer to strike another hammer, other hard metal objects, stones or concrete.

2.11 Do not redress, grind, weld or reheat-treat a hammer head.

2.12 Do not strike with the side or cheek of the hammer.

3.0 Pipe Cutters, Reamers, Taps and Threaders

3.1 Replace pipe cutter wheels which are nicked or otherwise damaged.

3.2 Use a three- or four-wheeled cutter, if there is not enough space to swing the single wheel pipe cutter completely around the pipe.

3.3 Choose a cutting wheel suitable for cutting the type of pipe material required:

- 3.3.1 Thin wheel for cutting ordinary steel pipe.
- 3.3.2 Stout wheel for cutting cast iron.
- 3.3.3 Other wheels for cutting stainless steel, plastic and other materials.

3.4 Select the proper hole diameter and correct tap size to tap a hole. The hole should be sized so that the thread cut by the tap will be about 75 percent as deep as the thread on the tap.

3.5 Use a proper tap wrench (with a "T" handle) for turning a tap.

3.6 Use lubricant or machine cutting fluid with metals other than cast iron.

3.7 Do not permit chips to clog flutes (groves in the tap that allow metal chips to escape from the hole). The chips may prevent the tap from turning – this may result in the tap breaking if you continue to apply pressure.

3.8 Do not attempt to thread hardened steel. This can chip or damage the die.

3.9 Do not thread any rod or other cylindrical object that is larger in diameter than the major diameter of the die thread.

3.10 Do not use a spiral reamer on a rotating pipe. The reamer may snag and cause serious injury.

4.0 Pliers and Wire Cutters

4.1 Pliers are made in various shapes and sizes and for many uses. Use the correct pliers or wire cutters for the job.

4.2 Choose pliers or wire cutters that have a grip span of 2½ – 3½ inches (6.4 – 8.9 centimeters) to prevent palm or fingers from being pinched when the tools are closed.

4.3 Use adjustable pliers that allow for a firm grip of the work piece while maintaining a comfortable handgrip (i.e., hand grasp is not too wide).

4.4 Use tools only if they are in good condition.

4.4.1 Make sure that the cutting edges are sharp. Dull and worn-down cutting edges require many times more force for cutting.

4.4.2 Make sure that the toothed jaws are clean and sharp. Greasy or worn-down jaws can result in compromised safety. Such tools also require increased force to hold the work piece which, in turn, increases the risk of muscular fatigue and repetitive strain injuries.

4.5 Oil pliers and wire cutters regularly. A drop of oil on the hinge will make the tools easier to use.

4.6 Pull on the pliers; do not push away from you when applying pressure. If the tool slips unexpectedly, you may lose your balance or injure your hand.

4.7 Cut at right angles. Never rock the cutting tool from side to side or bend wire back and forth against the cutting edges.

4.8 Do not cut hardened wire unless the pliers or wire cutters are specifically manufactured for this purpose.

4.9 Do not expose pliers or wire cutters to excessive heat.

4.10 Do not bend stiff wire with light pliers. Needle-nose pliers can be damaged by using the tips to bend large wire. Use a sturdier tool.

4.11 Do not use pliers as a hammer.

4.12 Do not hammer on pliers or wire cutters to cut wires or bolts.

4.13 Do not extend the length of handles to gain greater leverage. Use a larger pair of pliers for gripping or a bolt cutter for cutting.

4.14 Do not use cushion grip handles for jobs requiring tools with electrically insulated handles. Cushion grips are for comfort primarily and do not protect against electric shock.

4.15 Do not use pliers on nuts and bolts; use a wrench.

5.0 Screwdrivers

5.1 Screwdrivers are made in various shapes and sizes and for many uses. Use the correct screwdriver for the job.

5.2 Choose contoured handles that fit the shank tightly, with a flange to keep the hand from slipping off the tool.

5.3 Use a slot screwdriver with a blade tip width that is the same as the width of the slotted screw head.

5.4 For cross-head screws, use the correct size and type of screwdriver; a Phillips screwdriver may slip out of a screw head designed for use with the slightly flatter-tipped Pozidriv screwdriver.

5.5 Use a vise or clamp to hold the stock if the piece is small or moves easily.

5.6 Keep the screwdriver handle clean. A greasy handle could cause an injury or damage from unexpected slippage.

5.7 If work must be carried out on “live” electrical equipment, use screwdrivers that have insulated handles designed for electrical work and a non-conducting shaft. Remember, most plastic handles are designed for grip and comfort.

5.8 Use non-magnetic tools when working near strong magnets (e.g., in some laboratories).

5.9 Use a screw-holding screwdriver (with screw-holding clips or magnetic blades) to get screws started in awkward, hard-to-reach areas. Square-tipped screwdrivers (e.g., Robertson) that hold screws with recessed square holes are also useful in such situations.

5.10 Use an offset screwdriver in close quarters where a conventional screwdriver cannot be used.

5.11 Use a screwdriver that incorporates the following features when continuous work is needed:

5.11.1 Use a pistol grip to provide for a straighter wrist and better leverage.

5.11.2 Use a "Yankee drill" mechanism (spiral ratchet screwdriver or push screwdriver) which rotates the blade when the tool is pushed forward.

5.11.3 Use a ratchet device to drive hard-to-move screws efficiently, or use a powered screwdriver.

5.12 File a rounded tip square making sure the edges are straight. A dull or rounded tip can slip out of the slot and cause hand injury or damage to materials.

5.13 Store screwdrivers in a rack or partitioned pouch so that the proper screwdriver can be selected quickly.

5.14 Do not lean or push on a screwdriver with any more force than necessary to keep contact with the screw. A screw properly piloted and fitted will draw itself into the right position when turned. Keep the shank directly over the screw being driven.

5.15 Do not hold the stock in one hand while using the screwdriver with the other as an injury may result if the screwdriver slips out of the slot.

5.16 Do not hammer screws that cannot be turned.

5.17 Do not grind the screwdriver tip to fit another size screw head.

5.18 Do not try to use screwdrivers on screw heads for which they are not designed (e.g., straight blade screwdrivers on Phillips, clutch head, Torx or multi-fluted spline screw heads).

5.19 Do not use defective screwdrivers (e.g. rounded or damaged edges or tips; split or broken handles; bent shafts).

5.20 Do not use a screwdriver for prying, punching, chiseling, scoring, scraping or stirring paint.

5.21 Do not use pliers on the handle of a screwdriver for extra turning power. A wrench should be used only on the square screwdriver shank designed for that purpose.

5.22 Do not expose a screwdriver blade to excessive heat. Heat can affect the temper of the metal and weaken the tool.

5.23 Do not use a screwdriver to check if an electrical circuit is live. Use a suitable meter or other circuit testing device.

5.24 Do not carry screwdrivers in clothing pockets.

6.0 Snips

6.1 Wear safety glasses and protective gloves when working with snips. Small pieces of metal may go flying in the air and cut edges of metal are sharp.

6.2 Snips are made in various shapes and sizes for various tasks. The handle can be like those on scissors with finger and thumb holes or like plier handles. Models are available for cutting in straight lines and in curves to the left or right.

6.3 Select the right size and type of snips for the job; check the manufacturer's specifications about the intended use of the snips (e.g., type of cut - straight, wide curve, tight curve, right or left, and maximum thickness and kind of metal or other material that can be cut).

- 6.3.1 Universal snips can cut in both straight and wide curves.
- 6.3.2 Straight snips and duckbill snips (flat blade, "perpendicular" to the handle, with pointed tips) are generally designed to cut in straight lines; some duckbill snips are designed for cutting curved lines.
- 6.3.3 Hawk's bill snips (with crescent-shaped jaws) are used for cutting tight circles.
- 6.3.4 Aviation snips have compound leverage that reduces the effort required for cutting.
- 6.3.5 Offset snips have jaws that are set at an angle from the handle.

6.4 Use only snips that are sharp and in good condition.

6.5 Use snips for cutting soft metal only. Hard or hardened metal should be cut with tools designed for that purpose.

6.6 Use ordinary hand pressure for cutting. If extra force is needed, use a larger tool.

6.7 Cut so that the waste is on the right if you are right-handed or on the left if you are left-handed.

6.8 Avoid springing the blades. This results from trying to cut metal that is too thick or heavy for the snips you are using.

6.9 Keep the nut and the pivot bolt properly adjusted at all times.

6.10 Oil the pivot bolt on the snips occasionally.

6.11 Do not try to cut sharp curves with straight cut snips.

6.12 Do not cut sheet metal thicker than the manufacturer's recommended upper limit (e.g., cuts up to 16-gauge cold, rolled steel or 18-gauge stainless steel). Do not extend the length of handles to gain greater leverage.

6.13 Do not hammer or use your foot to exert extra pressure on the cutting edges.

6.14 Do not use cushion grip handles for tasks requiring insulated handles. They are for comfort primarily and not for protection against electric shocks.

6.15 Do not attempt to re-sharpen snips in a sharpening device designed for scissors, garden tools, or cutlery.

7.0 Wrenches

7.1 Use the correct wrench for the job - pipe wrenches for pipes and plumbing fittings, and general-use wrenches for nuts and bolts.

- 7.1.1 Do not use pipe wrenches on nuts and bolts.
- 7.1.2 Use a box or socket wrench with a straight handle, rather than an off-set handle, when possible.
- 7.1.3 Do not use a conventional adjustable wrench for turning a tap – it will cause uneven pressure on the tap that may cause it to break.
- 7.1.4 Do not use a makeshift wrench.

7.2 Inspect pipe wrenches periodically for worn or unsafe parts and replace them:

7.2.1 Wrenches must not be used when jaws are sprung to the point that slippage occurs.

7.2.2 Ensure that the teeth of a pipe wrench are sharp, clean and free of oil and debris.

7.2.3 Do not use worn adjustable wrenches. Inspect the threads, knurl, jaw and pin for wear.

7.2.4 Discard any bent or damaged wrenches (e.g., open-ended wrenches with spread jaws or box wrenches with broken or damaged points).

7.3 Select the correct jaw size to avoid slippage.

7.3.1 Ensure that the jaw of an open-ended wrench is in full contact (fully seated, “flat,” not tilted) with the nut or bolt before applying pressure.

7.3.2 Face a pipe wrench or adjustable wrench “forward,” adjust tightly and turn the wrench so pressure is against the permanent or fixed jaw. Do not pull on a wrench that is loosely adjusted.

7.3.3 Adjust the pipe wrench grip to maintain a gap between the back of the hook jaw and the pipe. This concentrates the pressure at the jaw teeth, producing the maximum gripping force. It also aids the ratcheting action.

7.3.4 Do not insert a shim in a wrench for better fit.

7.3.5 Before applying pressure, ensure that the jaws have a good bite.

7.3.6 Make sure adjustable wrenches do not "slide" open during use.

7.3.7 Do not increase the leverage by adding sleeved additions (e.g., a pipe) to increase tool handle length. Use a larger wrench as necessary.

7.4 Ensure that the pipe or fitting is clean to prevent unexpected slippage and possible injury.

7.5 Maintain a proper stance with feet firmly placed to maintain balance.

7.5.1 Position the body in a way that will prevent loss of balance and injury if the wrench slips or something (e.g., a bolt) suddenly breaks.

7.5.2 Pull, rather than push on the wrench handle as body balance is more likely to be maintained if the wrench slips.

7.5.3 Pull using a slow, steady pull; do not use fast, jerky movements.

7.6 Apply a small amount of pressure to a ratchet wrench initially to ensure that the ratchet wheel (or gear) is engaged with the pawl (a catch fitting in the gear) for the direction you are applying pressure.

7.7 Support the head of the ratchet wrench when socket extensions are used.

7.8 Stand aside when work is done with wrenches overhead.

7.9 Do not use a wrench on moving machinery.

7.10 Do not use the wrong tools for the job. For example: Do not use pliers instead of a wrench or a wrench as a hammer. Do not use pipe wrenches for lifting or bending pipes.

7.11 Do not strike a wrench (except a "strike face" wrench) with a hammer or similar object to gain more force.

7.12 Do not expose a wrench to excessive heat (like from a blow torch) that could affect the temper of the metal and ruin the tool.

8.0 Files/Rasps

8.1 Do not use a file as a pry bar, hammer, screwdriver, or chisel.

8.2 When using a file or a rasp, grasp the handle in one hand and the toe of the file in the other.

8.3 Do not hammer on a file.

9.0 Chisels and Punches

9.1 Use the right size and type of chisel (metal or wood) or punch (drift pin, centre, pin) for the job.

9.2 Use tools only if they are good condition (i.e., cutting edges are sharp, struck head is not mushroomed or chipped).

9.2.1 Do not use chisels or punches if the cutting edge is dull, mushroomed or chipped, or if the point of a punch is slanted or damaged.

9.2.2 Choose smooth, rectangular handles that have no sharp edges and are attached firmly to the chisel. Replace broken or splintered handles.

9.2.3 Redress striking tools with burred or mushroomed heads.

- Redress the point or cutting edge to its original shape.
- Do not use a grinder to redress heat-treated tools. Use a whetstone.
- Grind to a slightly convex cutting edge.
- The point angle of the chisel should be 70° for hard metals, 60° for soft.
- Do not apply too much pressure to the head when grinding a chisel. The heat generated can remove the temper. Immerse the chisel in cold water periodically when grinding.

9.2.4 Replace any chisel or punch that is bent, cracked, shows excessive wear or cannot successfully be redressed.

9.3 Check stock thoroughly for knots, staples, nails, screws, or other foreign objects before chiseling or punching.

9.4 Hold the chisel, for shearing and chipping, at an angle which permits the bevel of the cutting edge to lie flat against the shearing plane.

9.5 Use the appropriate type and size of hammer for the chisel or punch, such as:

9.5.1 A wooden or plastic mallet with a large striking face on chisels.

9.5.2 Heavy-duty or framing chisels made of a solid or molded handle can be struck with a steel hammer.

9.5.3 Ball-peen hammers are generally chosen for use with punches.

9.5.4 Refer to the ‘Hammers’ section of this document for further guidance.

9.6 Chip or cut away from the body. Keep hands and body behind the cutting edge.

9.7 Make finishing or paring cuts with hand pressure alone.

9.8 Provide hand protection if possible:

9.8.1 Use a sponge rubber shield, punch or chisel holder.

9.8.2 Clamp small work pieces in a vise and chip towards the stationary jaw when working with a chisel.

9.8.3 Do not allow bull point chisels to be hand-held by one employee and struck by another. Use tongs or a chisel holder to guide the chisel so that the holder's hand will not be injured.

9.9 Do not use cold chisels for cutting or splitting stone or concrete.

9.10 Do not use a drift pin punch (also called an aligning punch) as a pin punch intended for driving, removing, or loosening pins, keys, and rivets.

9.11 Do not use a wood chisel on metal.

9.12 Do not use a wood chisel as a pry or a wedge.

9.13 Place chisels safely within the plastic protective caps to cover cutting edges when not in use.

9.14 Store chisels in a “storage roll,” a cloth or plastic bag with slots for each chisel, and keep them in a drawer or tray.

10.0 Hacksaws

10.1 Select correct blade for material being cut.

10.2 Keep saw blades clean and lightly oiled using light machine oil on the blade to keep it from overheating and breaking.

10.3 Secure blade with the teeth pointing forward. Tighten the nut until the blade is under tension.

10.4 Keep blade rigid, and frame properly aligned.

10.5 Cut using steady strokes, directed away from you.

10.6 Use entire length of blade in each cutting stroke.

10.7 Cut harder materials more slowly than soft materials.

10.8 Clamp thin, flat pieces requiring edge cutting.

10.9 Do not apply too much pressure on the blade as the blade may break.

10.10 Do not twist when applying pressure.

10.11 Do not use when the blade becomes loose in the frame.

11.0 Vises

11.1 When clamping a long work piece in a vise, support the far end of the work piece by using an adjustable pipe stand, saw horse or box.

11.2 Position the work piece in the vise so that the entire face of the jaw supports the work piece.

11.3 Do not use a vise that has worn or broken jaw inserts, or has cracks or fractures in the body of the vise.

11.4 Do not slip a pipe over the handle of a vise to gain extra leverage.

12.0 Clamps

12.1 Do not use a C-clamp for hoisting materials.

12.2 Do not use a C-clamp as a permanent fastening device.

13.0 Pry Bars

13.1 Establish balance and stable footing when using a bar for prying.

13.2 Pry bars must be appropriate to the task to prevent slipping or tool breakage.

14.0 Jacks

14.1 All jacks—including lever and ratchet jacks, screw jacks, and hydraulic jacks—must have a stop indicator, and the stop limit must not be exceeded.

14.2 The manufacturer’s load limit must be permanently marked in a prominent place on the jack, and the load limit must not be exceeded.

14.3 A jack should never be used to support a lifted load. Once the load has been lifted, it must immediately be blocked up. Put a block under the base of the jack when the foundation is not firm, and place a block between the jack cap and load if the cap might slip.

14.4 To set up a jack, make certain of the following:

14.4.1 The base of the jack rests on a firm, level surface;

14.4.2 The jack is correctly centered;

14.4.3 The jack head bears against a level surface; and

14.4.4 The lift force is applied evenly.

14.5 Clear all tools, equipment and any other obstructions from under the load before lowering the jack.

14.6 Proper maintenance of jacks is essential for safety. All jacks must be lubricated regularly. In addition, each jack must be inspected according to the following schedule:

14.6.1 For jacks used continuously or intermittently at one site—inspected at least once every 6 months;

14.6.2 For jacks sent out of the shop for special work—inspected when sent out and inspected when returned; and

14.6.3 For jacks subjected to abnormal loads or shock—inspected before use and immediately thereafter.

Americas

Small Engines

S3AM-305-ATT16

1.0 Objective / Overview

1.1 Operate small engine machines (liquid fuel tools), such as push mowers, weed trimmers, pumps and leaf blowers, in a safe manner.

1.2 Workers must be trained and competent in the safe operation and maintenance of the tool.

2.0 Potential Hazards

2.1 Flying debris

2.2 Noise

2.3 Moving and sharp parts

2.4 Hot surfaces

3.0 Safe Operating Guidelines

3.1 Review *S3AM-305-PR1 Hand & Power Tools* and the manufacturer's operating manual for further guidance.

3.2 Do not wear loose or baggy clothing around tools with rotating parts.

3.3 Never run the engine indoors, in poorly ventilated areas, or in a location where the exhaust could be drawn into a building through an opening.

3.3.1 When an engine must be operated in an enclosed space, effective ventilation and/or proper respirators such as atmosphere-supplying respirators must be utilized to avoid breathing carbon monoxide.

3.4 Never store engine with fuel in fuel tank inside a building with potential sources of ignition such as hot water and space heaters, clothes dryers, electric motors, etc.

3.5 Ensure the fuel cap is in place. Never start or operate the engine with the fuel fill cap removed.

3.6 Refuelling:

3.6.1 Never remove fuel cap or add fuel when engine is running.

3.6.2 Shut down the engine and allow it to cool prior to refueling to prevent accidental ignition of hazardous vapors.

3.6.3 Never pour gasoline on hot surfaces.

3.6.4 Fill in well-ventilated area.

3.6.5 Do not re-fuel around an open flame or while smoking.

3.7 Use only properly labelled, American National Standards Institute/Canadian Standards Association-approved red gasoline containers to store and dispense fuel.

3.8 The worker must be careful to handle, transport, and store gas or fuel only in approved flammable liquid containers, according to proper procedures for flammable liquids.

3.9 Noise hazards associated with gasoline engines must be mitigated by the use of proper hearing protection. Ear plugs, ear muffs or a combination of the two must be used to protect workers from excessive noise levels.

3.10 Appropriate fire extinguishers must also be available in the area.

3.11 Do not pour fuel from engine or siphon fuel by mouth.

3.12 Never leave the engine unattended while it is running.

3.13 Never operate the engine with an unguarded engine shaft.

3.14 Do not modify the engine or tamper with the factory setting of the engine governor.

3.15 Never operate the engine without a muffler guard in place and avoid touching hot areas of the engine.

3.16 Keep all flammable materials away from the muffler and the rest of the engine; do not idle or park the engine in dry grass or ground cover.

3.17 When working on the equipment, avoid accidental starts by removing the ignition key, turn off all engine switches, disconnect the battery and disconnect the spark plug, keeping it away from metal part.

4.0 Personal Protective Equipment

4.1 Always wear safety glasses with shields. Add face shield if potential for flying debris.

4.2 Gloves providing the appropriate protection (e.g. impact, abrasion, chemical, etc.).

4.3 Wear proper apparel for the task. Long hair, loose or baggy clothing, ties, or jewellery can become caught in moving parts. Long pants and long sleeve shirt.

4.4 Safety toe work boots.

4.5 Hearing protection (earmuffs or earplugs).

Americas

Electric & Battery Hand Tools

S3AM-305-ATT17

1.0 Objective / Overview

1.1 Electric and battery hand tools, also known as power tools, allow the user to perform their task more easily by providing more torque, speed, etc.

2.0 Hazards

2.1 Electricity

3.0 Safe Work Practices (General)

3.1 Review manufacturer's operating manual and *S3AM-305-PR1 Hand & Power Tools* for additional guidelines.

3.2 All electrical tools and equipment must be operated in accordance with the requirements of *S3AM-302-PR1 Electrical Safety.*

3.3 Keep all people not involved with the work at a safe distance from the work area.

3.4 Inspect power tools prior to each use.

- 3.4.1 Ensure that the power tool has the correct guard, shield or other attachment that the manufacturer recommends.
- 3.4.2 Ensure that the tools are properly grounded using a three-prong plug (no loose or faulty prongs), are double insulated (and are labeled as such), or are powered by a low-voltage isolation transformer; this will protect users from an electrical shock.
- 3.4.3 Check the handle and body casing of the tool for cracks or other damage.
- 3.4.4 If the tool has auxiliary or double handles, check to see that they installed securely.
- 3.4.5 Inspect cords for defects: check the plug and power cord for cracking, fraying, and other signs of wear or faults in the cord insulation.
- 3.4.6 Ensure power tool switches and triggers are fully functional.
- 3.4.7 If equipped with a trigger-lock, ensure it is disabled.
- 3.4.8 If a power tool is defective, remove it from service, and tag it clearly "Out of service for repair" or "Do Not Use". Replace damaged equipment immediately – do not use defective tools "temporarily." DO NOT ATTEMPT FIELD REPAIRS.

3.5 Maintain tools with care; keep them sharp and clean for best performance.

3.6 Follow instructions in the user's manual for lubricating and changing accessories.

3.7 Do not over-reach. Be sure to keep good footing and maintain good balance when operating power tools.

3.8 If they are available, choose tools with double handles to permit easier holding and better manipulation of the tool.

3.9 Do not brush away sawdust, shavings or turnings while the power tool is running. Never use compressed air for cleaning surfaces or removing sawdust, metal turnings, etc.

3.10 Do not operate power tools that are not specified as intrinsically safe in an area containing explosive vapors or gases.

3.11 Do not clean tools with flammable or toxic solvents.

3.12 Do not surprise or touch anyone who is operating a power tool. Startling an operator could result in injury or

property damage.

3.13 Hand-held power tools must be equipped with a constant-pressure switch or control that shuts off the power when pressure is released.

3.13.1 Powered hand tools shall not be capable of being locked in the ON position. Trigger locks are not permitted.

3.13.2 All power tools should be ordered without trigger locks; if a tool is found with a trigger lock intact it must be disabled.

3.14 Avoid accidental starting. Do not hold fingers on the switch button, and ensure it is in the OFF position while plugging the tool in or while carrying an energized (plugged-in, battery in place) tool.

3.15 Do not leave a running tool unattended and ensure the power tool will not re-energize when not in use and when servicing, cleaning, making adjustments, applying flammable solutions or changing accessories:

3.15.1 Ensure it has stopped running completely.

3.15.2 Ensure the trigger or switch is OFF.

3.15.3 Ensure the power tool is disconnected from the power supply (unplugged or battery removed).

3.16 Operate power tools within their design limitations.

3.17 Store power tools, batteries and electrical cords in a clean, dry area off the ground when not in use.

3.18 Do not use power tools in damp or wet locations unless they are approved for that purpose.

3.19 Keep work areas well lighted when operating power tools.

3.20 Equipment must have proper guards or shields and they must remain in place to protect the operator and others from the following:

3.20.1 Point of operation.

3.20.2 In-running nip points.

3.20.3 Rotating parts.

3.20.4 Flying chips and sparks.

3.21 If a guard is removed to clean or repair parts, replace it before testing the equipment and returning the machine to service

3.22 If, due to damage or deterioration, the original guard provided on a piece of equipment cannot be put in place, the tool must be removed from service.

3.23 Do not modify, remove, or disable any machine guards.

3.24 Remove any wrenches and adjusting tools before turning on a tool.

3.25 Use clamps, a vice or other devices to hold and support the piece being worked on, when practical to do so. This will allow you to use both hands for better control of the tool and will help prevent injuries if a tool jams or binds in a work piece.

4.0 Battery Powered Tools

4.1 Use only the type of battery specified by the tool manufacturer for the battery-powered tool to be used.

4.2 Recharge a battery or battery-powered tool only with a charger that specified for the battery.

4.3 Store a battery pack safely so that no metal parts, nails, screws, wrenches and so on can come in contact with the battery terminals; this could result in shorting out the battery and possibly cause sparks, fires or burns.

5.0 Safe Work Practice (Electric)

5.1 During use, keep power cords clear of tools and the path that the tool will take.

5.2 Employees' hands shall not be wet when plugging and unplugging cord and plug connected equipment and extension cords.

5.3 Portable electric equipment shall be disconnected when not in use, before servicing, and when changing accessories such as blades, bits, and cutters.

5.4 Portable electric equipment and extension cords used in potentially wet locations shall be approved for use in those locations by a nationally recognized testing laboratory, inspection agency, or other organization concerned with product evaluation (e.g., F.M., UL, etc.).

5.5 The outlet box for portable extension cords for outdoor use shall be weatherproof and shall be maintained in good condition.

5.6 Maintain electrical cords and connections in good working order:

5.6.1 Cords and connection must be American National Standards Institute/Canadian Standards Association approved and bear a standardized certification marking (e.g., CSA, ANSI, UL, CE etc.).

5.6.2 To prevent overheating, use only approved extension cords that have the proper wire size for the length of cord and power requirements of the electric tool to be used.

- Do not connect or splice extension cords together to make a longer connection.
- For outdoor work, use outdoor extension cords marked “W-A” or “W.”

5.6.3 Eliminate octopus connections: if more than one receptacle plug is needed, use a power bar or power distribution strip that has an integral power cord and a built-in overcurrent protection.

5.6.4 Portable electrical equipment shall not be carried by the cord, nor raised or lowered by the cord.

5.6.5 Electrical cords shall not be removed from a receptacle by pulling on the cord line.

5.6.6 Cords shall not be placed across walkways unless appropriate cord and worker protection is in place to prevent damage to the cord and worker tripping hazards (e.g. cable protectors, cords suspended over walkway, etc.).

5.6.7 Do not walk on or allow vehicles or other moving equipment to pass over unprotected power cords. Cords should be put in conduits or protected by placing planks on each side of them.

5.6.8 A cord should not be pulled or dragged over nails, hooks, or other sharp objects that may cause cuts in the insulation.

5.6.9 Keep cords away from heat, oil, sharp edges and moving parts.

5.6.10 Never use extension cords as permanent wiring as they are for temporary use only. Do not run behind bookshelves, or furniture if the cord cannot be monitored for severe bending or damage.

5.6.11 Inspect cords frequently for such damage such as fraying, kinks, cuts, and cracked or broken outer jackets. Any cord that exhibits damage or feels more than comfortably warm to the touch shall be removed from service, tagged “Do Not Use’ and checked by an electrician.

5.6.12 Do not tie power cords in knots. Knots can cause short circuits and shocks. Loop the cords or use a twist lock plug.

5.7 Electrical shock associated with power tool use can cause heart failure and burns, as well as injury from falls. Under certain conditions, even a small amount of electric current can result in fibrillation of the heart and death.

5.7.1 Verify that the power source is the same voltage and current as indicated on the nameplate of the tool. Using a higher voltage can cause serious injury to the operator as well as burn out the tool.

5.7.2 All electrical connections for these tools must be suitable for the type of tool and the working

conditions (wet, dusty, flammable vapors).

5.7.3 To protect the worker from shock and burns, electric tools must have a three-wire cord with a ground and be plugged into a grounded receptacle, be double insulated, or be powered by a low-voltage isolation transformer.

5.7.4 All outdoor receptacles must be protected by means of a ground fault circuit interrupter (GFCI or GFI) available in portable or fixed models. Do not use any electric power tools outdoors in a receptacle that is not properly protected.

5.7.5 Three-wire cords contain two current-carrying conductors and a grounding conductor. Any time an adapter is used to accommodate a two-hole receptacle, the adapter wire must be attached to a known ground.

5.7.6 The third prong must never be removed from the plug.

5.7.7 Double-insulated tools are available that provide protection against electrical shock without third-wire grounding. On double-insulated tools, an internal layer of protective insulation completely isolates the external housing of the tool.

5.7.8 Avoid body contact with grounded surfaces like refrigerators, pipes and radiators when using electric powered tools; this will reduce the likelihood of shock if the operator's body is grounded.

5.7.9 Report all shocks and/or sparks from electrical tools, no matter how minor. The tool in question should be tagged out and not be used until it has been checked for ground fault.

5.8 Only authorized persons are permitted to activate, de-activate or lockout electrical equipment.

5.9 Where there is or may be a danger to a worker, from the inadvertent operation of electrical equipment, then that equipment must be locked out and tagged prior to commencing work. Refer to *S3AM-325-PR1 Lockout Tagout*.

5.9.1 Switch off all appropriate devices (MCC, Distribution Panel, Disconnect).

- Stand to one side when engaging or disengaging an electrical circuit breaker to avoid electrical flash backs Lock and tag Electrical Supply devices in the “OFF” position.

5.9.2 Test to be sure the equipment cannot be operated at the STOP-START switch.

5.9.3 Test to be sure electrical equipment is de-energized.

5.9.4 After completion of task, remove padlocks and destroy tags.

6.0 Personal Protective Equipment (Level D PPE)

6.1 Wear proper apparel for the task. Long hair, loose or baggy clothing, ties, or jewellery can become caught in moving parts.

6.2 Use gloves with protection appropriate to the task (e.g. impact, abrasion, puncture, etc.).

6.3 Safety toed boots.

6.4 Use hearing protection as necessary.

6.5 Kickback aprons as necessary.

6.6 Wear safety glasses with side shields at all times (or safety goggles) and face shield if flying debris may be encountered.

7.0 Belt Sanders

7.1 Refer to *S3AM-305-ATT11 Sanders.*

8.0 Drills

8.1 Refer to *S3AM-305-ATT8 Power Drill*.

9.0 Planers and Joiners

9.1 Use blades of the same weight and set at the same height.

9.2 Ensure that the blade-locking screws are tight.

9.3 Guard planers and joiners to prevent contact with the blades throughout the full length of the cutting area.

9.4 Support the material (stock) in a comfortable position that will allow the job to be done safely and accurately.

9.5 Check stock thoroughly for staples, nails, screws, or other foreign objects before using a planer.

9.6 Start a cut with the infeed table (front shoe) resting firmly on the stock and with the cutter head slightly behind the edge of the stock.

9.7 Use two hands to operate a planer - one hand on the trigger switch and the other on a front handle.

9.8 Do not put fingers or any object in a deflector to clean out chips while a planer is running.

9.9 Disconnect the power supply when stopping to dump out chips.

9.10 Do not set a planer down until blades have stopped turning.

9.11 Keep all cords clear of cutting area.

10.0 Routers

10.1 Ensure that the bit is securely mounted in the chuck and the base is tight.

10.2 Put the base of the router on the work, template or guide. Make sure that the bit can rotate freely before switching on the motor.

10.3 Secure stock. Never hold or have another individual hold the material. Sudden torque or kickback from the router can cause damage and injury.

10.4 Before using a router, check stock thoroughly for staples, nails, screws or other foreign objects.

10.5 Keep all cords clear of cutting area.

10.6 Always hold both hands on router handles, until a motor has stopped. Do not set the router down until the exposed router bit has stopped turning.

10.7 When inside routing, start the motor with the bit above the stock. When the router reaches full power, lower the bit to two times the required depth.

10.8 When routing outside edges, guide the router counter clockwise around the work.

10.9 When routing bevels, moldings and other edge work, make sure the router bit is in contact with the stock to the left of a starting point and is pointed in the correct cutting direction.

10.10 Feed the router bit into the material at a firm, controlled speed.

10.11 Softwood may enable fast router cutting speed. With hardwood, knotty and twisted wood, or with larger bits, cutting may be very slow.

10.12 The sound of the motor can indicate safe cutting speeds. When the router is fed into the material too slowly, the motor makes a high-pitched whine. When the router is pushed too hard, the motor makes a low growling noise.

10.13 When the type of wood or size of the bit requires going slow, make two or more passes to prevent the router from burning out or kicking back.

10.14 To decide the depth of cut and how many passes to make, test the router on scrap lumber similar to the work.

11.0 Circular Saws

11.1 Refer to *S3AM-305-ATT2 Circular Saw*.

12.0 Other Saws

12.1 Use lubricants when cutting metals.

12.2 Keep all cords clear of cutting area.

12.3 Cut green or wet material slowly and with caution. Check all material being cut for nails, hard knots, etc.

12.4 Make sure guards are installed and are working properly.

12.4.1 Table saws must be fitted with blade guards and a splitter to prevent the work from squeezing the blade and kicking back on the operator.

- Exposed parts of the saw blade under the table must be properly guarded.
- All swing cutoff and radial saws that are drawn across a table with limit stops to prevent the saw from traveling beyond the edge of the table

12.4.2 Ensure band saw blades are fully enclosed except at the point of operation.

12.4.3 Ensure swing cut-off saws have a guard completely covering the upper half of the saw.

12.5 Remember sabre saws cut on the upstroke.

12.6 Position the saw beside the material before cutting and avoid entering the cut with a moving blade.

12.7 Secure and support stock as close as possible to the cutting line to avoid vibration.

12.7.1 Hold the material being cut firmly against a back guide or fence and cut with a single, steady pass.

12.7.2 Use a push stick or guide when cutting operation requires the hands of the operator to come close to the blade.

12.7.3 When cutting long stock, provide extension tables and a helper to assist the operator.

12.7.4 Keep the base or shoe of the saw in firm contact with the stock being cut.

12.7.5 Automatic feed devices should be used whenever feasible.

12.8 Select the correct blade for the material being cut and allow it to cut steadily. Do not force it. Clean and sharp blades operate best.

12.9 Set the blade to go no further than 1/8 to 1/4 inch deeper than the material being cut.

12.10 Do not start cutting until the saw reaches its full power.

12.11 Do not force a saw along or around a curve. Allow the machine to turn with ease.

12.12 Do not insert a blade into or withdraw a blade from a cut or lead hole while the blade is moving.

12.13 Do not put down a saw until the motor has stopped.

12.14 Do not reach under or around the stock being cut.

12.15 Maintain control of the saw always. Avoid cutting above shoulder height.

12.16 External Cuts

12.16.1 Make sure that the blade is not in contact with the material or the saw will stall when the motor starts.

12.16.2 Hold the saw firmly down against the material and switch the saw on.

12.16.3 Feed the blade slowly into the stock, maintaining an even forward pressure.

12.17 Internal Cuts

12.17.1 Drill a lead hole slightly larger than the saw blade. With the saw switched off, insert the blade in the hole until the shoe rests firmly on the stock.

12.17.2 Do not let the blade touch the stock until the saw has been switched on.

Highway and Road Work

S3AM-306-PR1

1. Purpose and Scope

To address potential hazards that may occur while working on public or private roadways or within the right-of-way of a public or private roadway.

- This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.
- This procedure is designed to assure that work on highway and roads meets the requirements established in federal, state, provincial, territorial, and local department of transportation laws, regulations, and guidance (jurisdictional requirements and guidance). If discrepancies exist between this procedure and other applicable materials, the most stringent option shall be selected.

2. Procedure

2.1 Planning Work in a Highway or Road Setting

2.1.1 The Project Manager will prepare an SH&E Plan consistent with *S3AM-209-PR1 Risk Assessment & Management* and include a thorough assessment of all hazards. Priority shall be placed on eliminating the need to place workers on an active roadway, followed by using barriers to physically separate workers from traffic. PPE and other warning devices that do not offer substantial protection from moving vehicles and equipment will be selected and used in combination with more advanced controls.

2.1.2 For work that occurs in the right-of-way (area that includes the traveled way, shoulders, and clear zone) or may otherwise expose workers to the motoring public, a Traffic Control Plan shall be developed and incorporated directly into the SH&E Plan or included as a separate Plan by attachment or reference. This applies to both long and short duration activities in/or adjacent to roadways even when not required by a local jurisdiction.

2.1.3 For work within a worksite that involves the movement of vehicles or equipment, a Traffic Protection Plan shall be developed and incorporated directly into the SH&E Plan by or included as a separate Plan by attachment.

2.1.4 Applicable jurisdictional requirements and guidance as well as industry standards and best practices shall be consulted during plan development and appropriate control measures established. These include the Occupational Health and Safety regulations and associated standards or guidebooks, and local jurisdictional manuals on the uniformity of traffic control devices in temporary construction, maintenance, and utility work zones.

2.1.5 Additional risk-specific plans may be necessary for specialized work. Examples include fall protection, respiratory protection, work over water, confined spaces, hazardous materials/waste, tunneling/blasting, heat/cold stress, excavation, heavy equipment operation, aerial lifts, and hearing conservation.

2.1.6 Emergency response plans specific to roadway emergencies that take into account limited access/egress areas such as bridges will be developed and included in the SH&E Plan. Refer to *S3AM-010-PR1 Emergency Response Planning – Americas*.

2.1.7 A system for checking workers in and out at a worksite and the work zone should be included in the SH&E Plan.

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2.1.8 PPE requirements shall be designated on a task hazard assessment for each task performed on a project (surveying, inspection, environmental, management, equipment operation). Refer to *S3AM-208-PR1 Personal Protective Equipment*.

2.1.9 Where several projects occur simultaneously, the coordination of vehicle routes and communication between contractors shall occur to reduce vehicular struck-by and backing incidents.

2.1.10 A Traffic Control Plan shall be prepared by or reviewed by a Competent Person with credentials, certifications, and experience required by jurisdictional requirements and guidance.

2.1.11 A Traffic Protection Plan shall be prepared by a Competent Person with credentials, certifications, and experience required by jurisdictional requirements and guidance.

- For long-term duration work activities that are performed at construction projects, the constructor of the project is required to develop a Traffic Protection Plan.
- If AECOM has assumed the role of constructor for the project, the Traffic Protection Plan shall be developed and implemented prior to the commencement of work activities at the project.
- If AECOM is not the constructor for the project, the Traffic Protection Plan for the project shall be developed by our client or a constructor designated by the client.
- The Traffic Protection Plan should be reviewed with AECOM employees during orientation to the project.

2.2 Selecting Protective Measures

Protective measures for traffic control and worker protection shall be selected in accordance with work conditions and prevailing requirement of jurisdictional requirements and guidance. Additionally, the Project Manager, Traffic Control Engineer (if applicable), and/or Competent Person shall reduce risk to Roadway Workers by employing the Hierarchy of Controls as described in *S3AM-209-PR1 Risk Assessment & Management*. Below are examples:

- Elimination: Completely eliminate public traffic from the work area and construction traffic. This can occur by locating survey monuments and other data gathering points outside of roadways, utilizing alternative data collection methods, constructing detours and alternate routes, or otherwise isolating the work zone.
- Substitution: Substitute the use of an exposed worker with an alternate method to perform the work such as aerial photography, remote sensing, and remote control such as Automated Flagger Assistance Devices (AFADs).



- Engineering Controls: Use prescribed temporary traffic control devices and layouts to effectively control traffic, through a work zone, permitting public traffic and construction to interact without the use of Flag Persons or other exposed workers. Positive protection, or devices that contain and redirect vehicles preventing their intrusion into the work zone. Please also refer to *S3AM-306-ATT1 Protective Devices for Temporary Traffic Control* and *S3AM-306-ATT2 Short and Long Duration Work Zones*.
- Administrative Controls: Schedule the work at times when traffic volume is low, reducing the exposure to traffic. This may also include requiring workers to perform work in a prescribed way such as facing traffic or using a Spotter. Training and emergency procedures are also considered administrative controls. Please also refer to *S3AM-306-ATT4 Safe Work Practices for Roadway Workers*.

- Personal protective equipment: Traffic vests, safety glasses, and high visibility clothing should always be worn to increase visibility but rarely, if ever, solely relied upon as a protective measure for moving traffic.

3. Responsibilities

3.1 Manager or Supervisor

- Verify development and administration of the procedures, communication methods, and the measures and configuration of the temporary traffic control zone in accordance with specifications for workers, motorists, and pedestrians, and the protection of AECOM employees. Please also refer to *S3AM-306-ATT1 Protective Devices for Temporary Traffic Control*.
- Confirm the SH&E Plan, Traffic Control Plan, and as applicable, the Traffic Protection Plan are developed and communicated to all involved and affected employees.
- Confirm compliance with the SH&E Plan, Traffic Control Plan, Traffic Protection Plan (if applicable), and this procedure.
- Confirm compliance with jurisdictional requirements and guidance governing highway and road work.
- Confirm site-specific or client-required safety training is completed and documented for all assigned Roadway Workers.
- Confirm employees assigned to work zones are trained in safe work practices and the use of traffic control systems, communication systems, and PPE. Please also refer to *S3AM-306-ATT3 Safe Work Practices for Roadway Workers.*
- Lead inspections or investigations, as appropriate.
- Identify the Competent Person and, as applicable, Traffic Control Engineer for the project.

3.2 Flag Person

- Comply with the applicable SH&E Plan, Traffic Control Plan, and Traffic Protection Plan (if applicable), and with communication requirements.
- Maintain training and competency in traffic control and flagging procedures.
- Receive and communicate specific instructions clearly, firmly, and courteously to other Roadway Workers and the public.
- Maintain alertness at their points of duty until relieved. Report to work “Fit-for-Duty” and able to move and maneuver quickly in order to avoid danger from errant vehicles.
- Properly use signaling devices (such as paddles and flags) in order to provide clear and positive guidance to drivers.
- Properly use PPE and communication devices and signals.
- Monitor work area for new and changing conditions and effectively communicate information to other Roadway Workers and Supervisors, including emergency or rapidly changing situations.
- Test and verify emergency procedures within a work zone.

3.3 SH&E Representative/Site Safety Officer

- Assist the Project Manager with implementation of SH&E Plan, Traffic Protection Plan (if applicable), and Traffic Control Plans at the work zone.
- Coordinate safety on the specified project to include traffic and non-traffic hazards.
- Conduct hazard assessments, inspections, and safety observations.

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- Develop mitigating strategies, and review and monitor their implementation.
- Conduct worksite inspections including the use of traffic control devices as required, make recommendations for improvement, and coordinate changes with the Project Manager and, as applicable, the Traffic Control Engineer.
- Coordinate the modification of traffic control devices with the Project Manager and Traffic Control Engineer (if applicable), Flag Person, and Competent Person in order to provide mobility and positive guidance to road users and Roadway Workers.
- Stop work in the event of an unsafe act or condition.

3.4 Spotter

- Comply with the applicable SH&E Plan, Traffic Control Plan, and Traffic Protection Plan (if applicable), and with communication requirements.
- Facilitate the safe movement of equipment and vehicles within and between work zones.
- Spotters are not permitted to act as a Flag Person.
- Monitor surrounding areas for moving vehicles and provide warning to workers.
- Maintain training and competency in spotting procedures.
- Receive and communicate specific instructions clearly, firmly, and courteously to other workers and the public.
- Maintain alertness at their points of duty until relieved. Report to work “Fit-for-Duty” and able to move and maneuver quickly in order to avoid danger from moving vehicles.
- Properly use PPE, and communication devices and signals.
- Maintain a position that is visible to moving equipment and vehicles.
- Monitor work area for new and changing conditions and effectively communicate information to other workers and Supervisors, including emergency or rapidly changing situations.

3.5 Traffic Control Engineer

- Maintain certifications and credentials to perform duties.
- Maintain knowledge on current traffic control devices and methods.
- Perform engineering studies to evaluate best methods for traffic control and protection.
- Develop traffic protection and control strategies consistent with local jurisdiction guidance and requirements.
- Incorporate best practices and more conservative safety measures when they provide increased protection for workers and/or the public.
- Monitor effectiveness of traffic control strategies.

3.6 Competent Person, Traffic Control

- Maintain knowledge and experience in traffic control consistent with the work environment assigned.
- Determine communication methods (hand signals, warning alarms) to be used within a worksite.
- Provide training to workers on communication methods.
- Perform inspections of traffic control devices, make recommendations for improvement, and coordinate changes with the Project Manager and Traffic Control Engineer.
- Stop work in the event of an unsafe act or condition.

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4. Help & Training

- All Roadway Workers shall be trained on how to work next to motor vehicle traffic in a way that eliminates or minimizes their exposure. Refer to *S3AM-003-PR1 SH&E Training* and *S3AM-306-ATT3 Safe Work Practices for Roadway Workers.*
- Individuals that oversee work occurring on highways and roads shall receive appropriate training per jurisdictional requirements and guidance.
- Workers with specific responsibilities and duties (Competent Person, Flag Person, Spotter, Supervisor) shall have additional training, experience, and authorization to perform assigned duties.
- All Roadway Workers shall receive a site-specific orientation to the hazards and controls, including as applicable, Traffic Protection Plan, Traffic Control Plan, and communication requirements for the site(s) to which they are assigned. No personnel shall be allowed onto the site without first reviewing the project-specific Traffic Control Plan and/or Traffic Protection Plan. Additional orientation topics are specified in the SH&E Plan.
- Only persons designated by the Project Manager, with appropriate training and experience will serve as a Flag Person (traffic control). Flag Person training shall comply with jurisdictional requirements and guidance, which may vary between work locations.
- Flag Persons and Spotters shall be instructed by the Competent Person on the specific project Traffic Protection Plan (if applicable) and Traffic Control Plan.
- Flag Persons shall be trained / certified in signaling methods. Training shall comply with jurisdictional requirements and guidance (American Traffic Safety Services Association or equivalent).
- Roadway Workers, Equipment Operators, and Drivers in internal work zones shall be trained to their respective tasks and know the routes of construction vehicles. Where AECOM is not a controlling contractor at the site, training should be provided by the controlling contractor or owner.
- Equipment Operators and Spotters shall know the hand signals to be used, and the communication methods and requirements applicable to the worksite.
- Equipment Operators, Spotters, and Roadway Workers shall be trained on the visibility limits and the "blind spots" for each vehicle on site.
- Roadway Workers shall be trained on the hazards associated with shift work and night work. Please also refer to *S3AM-306-ATT4 Safe Work Practices for Night Work*.

5. Terms and Definitions

a.	Channeling Device	devices to warn road users of conditions created by work activities in or near the roadway and to guide road users. Channelizing devices include cones, tubular markers, vertical panels, drums, barricades, and longitudinal channelizing devices.
b.	Clear Zone	the total roadside border area, starting at the edge of the traveled way that is available for an errant driver to stop or regain control of a vehicle. This area might consist of a shoulder, a recoverable slope, and/or a non-recoverable, traversable slope with a clear run-out area at its toe. See Figure 1.
c.	Competent Person	those who are knowledgeable about the fundamental principles of temporary traffic control and the work activities to be performed, and who have the authority to propose and implement corrective measures to eliminate hazardous situations associated with temporary traffic control.
d.	Flag Person	a person who actively controls the flow of vehicle traffic into and/or through a temporary traffic control zone using hand-signaling devices or an Automated Flagger Assistance Device (AFAD).

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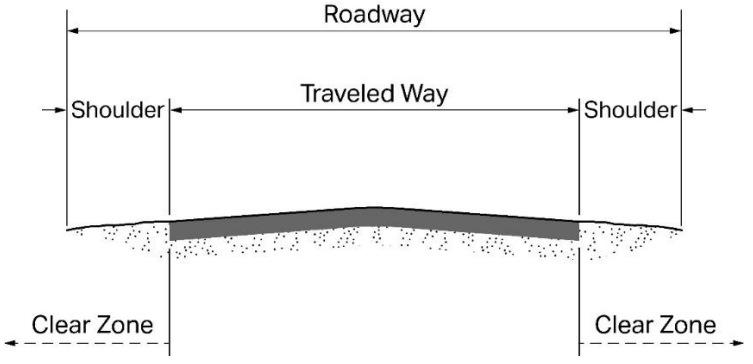
e.	Highway	a general term for denoting a public way for purposes of vehicular travel, including the entire area within the right-of-way.
f.	Personal Protective Equipment (PPE)	safety clothing and equipment worn by workers in traffic areas to provide protection and heightened visibility from physical hazards, including moving vehicles and construction equipment.
g.	Right-of-Way	a general term for denoting the traveled way, and adjacent clear zone, berms, shoulders, and sidewalks that encompass public space potentially impacted by construction, maintenance, or other activities.
h.	Roadway	that portion of a highway improved, designed, or ordinarily used for vehicular travel and parking lanes. Excludes the sidewalk, berm, or areas used solely by persons riding bicycles or other human-powered vehicles. See Figure 1.
i.	Roadway Worker	a person on foot whose duties place him or her within the right-of-way.
j.	Temporary Traffic Control Zone	an area of a highway where road user conditions are changed because of temporary traffic control devices, flag persons, uniformed law enforcement officers, or other authorized personnel.
k.	Temporary Traffic Control Device	a sign, signal, marking, or other device used to regulate, warn, or guide traffic, placed on, over, or adjacent to a street, highway, private road open to public travel, pedestrian facility, or shared-use path by authority of a public agency or official having jurisdiction, or, in the case of a private road open to public travel, by authority of the private owner or private official having jurisdiction.
l.	Traffic Control Engineer	a person who by qualification, experience, and certification is licensed and authorized to perform the duties associated with the design of traffic control systems, including temporary traffic control.
m.	Traffic Protection Plan	a detailed plan for the protection of workers within a work zone. The plan shall contain a written description of the traffic hazards to which workers may be exposed within the confines of a work zone. Traffic Protection Plans are commonly referred to as Internal Traffic Control Plans.
n.	Traffic Control Plan	a detailed plan for the control of traffic (public) during construction, maintenance, or utility operations on a highway/road, taking into account the organized, systematic, safe conduct of the project, including, as applicable, detours, staging sequences, work vehicle access and egress from worksites, temporary barriers, removal of old pavement markings, and selection and planned implementation of appropriate typical layouts for traffic control. Plan shall be written to meet jurisdictional requirements and guidance. Traffic Control Plans are commonly referred to as Traffic Management Plans.
o.	Traveled Way	the portion of the roadway for the movement of vehicles, exclusive of the shoulders, berms, sidewalks, and parking lanes. See Figure 1.
p.	Work Zone	a controlled access area due to the presence of construction, maintenance, or operational activity.

Figure 1. Depiction of Traveled Way, Roadway, Shoulder, Clear Zone



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6. References

List other procedures or external standards/regulations that apply to carrying out the process in this document. List using 'Alpha List' option from the AECOM Procedure List dropdown on the Home tab.

a. S3AM-003-PR1 SH&E Training

b. S3AM-208-PR1 Personal Protective Equipment

c. S3AM-209-PR1 Risk Assessment & Management

d. S3AM-202-PR1 Competent Person Designation

e. S3AM-008-PR1 Fitness for Duty

f. S3AM-008-PR1 Emergency Response Planning – Americas

7. Records

Traffic Protection Plans, Traffic Control Plans, and completed Equipment Checklists shall be maintained in project files.

8. Appendices

a. S3AM-306-FM1 Equipment Checklist

b. S3AM-306-ATT1 Protective Devices for Temporary Traffic Control (TCC)

c. S3AM-306-ATT2 Short and Long Term Work Zones

d. S3AM-306-ATT3 Safe Work Practices for Roadway Workers

e. S3AM-306-ATT4 Safe Work Practices for Night Operations in Work Zones

9. Change Log

List the change history pertaining to this document including if it was identified differently throughout its life-cycle:

Rev #	Change Date	Description of Change	Location of Change
2	Mar 1, 2016	AECOM URS integration of legacy documents	
3	Dec 15, 2016	See Level III Americas Revision Summary - December 15, 2016	Various locations
4	Jul 31, 2019	See Level III Americas Revision Summary – July 31, 2019	Scope & Purpose
5	Nov 13, 2019	Complete rewrite & formatting – tracked changes document on file	Comprehensive changes

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Americas

Highway and Road Work Equipment Checklist

S3AM-306-FM1

Name of Contractor (or N/A): _____ Project Name: _____

Location: _____ Project #: _____

Date: _____ Time: _____ Weather: _____

Person Conducting Inspection _____ Title: _____

*Note: As you conduct your inspection you should be able to answer each question with a **YES**. If the answer to any question is **NO,** this deficiency should be corrected as soon as possible.*

	YES	NO	Deficiency Corrected? OK	N/A
Is an approved traffic control/protection plan on site?	☐	☐	☐	☐
Are accident prevention signs, tags clearly visible?	☐	☐	☐	☐
Are danger signs used where immediate hazards exist?	☐	☐	☐	☐
Are caution signs used to warn against potential hazards or to caution against unsafe practices?	☐	☐	☐	☐
Are exit signs posted at all exit locations?	☐	☐	☐	☐
Are proper visual warning signs posted prior to (in advance of) the work area?	☐	☐	☐	☐
Are flaggers provided with signs, signals, and barricades to provide the necessary protection?	☐	☐	☐	☐
Are flaggers using red lights when signaling during periods of darkness?	☐	☐	☐	☐
Are flaggers wearing highly visible warning garments?	☐	☐	☐	☐
Are the flaggers trained in proper flagging procedures?	☐	☐	☐	☐
Are all workers trained in working in proximity to motor vehicle traffic?	☐	☐	☐	☐
Are warning garments worn at night reflectorized?	☐	☐	☐	☐
Are highly visible flags used by the flaggers at least 18 inches (45 centimeters) square?	☐	☐	☐	☐
Are barricades used to totally obstruct the passage of people and vehicles to protect the work area?	☐	☐	☐	☐
Do barricades meet the requirements set forth in the Manual of Uniform Traffic Control Devices?	☐	☐	☐	☐
Has effectiveness of the traffic control/protection plan been evaluated?	☐	☐	☐	☐

COMMENTS:

Protective Devices for Temporary Traffic Control (TCC)

S3AM-306-ATT1

1. Temporary Traffic Control Devices (TCC) - alphabetical

Protective Device	Common Applications	General Guidance (refer to jurisdictional requirements and guidance for further detail)
Arrow Boards	There are a variety of arrow board application: low-speed urban streets, intermediate speed facilities and for maintenance or mobile operations on high-speed roadways, high-volume motor vehicle traffic control projects, or those intended only for use on vehicles authorized by the state or local agency.	An arrow board should be used in combination with appropriate signs, channelizing devices, or other TTC devices. An arrow board should be placed on the shoulder of the roadway or, if practical, farther from the traveled lane. An arrow board should be delineated with retroreflective TTC devices. When an arrow board is not being used, it should be removed; if not removed, it should be shielded; or if the previous two options are not feasible, it should be delineated with retroreflective TTC devices.
Attenuator Vehicles	Conditions which require or recommend the use of an attenuator vehicle are generally specified in jurisdictional requirements and guidance. Other scenarios (bridge inspections, debris removal) may warrant the use of an attenuator vehicle. Attenuator vehicles are best suited for situations when workers or a hazard are confined to a limited area rather than spread over a longer distance.	It is good construction practice to place an attenuator truck or trailer (minimum) an appropriate distance and immediately in advance of workers in a work zone to protect workers from vehicle intrusions and to warn approaching drivers that the shoulder or traveled lane is occupied by work activities. The attenuator vehicle should be placed a sufficient distance to protect the work zone but avoid creating so much distance that a vehicle can travel around the attenuator vehicle and re-enter the lane ahead of the protected work. The tires should be placed so that if the vehicle is struck, it turns away from workers. Attenuator vehicles shall be equipped with flashing arrows, changeable message signs, and/or high-intensity rotating, flashing, oscillating or strobe lights to warn approaching motorists. Specific requirements for markings may be specified in jurisdictional requirements and guidance.
Automated Flagger Assistance Devices	These devices are designed to be remotely operated either by a single flag person at one end of the temporary traffic control zone or at a central location, or by separate flag persons near each device's location.	Automated Flagger Assistance Devices (AFADs) shall only be used in situations where there is only one lane of approaching traffic in the direction to be controlled.
Channelizing Devices	The function of channelizing devices is to warn road users of conditions created by work activities in or near the roadway and to guide road users. Channelizing devices include cones, tubular markers, vertical panels, drums, barricades, and longitudinal channelizing devices.	Channelizing devices should be placed to provide for smooth and gradual vehicular traffic flow from one lane to another, onto a bypass or detour, or into a narrower traveled way. Channelizing devices should be used to channelize vehicular traffic away from the work space, pavement drop-offs, pedestrian or shared-use paths, or opposing directions of vehicular traffic.

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Protective Device	Common Applications	General Guidance (refer to jurisdictional requirements and guidance for further detail)
		Channelizing devices should be selected and placed in work zones in accordance with jurisdictional requirements and guidance. Devices that are damaged or have lost a significant amount of their retro-reflectivity and effectiveness shall be replaced. Devices should be secured against tipping, particularly by wind generated by moving traffic (or other). Tubular markers are less visible and should only be selected where space restrictions prevent the use of other markers.
Crash Cushions	Crash cushions are systems that mitigate the effects of errant vehicles that strike obstacles either by smoothly decelerating the vehicle to a stop when hit head on or by redirecting the errant vehicle. Crash cushions include concrete barriers, ballast-filled barriers, and moveable concrete barriers, as well as shadow vehicles with truck-mounted attenuators, and vehicle arresting systems that prevent road users from entering a closed section of roadway.	Stationary crash cushions selected for use in a temporary traffic control zone must be crashworthy, designed for the application they are selected, periodically inspected, and promptly repaired or replaced to maintain their effectiveness. Specific information on the use of crash cushions can be found in jurisdictional requirements and guidance.
Flag Person	A flag person is a trained/qualified position used in conjunction with other TTC measures to facilitate the movement of vehicles away from the work zone. Flag persons also monitor the work zone for intrusions and give warnings to workers.	Flag persons shall stand in a safe position, be clearly visible, and have an unobstructed view of approaching traffic. Flag persons must remain visible to other road users. Flag persons shall be positioned a suitable distance away from the work area (a distance permitting vehicles to slow down or stop before reaching the work area). Distances are defined in local jurisdictional requirements and guidance. Flag person stations must be located such that an errant vehicle has additional space to stop without entering the work zone. Flag persons must have an escape route that can be used to avoid an errant vehicle. The Traffic Control Plan should include advanced warning signage notifying drivers of the presence of a flag person. “Flag Person Ahead" (or similar) signs shall be posted in advance of each flag person's station. Such signs shall be removed promptly when the flagging operation terminates. Specification for size, color, and proper use of the “Flag Person Ahead” sign is prescribed in jurisdictional requirements and guidance. Flag persons should use STOP/SLOW signs or paddles. Specification for size, color, and proper use of the STOP/SLOW paddles is prescribed in jurisdictional requirements and guidance. Flag person stations should be illuminated at night. Refer to S3AM306-FM5 Safe Practices for Night Work in Work Zones. Flag persons and others providing temporary traffic control shall wear high visibility retro-reflective clothing in compliance with jurisdiction requirements and guidance.

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Protective Device	Common Applications	General Guidance (refer to jurisdictional requirements and guidance for further detail)
		Class III is typically the minimum requirement for normal conditions. Flag persons shall be provided with sufficient breaks, shade, water, and a rest area away from the roadway. Flag persons shall not be distracted, wear head phones, use a cell phone or mobile device, or engage in multitasking or other conversations while flagging. Flay persons should stand away from other workers, vehicles, and equipment but should be periodically monitored by the site supervisor or site safety officer to assure they are maintaining alertness, taking breaks, and performing duties as prescribed. If railroad tracks are adjacent to the work zone, the flag station should be positioned so that vehicles are stopped in advance of the railroad tracks and the work zone.
Law Enforcement	Local law enforcement agencies can be useful in enforcing and supporting safe work zones, especially in areas where fines for speeding and other traffic violations exist, during nighttime operations, short-term and mobile operations with minimal controls, and around schools and other sensitive locations.	Use of local law enforcement agencies shall be coordinated in advance and frequent meetings shall be held to establish communication procedures.
Portable Changeable Message Signs	Portable changeable message signs have a wide variety of applications in TTC zones, including roadway, lane, or ramp closures; incident management; width restriction information; speed control or reductions; advisories on work scheduling; road user management and diversion; warning of adverse conditions or special events; and other operational control. The primary purpose of portable changeable message signs in TTC zones is to advise the road user of unexpected situations. Portable changeable message signs are particularly useful as they are capable of: A. Conveying complex messages, B. Displaying real time information about conditions ahead, and C. Providing information to assist road users in making decisions prior to the point where actions must be taken.	When portable changeable message signs are used for route diversion, they should be placed far enough in advance of the diversion to allow road users ample opportunity to perform necessary lane changes, to adjust their speed, or to exit the affected highway.
Rolling Closures	A rolling closure is the use of police	In such cases, these very short duration operations can be

Protective Device	Common Applications	General Guidance (refer to jurisdictional requirements and guidance for further detail)
	car(s), crash truck(s), and/or sign truck(s) to control the speed and restrain vehicles upstream of a construction site, so as to create a time window (usually 5 to 15 minutes) when the road downstream of the lead vehicles is effectively clear of vehicles, which creates an unhindered opportunity for workers to do work and/or make traffic control changes at the work site clear of live traffic. Example situations of where rolling closures may be a good method of traffic control include: Changing a lane closure on a freeway from a right lane closure to a left lane closure, or vice versa. Removing large debris from a roadway.	safely and efficiently carried out if traffic is temporarily prevented from entering the work zone. It is the decision of the road authority to use rolling closures. Paid-duty police officers and coordination and approval from local jurisdictions are required for freeway rolling closures due to increased hazard levels to the general public. Other road closures shall be coordinated with the road authority and executed in accordance with jurisdictional requirements and guidance. Prior to initiating a rolling closure, all parties shall have verbal communication to establish procedures, signals, and sequencing of the closure. Communication should be direct and verbal, or otherwise distinguishable from other roadways sounds (horns, sirens, etc.).
Rumble Strips	Transverse rumble strips consist of intermittent, narrow, transverse areas or rough texture or slightly raised or depressed road surface that extends across the travel lane. Transverse rumble strips alert drivers to unusual traffic conditions through noise and vibration. Longitudinal rumble strips alert drivers they are leaving a lane.	Design, placement, and use of rumble strips must be in accordance with jurisdictional requirements and guidance, and with approved Traffic Control Plan.
Shadow Vehicles	Shadow vehicles can be selected to provide greater warning to drivers and protection to the work zone, particularly in short duration scenarios where other TTC devices in use are lightweight/ mobile.	Shadow vehicles without an attenuator can cause increased injuries to the occupants of the shadow vehicle as well as the errant vehicle. Generally, shadow vehicles should be unoccupied when serving as protection from traffic. However, some mobile or short duration activities may require a driver to remain in the vehicle. If a driver remains in the vehicle, the driver's seatbelt and vehicle safety features must be used at all times. When used, shadow vehicles shall be equipment with flashing arrows, changeable message signs, and/or high-intensity rotating, flashing, oscillating, or strobe lights to warn approaching motorists. Specific requirements for markings may be specified in jurisdictional requirements and guidance. Roadway workers must maintain a buffer zone (minimum 50 feet) from shadow vehicles in the event the shadow vehicle is struck. Jurisdictional requirements and guidance for the design specification and use of shadow vehicles shall be followed.

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Protective Device	Common Applications	General Guidance (refer to jurisdictional requirements and guidance for further detail)
Spotters	Spotters shall be used to facilitate the safe movement of equipment and vehicles within a work zone or construction site. Spotters shall be assigned to monitor traffic when a task prevents a worker from effectively monitoring traffic, or when road configuration prevents a worker from having visibility of traffic approaching the work area. Spotters can monitor traffic flow, backing vehicles, pedestrian access/egress, driveways, and parking activity.	Spotters are not to serve as flag persons unless they are trained and designated in a dual role by the project manager and duties are performed separately. Spotters are responsible for maintaining visibility by operators when performing their duties. Spotters must utilize the agreed upon and trained method of communicating (hand signals or other) with operators. Spotters shall not be distracted, wear head phones, use a cell phone or mobile device, or engage in multitasking or other conversations while spotting.
Warning Signs	Warning signs call attention to unexpected conditions on or adjacent to a highway or street and to situations that might not be readily apparent to road users. Warning signs alert road user to conditions that might call for reduction in speed or an action in the interest of safety. Warning signs internal to a construction zone may perform the same/similar function. Additional signage may be used to call attention to designated areas, paths of travel, restrictions, and appropriate use of certain areas.	The use of warning signs shall be selected by the traffic control engineer based on study or engineering judgement. Placement of signs in or near a work zone shall be determined based on driver perception, identification, emotion, and volition time. Generally, this is considered 6 seconds or more for high speed scenarios. Signs should not be placed so far in advanced distance that drivers may forget the warning and fail to respond. The location of driveways, parking, and similar locations between the warning sign and the work area should considered in placing signs and providing warning to potential drivers of parked vehicles. Signage shall be of acceptable standards, in good condition, clean, legible, suited to the purpose, and meeting local legislation requirements. Signage shall be secured or weighted. Routinely inspect signage for placement, cleanliness, and physical damage. Cover road traffic control signage when no activity is present. Provide appropriate instructional signage such as: EVACUATION ROUTE; DO NOT ENTER; REDUCED SPEED AHEAD; ROAD CLOSED; WORKERS AHEAD; and NO OUTLET.

2. Change Log

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DCS Americas

Subcontracting Temporary Traffic Control

S4[DCS]AM-306-ATT1

1. Purpose and Scope

Contractors providing temporary traffic control (TTC) for work in roadways are a critical part of ensuring safety for all workers conducting lane closure activities.

TTC workers have an increased level of risk due to their exposure to active traffic and increasingly unpredictable behavior of drivers. The following requirements and guidelines have been developed to supplement *S3AM-306-PR1 Highway and Road Work* to further address this risk.

2. Requirements and Guidelines

Project Managers shall examine the full hierarchy of controls to determine and verify exposure to live traffic cannot be eliminated through other means (elimination, substitution).

Safety requirements and expectations should be communicated to traffic control contractors through coordination with AECOM Procurement. The Project Manager-prepared scope of work (request for proposal) and the subcontract's terms and conditions must include the following at a minimum:

- TTC contractor should conduct a site visit to develop the site-specific Traffic Control Plan. Positive protection (such as portable, movable, ballast filled barriers, shadow trucks, attenuators) and speed reductions should be included whenever possible, with approval from local jurisdiction.
- Supervisors provided by TTC contractor should have the following qualifications:
  - (2) years' TTC supervisor experience in a non-highway settings and
  - (5) years' TTC supervisor experience in a highway setting
- Workers provided by the TTC contractor should have verifiable training recognized by American Traffic Safety Services Association (ATSSA) or other equivalent certifying organization acceptable for the given jurisdiction.
- If a TTC contractor provides a worker(s) with less than six (6) months experience, the contractor shall assign a safety mentor consistent with AECOM's Newly Hired/Transferred Employee Program (e.g., Green Hat). TTC teams should not exceed one (1) newly hired employee per five (5) team members.
- In advance of work the TTC contractor shall submit risk assessment documents (Task Hazard Assessment) for the following tasks (at a minimum:)
  - TTC scene set up
  - Flagging and directing traffic
  - TTC scene termination and retrieval

AECOM Project Manager shall conduct project safety orientations/kick-off within one (1) week of field work and include a management or supervisory representative from the TCC contractor in the orientation.

- TCC contractor's workers shall be included in each subsequent daily tailgate safety meeting and attendance shall be documented.

AECOM Field Supervisors shall receive advanced training from ATSSA or equivalent certifying organization so they can provide effective spot checks of TCC contractor performance.

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Short and Long Duration Work Zones

S3AM-306-ATT2

1. Short-Term Traffic Protection

Short-term work zones are defined in jurisdictional requirements and guidance. In general, the following categories may apply:

- Mobile operations: move intermittently or continuously, such as litter and debris removal, pothole patching, utility operations.
- Very Short or Short Duration operations: occur for less than 1 hour (some jurisdictions are as low as 30 minutes). Roadside assistance, incident response, surveying, or other data collection may fall into this category.
- Short Duration, stationary: occurs for more than 1 hour (some jurisdictions are as low as 30 minutes) but less than one daylight period. Examples include maintenance and utility operations.

1.1 General

1.1.1 Most guidance allows for less permanent barriers and active devices (such as flashing arrow boards) to be used for short duration or mobile work tasks in order to reduce the amount of time that a worker is exposed to moving traffic.

1.1.2 When calculating the work duration, the time required to set up and take down traffic control should be included.

1.1.3 Personal protective equipment as defined in the SH&E Plan / Task Hazard Assessment (THA) shall be worn.

1.2 Safe Work Practices for Short Duration Work Zones

1.2.1 Consider timing of heaviest traffic flow on the specified roadway, and plan work to avoid roadway impact during high flow events such as morning and evening rush hours; holiday weekends; and notable community events such as fairs, parades, and entertainment venue events.

1.2.2 Minimize time for set-up and removal of traffic control devices:

- Plan the number and placement of devices in advance to assure maximum protection with minimal number of devices.
- Eliminate unnecessary steps from work or identify tasks that can be performed outside the work zone and locate those tasks in a fully protected area.
- Substitute portable signage with vehicle-mounted signs that do not require additional time on the roadside to deploy.
- Use lightweight portable signs.
- Use a work vehicle to place devices.

1.2.3 Unexpected and emergency work:

- Use high-intensity rotating, flashing, oscillating, or strobe lights on appropriately colored or marked vehicles.

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- Arrow panels and portable changeable message signs can be used for advanced notifications and messaging to drivers.
- Law enforcement officers are often available in unexpected or emergency situations to assist with increasing visibility of the work zone.

1.2.4 Mobile operations (continuous movement at slow speeds with some short stops):

- Utilize vehicle-mounted devices (arrow boards, portable changeable message boards).
- Shadow and attenuator vehicles may be utilized to follow the work vehicle, especially in high speed or high-volume situations.

1.2.5 Managing intersections, driveways, and parking:

- Identify potential access points in pre-planning.
- Use flag persons or route diversion where needed to communicate the presence of the work zone.
- Consider law enforcement officers to assist with traffic control in complicated or high traffic flow intersections.
- Coordinate closures with owners/operators in advance of closing.
- Parking lane closures should include the use of channelizing devices in a manner that prevents vehicles from using or departing spaces and provide adequate buffer space for worker protection.

1.2.6 Accommodating non-motorized users and transit:

- Identify non-motorized facility user needs in and near the work area during pre-planning.
- Notify affected agencies.
- Incorporate non-motorized user and transit needs into Traffic Control Plan.
- Use temporary traffic control, including warning devices to alert users of changes and closures.
- Presence of transit facilities (rail) can increase work zone length or require additional flag persons and spotters.

1.2.7 Aerial Lift Trucks and other Work Vehicles:

- Never extend lifts over traffic lanes.
- Lane closures may be required for any lane over which a bucket will be extended.
- Use a shadow truck or attenuator vehicle when aerial lifts or other special purpose equipment is in use.
- Rolling stops, law enforcement, and other supporting jurisdictional services are required.
- Refer to *S3AM-323-Aerial Work Platforms* for further information.

2. Long-Term Traffic Protection

Long-term work zones are defined in jurisdictional requirements and guidance. In general, the following categories may apply:

- Intermediate-term stationary: more than one daylight period, up to 3 days or nighttime work lasting 1 hour.
- Long-term stationary: lasts more than 3 days in one location.

2.1.1 Traffic Control Plans may be extensive and require coordination with the supporting jurisdiction.

2.1.2 Traffic Protection Plans are required to facilitate the safe movement of vehicles and equipment within the work zone. These plans should include:

- Safe access and egress to and from the work zone;
- Location of light stands, generators, cranes, bins, and other supporting features of the work;
- Location of restrooms/handwashing, break areas; and
- Parking.

2.1.3 Temporary Traffic Control devices should be selected so provide maximum separation of work zone from traffic using detours or through positive protection (Portable Concrete Barriers, Movable Concrete Barriers, Ballast-Filled Barriers, Shadow Vehicles, and Vehicle Arrestor Systems, or similar).

2.1.4 Personal protective equipment as defined in the SH&E Plan / Task Hazard Assessment (THA) shall be worn.

2.1.5 For long duration work zones, traffic accommodation shall be provided BEFORE the work starts and shall be maintained until the work is completed.

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Safe Work Practices for Roadway Workers

S3AM-306-ATT3

1. Safe Work Practices

Roadway workers shall abide by the following safe work practices:

- Roadway workers shall be fit-for-duty; refer to *S3AM-008-PR1 –Fitness for Duty*.
- All roadway workers shall be trained on how to work next to motor vehicle traffic in a way that eliminates or minimizes their exposure. Refer to *S3AM-003-PR1 SH&E Training*.
- All SH&E Plans, Traffic Control Plans, Traffic Management Plans (if applicable), and Task Hazard Assessments shall be reviewed and acknowledged by signature by each roadway worker prior to starting work.
- Roadway workers shall work distraction free. Use of cell phones, earphones/ear buds, or headsets or other distractions are prohibited while working within the work zone.
- Photography, videography, note, or measurement taking should be done with the use of a spotter to monitor traffic while engaged in immersive tasks.
- Seatbelts shall be worn, even when work vehicles are parked within a work zone.
- Vehicles should be positioned so that access and egress to and from vehicles are protected from traffic either by barriers or by entering and exiting the vehicle from the non-traffic exposed side of the vehicle.
- Roadway workers should maintain a body position that allows for visual monitoring of traffic; if such a position cannot be achieved or the assigned task prohibits a roadway worker from monitoring traffic, then a spotter(s) should be assigned.
- Crossing active lanes of traffic should be avoided. Crossing active lanes can be avoided by using short duration work zones, rolling closures, and parking in designated parking areas within lane closures.
- If accessing active lanes cannot be avoided due to a necessary work function (such as incident management, debris removal), then a spotter or warning signage to divert traffic should be deployed. Workers that enter lanes as a necessary work function shall be trained and evaluated on a method to assess vehicle speed and other risk factors for this task. Roadway workers shall notify their supervisors, or equivalent, prior to entering lanes and when they return from lanes.
- Roadway workers should maintain a body position that prevents them from being caught between two pieces of equipment, equipment and structures, or other crush points.

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Safe Work Practices for Night Work

S3AM-306-ATT4

1. Safe Work Practices

- Shifting work to nighttime hours could provide an advantage in areas where traditional daytime traffic controls cannot achieve an acceptable balance between worker and public safety and traffic/community impact.
- Night work poses the increased risks of reduced visibility in darkness, potentially higher speeds on roads with fewer vehicles, and more impaired drivers especially on weekends and holidays.
- Night work on roadways should not be done unless there is sufficient justification that safety and community impact can be effectively balanced.
- A records review of impairment-related incidents can be completed to determine the risk level and appropriate levels of protection required.
- Local law enforcement should be used to calm traffic, monitor and enforce speed limits, identify and remove impaired motorists, and improve overall site security.
- Temporary traffic control devices may be larger and have increased reflectivity for night work.
- Spacing can be reduced between channelizing devices to discourage intrusions; in some settings (intersections, ramps), the channelizing device spacing should be reduced to half the normal tangent spacing or less to provide enhanced guidance through these critical areas.
- Reflectivity of surfaces on equipment, signs, and channelizing devices can be increased by adding reflective material.
- Attenuator vehicles and shadow vehicles are good choices for lane closures that occur at night and should be used for middle lane closures that occur at night, on highway, or where high speed traffic is present or possible.
- All reflective surfaces shall be cleaned as required so that the reflectivity of the material is not degraded. Any areas of reflective surface that are damaged or obscured shall be replaced.
- Personnel working at night shall have reflective tape on their hardhats and shall wear retroreflective ensembles that meet the jurisdictional requirements and guidance for night work. Refer to *S3AM-208-PR Personal Protective Equipment* and ANSI/ISEA 107-2015 for selection guidance.
- Additional measures, such as white coveralls, reflective bands, and personal battery-operated strobe lights may be used when practical. All devices should be planned to increase visibility by motorists as well as motorist ability to differentiate a worker from the background.
- Increasing the use of fluorescent materials during dawn or dusk may have a greater protective effect than reflectivity where light sources are low.

2. Illumination

- A lighting plan must be developed for long duration work zones that will have night work to assure proper lighting and support resources are provided.
- Whenever feasible and practical, light plants shall be used to illuminate the work area. Balloon or diffuse lighting portable light towers should be used along highways and where possible to provide glare-free illumination.
- On mobile operations, additional lighting such as spot lights, lights worn by workers and or lights added to equipment may be used to illuminate the work area.
- Lighting for workers on foot and equipment operators is to be at least 5 foot candles (54 Lux) or greater.

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- All equipment shall have working lights and, at a minimum, have working strobe or warning beacon lights.
- All flag persons shall be placed in illuminated areas only.
- All lighting must be checked after setup to confirm that it is not interfering with approaching traffic and other equipment in the work zone and meets the jurisdictional requirements and guidance.

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Heavy Equipment

S3AM-309-PR1

1.0 Purpose and Scope

1.1 Outline the safe working requirements for working with and near heavy equipment and heavy equipment operation.

1.2 Military related vehicles and equipment (e.g. tanks) are not covered under this standard.

1.3 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 **Heavy equipment** –All excavating equipment (e.g. scrapers, loaders, crawler or wheel tractors, excavators, backhoes, bulldozers, graders, agricultural and industrial tractors, etc.), cranes, lift trucks, drills, etc. This may include off-highway trucks (e.g. dump truck, heavy haul truck, etc.). For requirements related to crew trucks refer to *S3AM-005-PR1 Driving*.

2.2 **Operator** – Any person who operates the controls while the heavy equipment is in motion or the engine is running.

2.3 **Ground personnel/workers** – Personnel performing work on the ground around heavy equipment (note: operators are considered ground personnel when outside of the equipment cab).

3.0 References

3.1 S3AM-005-PR1 Driving

3.2 S3AM-202-PR1 Competent Person Designation

3.3 S3AM-213-PR1 Subcontractor Management

3.4 S3AM-303-PR1 Excavation

3.5 S3AM-322-PR1 Overhead Lines

3.6 S3AM-325-PR1 Lockout Tagout

3.7 S3AM-331-PR1 Underground Utilities & Subsurface Installation Clearance

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Managers / Supervisors**

- Responsible for confirming all equipment is in good working order and all equipment operators are verified as qualified on the piece of machinery they are assigned.
- As applicable, review as-built drawings.
- Maintain operation manuals at the site for each piece of equipment that is present on the site and in use.
- Maintain a list of operators for the project, and the specific equipment that they are authorized to operate.
- Prohibit equipment from being operated by any personnel who have not been specifically authorized to operate it.

- Confirm an equipment maintenance inventory is maintained, schedules adhered to and appropriate inspections of equipment are conducted.
- Confirm subcontractors are properly pre-qualified in accordance with *S3AM-213-PR1 Subcontractor Management.*
- Require that subcontractor employees follow established safety procedures in operation, inspection, and maintenance of vehicles and equipment.
- Inform AECOM and subcontractor machinery operators about applicable local regulations restricting the consecutive minutes of engine idling time allowed.
- Confirm subcontractor machinery and mechanized equipment is approved for use in accordance with the requirements of *S3AM-309-FM1 Approval of Machinery & Mechanized Equipment*.
- Confirm that all rented equipment bears any required current certification marks and arrives in proper working order with the manufacturer's operating manual before acceptance from the supplier.
- Confirm that AECOM and subcontractor machinery and mechanized equipment is certified, as applicable, in accordance with manufacturer specifications and/or regulatory requirements.
- Visually observe the subcontractors' vehicles and equipment, for any unsafe conditions or practices. Equipment or operation not in compliance with applicable safety standards is prohibited.

4.1.2 **Employees / Ground Personnel**

- Confirm that all rented equipment arrives in proper working order with the manufacturer's operating manual before acceptance from the supplier.
- Ground personnel when working in the vicinity of heavy equipment shall have received training, and comply with the applicable rules of engagement.

4.1.3 **Operators (of heavy equipment)**

- Operate the equipment safely, maintain full control of the equipment, and comply with manufacturer's operation manual and the laws governing the operation of the equipment.
- Inspect equipment and immediately report defects and conditions affecting the safe operation of the equipment to the appropriate Supervisor.
- Trainees may operate equipment in accordance with jurisdictional requirements and under the direct supervision of a trainer.

4.2 Communication

4.2.1 Communication between site Managers / Supervisors, heavy equipment Operators, and site Employees / Ground Personnel is a key method of preventing serious injury or death during heavy equipment operations.

4.2.2 Managers shall confirm the Industrial site or project specific SH&E Plan is developed and communicated to all affected and involved employees. Refer to *S3AM-209-PR1 Risk Assessment & Management*.

4.2.3 Task Hazard Assessments and Daily Tailgate meetings shall be conducted in accordance with *S3AM-209-PR1 Risk Assessment & Management.*

4.2.4 Concerning worksites in which other employers control concurrent operations and SH&E issues related to the worksite, the manager shall coordinate with those conducting concurrent operations to confirm appropriate control measures are in place to protect employees from the hazards associated with activities to be performed.

- Coordination shall occur prior to work commencing, periodically thereafter, and as necessary given changes in scope and/or working conditions.
- Affected employees (including managers and supervisors) shall seek to participate in all site SH&E meetings related to concurrent operations.

4.2.5 The following points outline the communication requirements during heavy equipment operations:

- Site Supervisors/t Managers shall confirm that all operators are notified/informed of when, where, and how many ground personnel will be working on site.
- Site Supervisors/ Managers shall inform all ground personnel before changes are made in the locations of designated work areas.
- Prior to work initiating on site, the Site Supervisor/ Manager is to confirm all operators and ground personnel are trained on the hand signals that will be used to communicate between operators and ground personnel.
- Ground Personnel working around heavy equipment operations are to maintain eye contact with operators to the greatest extent possible (always face equipment). Never approach equipment from a blind spot or angle.
- All heavy equipment whose backup view can be obstructed shall be equipped with reverse warning devices (e.g., backup alarms) that can be significantly heard over equipment and other background noise. Reverse signaling lights shall be in working order.
- When feasible, two-way radios shall be used to verify the location of nearby ground personnel.
- When an operator cannot adequately survey the working or traveling zone, a signal person shall use a standard set of hand signals to provide directions. Flags or other high visibility devices may be used to highlight these signals.

4.3 Ground Personnel

4.3.1 Ground clearance around heavy equipment may significantly reduce hazards posed during heavy equipment operations.

4.3.2 The following points outline the clearance requirements during heavy equipment operations:

- Ground Personnel shall always yield to heavy equipment.
- Ground Personnel shall maintain a suitable “buffer” area of clearance from all active heavy equipment.
- A task hazard assessment that identifies any special precautions shall be completed and communicated to all AECOM personnel associated with or affected by the activity.
- Site Supervisors/ Managers shall designate areas of heavy equipment operation and confirm that all ground personnel are aware of designated areas.
    - Designated areas shall include work zone boundaries and travel routes for heavy equipment.
    - Travel routes shall be set up to reduce crossing of heavy equipment paths and to keep heavy equipment away from ground personnel.
    - Work zone boundaries shall consider line of fire hazards related to the equipment and associated activities. Refer also to *S3AM-309-ATT2 Operator Line of Sight.*
    - If working near heavy equipment, Ground Personnel shall stay clear of loads to be lifted or suspended loads, and out of the travel and swing areas (excavators, all-terrain forklifts, hoists, etc.) of all heavy equipment.
    - During winch use, all swampers or other personnel will remain outside the “whip area” of the winch line or tow cable.

- At a minimum, employees shall maintain a distance of at least two pile lengths from where piles are being cut and dropped, other than in situations where cut piles are being guided to the ground utilizing mechanical means (e.g., pile driver and shackle) to control the direction and speed of fall of the cut pile.

- When feasible, Site Supervisors/ Managers shall set up physical barriers (e.g., caution tape, orange cones, concrete jersey barriers) around designated areas and confirm that unauthorized ground personnel do not enter such areas.
- Operators shall stop work whenever unauthorized personnel or equipment enter the designated area and only resume when the area has been cleared.
- Operators shall only move equipment when aware of the location of all workers and when the travel path is clear.
- Ground Personnel shall never stand between two pieces of operating heavy equipment or other objects (e.g., steel support beams, trees, buildings, etc.).
- Ground Personnel shall never stand directly below heavy equipment located on higher ground unless it can be verified ground stability is not a factor and grade of slope is such that it would not contribute to equipment tip-over.
- Ground Personnel may only enter the swing area, work area or path of travel of any operating equipment when:
  - They have attracted the operator's attention and established eye contact, and
  - The operator has idled the equipment down, placed it in neutral, grounded engaging tools, set brakes and communicated entry is permitted.
- Employees shall keep all extremities, hair, tools, and loose clothing away from pinch points and other moving parts on heavy equipment.
- Employees shall not talk, text, or otherwise use a cell phone while standing or walking on a roadway or other heavy equipment path.

4.3.3 At a minimum, all Ground Personnel and Operators outside of heavy equipment shall wear the following:

- High visibility safety vest (fluorescent background material and retro-reflective striping) meeting jurisdictional requirements that is visible from all angles.
  - Background material: should be fluorescent yellow-green, fluorescent orange-red or fluorescent red.
  - Combined-performance retro-reflective material (e.g. the stripes): should be fluorescent yellow-green, fluorescent orange-red or fluorescent red - and shall be in contrast (that is, have a distinct color difference) to the background material.
  - Hazards may require high visibility garments that cover torso, legs and arms.
  - Confirm that vest is not faded or covered with outer garments, dirt, etc.
- American National Standards Institute/Canadian Standards Association- (ANSI/CSA-) approved hard hat
- ANSI/CSA-approved safety glasses with side shields
- At a minimum, CSA or ASTM approved, high-cut (min. 6"), puncture, impact and compression resistant footwear.
- ANSI/CSA-approved hearing protection as needed
- Appropriate work clothes (e.g., full-length jeans/trousers and a sleeved shirt; no tank, crew tops or other loose clothing permitted).

4.4 Prior to work commencing

4.4.1 All heavy equipment will be inspected pre-shift and then regularly as required with the details of the inspection recorded in a log book.

- Roll-over protection systems (ROPS) and appropriate overhead protection (Fall Object Protection FOP) shall be in place given the specific equipment requirements. Utilize equipment with enclosed cabs where feasible or accessible.
    - Where use of equipment with enclosed cabs is not feasible or said equipment is not accessible, operators shall use any additional personal protective equipment determined as necessary (e.g. goggles, additional hearing protection, etc.).
- Equipment operated in hazardous atmosphere environments shall be equipped with the proper safety equipment (e.g., spark arrestors, positive air shut off, etc.).
- Operation of equipment that has or had cab glass (per the manufacturer's specifications) that is cracked/broken (obstructing the operator's view) or missing is prohibited.
- A locking device shall be provided that will prevent the accidental separation of towed and towing vehicles on every fifth-wheel mechanism and two-bar arrangement.
- Trip handles for tailgates of dump trucks and heavy equipment shall be arranged so that when dumping, the operator will be in the clear.
- The Operator will report defects and conditions affecting the safe operation of the equipment to the Site Supervisor or employer. Any repair or adjustment necessary for the safe operation of the equipment will be made before the equipment is used.
- Exposed moving parts on heavy equipment (belts, gears, shafts, pulleys, sprockets, spindles, drums, fan belts, flywheels, chains, or other reciprocating, rotating or moving parts) which are a hazard to the operator or to other workers will be guarded.
    - If a part will be exposed for proper function it will be guarded as much as is practicable consistent with the intended function of the component.

4.4.2 An approved 4A40BC fire extinguisher shall be present on all heavy equipment. An approved 4A40BC fire extinguisher of appropriate rating shall be present and readily accessible on all heavy equipment.

- Fire extinguishers shall be inspected by the operator prior to heavy equipment operation each shift. Monthly and annual inspections shall be documented.

4.4.3 All Operators shall inspect the area adjacent to the machine prior to starting.

- Evaluate ground conditions, concurrent operations and obstructions to identify approved routes of travel and work areas.
- As applicable, check that there is sufficient swing room and that the outriggers are adequately supported on solid and stable ground

4.4.4 Managers / Supervisors shall inform the operators of the equipment that AECOM employees are in the area and inquire if there are any restricted areas or specific rules or requirements. In some industrial facilities, heavy equipment has the 'right of way'.

4.4.5 Where the Operator will not have a full view of the path of travel, a signal person will be used on the ground that has a full view of the load, the operator, and the path.

4.4.6 All heavy equipment with limited visibility (operator cannot directly or by mirror or other effective device see immediately behind the machine) operated around workers or on a construction site:

- Shall have an audible back-up alarm installed that functions automatically when the vehicle or equipment is put into rear motion.

- All bi-directional equipment shall be equipped with a horn, distinguishable from the surrounding noise level, which shall be operated as needed when the machine is moving in either direction.
- Backing up or movement in both directions for bidirectional equipment shall occur only when a signal person communicates that it is safe to do so if alarms or horns are not feasible.

4.5 Operation

4.5.1 The Operator of heavy equipment is the only worker permitted to ride the equipment unless the equipment is equipped by the manufacturer for passengers. Manufacturer operator's manual shall be complied with.

4.5.2 A person will not operate heavy equipment unless the person has received adequate instruction and training in the safe use of the equipment, and has demonstrated to a qualified supervisor or instructor competency in operating the equipment.

- Oilers, apprentices, and other operators will not be allowed to operate equipment unless authorized by the Manager.

4.5.3 The Operator of heavy equipment will operate the equipment safely, maintain full control of the equipment, and comply with the manufacturer's operator manual and the laws governing the operation of the equipment.

- Operation of company-owned, leased, or rented vehicles or equipment while under the influence of alcohol or illegal drugs or otherwise impaired is prohibited.
- Do not operate any equipment beyond its safe load or operational limits.
- Operator shall not talk on, text, or otherwise use mobile phones while operating heavy equipment.
- Never use bucket teeth or boom for lifting or moving heavy objects.

4.5.4 When heavy equipment is used for lifting or hoisting or similar operations there shall be a permanently affixed notation stating the safe working load capacity of the equipment and the notation shall be kept legible and clearly visible to the operator.

4.5.5 A Supervisor or Manager will not knowingly operate or permit a worker to operate heavy equipment which is, or could create, an undue hazard to the health or safety of any person. Where compliance is refused, the Manager or his or her designate should be notified immediately.

4.5.6 The Operator of heavy equipment will not leave the controls unattended unless the equipment has been secured against inadvertent movement.

- The Operator is not to leave suspended load, machine or part or extension unattended, unless it has been immobilized and secured against inadvertent movement.
- Turn off heavy equipment, place gear in neutral and set parking brake prior to leaving vehicle unattended.
- Buckets and blades are to be placed on the ground and with hydraulic gears in neutral when not in use.
- Brakes shall be set and, as necessary, wheels chocked or equivalent (as applicable) when not in use.

4.5.7 The Operator will maintain the cab, floor and deck of heavy equipment free of material, tools or other objects which could create a tripping hazard, interfere with the operation of controls, or be a hazard to the operator or other occupants in the event of an accident.

4.5.8 If heavy equipment has seat belts required by law or manufacturer's specifications, the Operator and passengers will use the belts whenever the equipment is in motion, or engaged in an operation which could cause the equipment to become unstable.

- Seat belts shall be maintained in functional condition, and replaced when necessary to ensure proper performance.

4.5.9 All vehicles transporting material or equipment on public roads shall comply with local laws pertaining to weight, height, length, and width. Obtain any permits required for these loads.

4.5.10 Never jump on to or off of a piece of heavy equipment, always maintain 3-points of contact at a minimum.

4.5.11 Never exit heavy equipment while it is in motion.

4.5.12 Do not ride with arms or legs outside of the truck body of equipment cab.

- Never ride on the outside of a piece of heavy equipment (e.g. in a standing position on the body, on running boards, or seated on side fenders, cabs, cab shields, rear of truck bed, on the load, bucket, etc.).

4.5.13 Have vehicle headlights on at all times when driving in the area.

4.5.14 Park motor vehicles off the haul roads, or away from the work areas.

4.5.15 Do not wear loose clothing or jewelry where there is a danger of entanglement in rotating equipment.

4.5.16 Do not enter the swing area of machines such as cranes, heavy drill rigs, or excavators, without first making eye contact with the operator, and receiving permission to do so. Refer to *S3AM-309-ATT2 Operator Line of Sight.*

4.5.17 Stay out of the blind areas around heavy equipment and never assume that the equipment operators have seen you or are aware of your presence.

4.5.18 Maintain a distance of at least 2 feet (60 centimeters) between the counterweight of swing machines and the nearest obstacle. If this distance cannot be maintained, a spotter shall observe and be in constant communication with the operator to prevent contact.

4.5.19 Vibrations from moving traffic or heavy equipment can cause excavations or spoil piles to become unstable.

- Excavation activity shall be conducted according to *SOP S3AM-303-PR1 Excavation*.
- Equipment not involved in the excavating activity or not required to be in the vicinity shall keep clear. Equipment that shall operate in the vicinity shall maintain appropriate setback distances from edges of excavations or spoil piles.

4.5.20 All heavy equipment shall be operated in a safe manner that will not endanger persons or property.

- When ascending or descending grades in excess of 5 percent, loaded equipment shall be driven with the load upgrade.
- When operating an electric-powered, remote controlled, hydraulic device used for demolishing concrete structures and refractory linings as well as excavating, refer to the *S3AM-309-ATT1 Brokk 180* for more specifics.

4.5.21 All heavy equipment shall be operated at safe speeds. Do not drive any vehicle at a speed greater than is reasonable and safe for weather conditions, traffic, intersections, width, and character of the roadway, type of motor vehicles, and any other existing condition.

4.5.22 Always move heavy equipment up and down the face of a slope. Never move equipment across the face of a slope.

4.5.23 Slow down and stay as far away as possible while operating near steep slopes, shoulders, ditches, cuts, or excavations.

4.5.24 When feasible, Operators shall travel with the “load trailing”, if the load obstructs the forward view of the operator.

4.5.25 Slow down and sound horn when approaching a blind curve or intersection. Signal people equipped with 2-way radio communications may be required to adequately control traffic.

4.5.26 All haulage equipment / trucks, whose payload is loaded by means of cranes, power shovels, loaders, or similar equipment, shall have a cable shield and/or canopy adequate to protect the operator from shifting or falling material. If protection is not available for the operator, the operator shall leave the vehicle and wait in a designated safe location until it is loaded..

4.5.27 Equipment shall be shut down prior to and during fueling.

- Confirm proper grounding/ bonding between equipment and fuel vehicle prior to fueling operations.
- During fuel operations confirm fuel nozzle remains in contact with the tank.
- Do not smoke, use electrical devices or have an open flame present while fueling.
- Fuel shall not be carried in or on heavy equipment, except in permanent fuel tanks or approved safety cans.

4.5.28 Site vehicles will be parked in a designated parking location away from heavy equipment.

4.5.29 Operators shall never push/pull “stuck” or “broken-down” equipment unless a spotter determines that the area is cleared of all personnel around and underneath the equipment.

4.5.30 If designated for work in contaminated areas/zones, equipment shall be kept in the exclusion zone until work or the shift has been completed. Equipment will be decontaminated within designated decontamination areas.

4.5.31 Equipment left unattended at night adjacent to travelled roadways shall have appropriate lights or reflectors, or barricades equipped with appropriate lights or reflectors, to identify the location of that equipment, and shall not be closer than 6 feet (1.8m) (or the regulatory requirement for the work location) to the active roadway.

4.5.32 Rubber / pneumatic-tired earthmoving haulage equipment shall be equipped with fenders on all wheels. Mud flaps may be used in lieu of fenders whenever motor vehicle equipment is not designed for fenders.

4.5.33 Lift trucks shall have the rated capacity clearly posted on the vehicle, and the ratings are not to be exceeded.

4.5.34 Steering or spinner knobs shall not be attached to steering wheels.

4.5.35 High-lift rider industrial trucks shall be equipped with overhead guards.

4.5.36 All hot surfaces of equipment, including exhaust pipes or other lines, that present a possible injury or fire hazard, shall be guarded or insulated.

4.5.37 All equipment having a charging skip shall be provided with guards on both sides and open end of the skip area to prevent persons from walking under the skip while it is elevated.

4.5.38 Platforms, foot walks, steps, handholds, guardrails, and toeboards shall be designed, constructed, and installed on machinery and equipment to provide safe footing and access ways.

4.5.39 Substantial overhead protection shall be provided for the operators of fork lifts and similar equipment.

4.5.40 In an effort to reduce air emissions, fuel costs, and run-time hours (that can impact equipment warranty), operators shall limit heavy equipment engine idling to not more than five consecutive minutes. Local regulations at the location of the vehicle operation could require less than five consecutive minutes idling time. The idling limit does not apply to:

- Idling when queuing.
- Idling to verify that the vehicle is in safe operating condition.

- Idling for testing, servicing, repairing or diagnostic purposes.
- Idling necessary to accomplish work for which the vehicle was designed (cranes, man-lifts, forklifts, etc.)
- Idling required to bring equipment/vehicle to operating temperature, as specified by the manufacturer. Engine heaters shall be used for cold weather starting to avoid engine idling where feasible.
- Idling necessary to ensure safe operation of the vehicle.
- Idling to keep equipment (including windows) clear of ice and snow.
- Idling to provide air conditioning or heat to ensure the health and safety of the operator, but only when seated inside the equipment or vehicle.

4.6 Utilities

4.6.1 When contacted by heavy equipment, aboveground and underground utilities may cause severe injuries or death as a result of electrocution, explosion, etc. Refer to the *S3AM-322-PR1 Overhead Lines* procedure for more specifics.

4.6.2 The following outline the requirements while performing heavy equipment operations that may lead to contact with aboveground or underground utilities:

- Always be aware of surrounding utilities.
- Confirm all equipment (e.g., dump trailers, loaders, excavators, etc.) is lowered prior to moving underneath aboveground utilities.
- Confirm utilities are cleared and identified prior to beginning any earthmoving operation. Contact the local utility service providers for clearance prior to performing work. Confirm documentation of the contact is made; date, number; contact name, organization, etc. Refer to *SOP S3AM-303-PR1 Excavation* and *S3AM-331-PR1 Underground Utilities & Subsurface Installation Clearance.*

4.7 Training

4.7.1 The Operator or other qualified supervisor will provide all on-site personnel with an orientation to the heavy equipment and its associated hazards and controls.

4.7.2 Only designated, qualified personnel shall operate heavy equipment.

4.7.3 Operators shall have all appropriate jurisdictional licenses or training to operate a designated piece of heavy equipment.

4.7.4 Operators shall be evaluated through documented experience and routine monitoring of activities unless the equipment is operated by an AECOM operator in which case a practical evaluation is required. Operators shall be knowledgeable and competent in the operation of a designated piece of heavy equipment.

4.8 Inspection and Maintenance

4.8.1 Maintenance records for any service, repair or modification which affects the safe performance of the equipment will be maintained and be reasonably available to the operator and maintenance personnel regulatory agencies upon request during work hours.

4.8.2 Maintenance records will be maintained on the site or project for heavy equipment.

4.8.3 Conduct maintenance as prescribed by the manufacturer in the Operation Manual for each piece of equipment.

4.8.4 Servicing, maintenance and repair of heavy equipment will not be done when the equipment is operating.

- Lockout and tagout safety procedures are followed. Refer to *S3AM-325-PR1 Lockout Tagout*.

- Motors are turned off, unless required for performing maintenance or repair.
- All ground-engaging tools are grounded or securely blocked.
- Controls are set in a neutral position and brakes are set.
- Electrically driven equipment is installed with provision for tagging and locking out the controls while under repair.
- Manufacturer's requirements for maintenance and repair are followed.
- If continued operation is essential to the process, a safe means of protection shall be provided.
- Provide and use a safety tire rack, cage, or equivalent protection when inflating, mounting, or dismounting tires installed on split rims, or rims equipped with locking rings or similar devices.

4.8.5 All heavy equipment shall have a documented inspection and if necessary, repaired prior to use.

- Operators shall not operate heavy equipment that has not been cleared for use.
- All machinery and mechanized equipment will be verified to be in safe operating condition (refer to *S3AM-309-FM1 Approval of Machinery & Mechanized Equipment*) by a competent person (refer to *S3AM-202-PR1 Competent Person Designation*) within seven days prior to operation on a new site or project. Clearance is valid for up to one year for the given site or project.
- As applicable, all machinery and mechanized equipment shall be inspected / certified and tested at appropriate intervals as required by the manufacturer and/or regulatory requirements.

4.8.6 All heavy equipment shall be inspected at a minimum to the manufacturer's recommendations prior to each work shift. All defects shall be reported to the Supervisor/ Manager immediately.

- Defective heavy equipment shall be immediately tagged and taken out of service until repaired.
- Inspection, maintenance, service and repair records shall be maintained at the site. If a manufacturer's or company-specific inspection checklist is not provided, use *S3AM-309-FM2 Heavy Machinery Pre-Operation Checklist*.
- Records shall be made available for review upon request. Note: Documents may be electronically stored in the project files.

4.9 Fueling and batteries

4.9.1 A well-ventilated area shall be used for refueling.

4.9.2 Only the type and quality of fuel recommended by the engine manufacturer shall be used.

4.9.3 Fuel tanks shall not be filled while the engine is running. All electrical switches shall be turned off.

4.9.4 If there is potential to spill fuel on hot surfaces, the surfaces shall be permitted to cool down prior to fueling. Any spillage shall be cleaned before starting engine.

4.9.5 Spilled fuel shall be cleaned with cotton rags or cloths and disposed of in the proper receptacle; do not use wool or metallic cloth.

4.9.6 Open flames, lighted smoking materials, sparking equipment or any other type of ignition source shall remain a minimum of 35' (10.7m) from the fueling area and/or fuel source. This clearance shall be increased if required or conditions warrant.

4.9.7 Heaters in carrier cabs shall be turned off when refueling the carrier or the drill rig.

4.9.8 Portable containers to be filled shall be placed directly on the ground or be properly grounded prior to filling to prevent creation of a static charge. Portable fuel containers shall not be filled completely to allow expansion of the fuel during temperature changes.

4.9.9 Control electrostatic hazards.

- Before activating fuel pump, touch some part of vehicle / equipment to de-energize any static electricity that may be present.
- The fuel nozzle shall be kept in contact with the tank being filled to prevent static sparks from igniting the fuel.
- Fuel containers and transfer hoses shall be kept in contact with a metal surface during travel to prevent build-up of a static charge.

4.9.10 Portable fuel containers shall not travel in the vehicle or carrier cab with personnel.

4.9.11 Batteries shall be serviced in a ventilated area while wearing appropriate Personal Protective Equipment.

4.9.12 When a battery is removed from a vehicle or service unit, the battery shall be disconnected ground post first. Consult the SDS applicable to the battery and/or contents for additional information including; handling, precautions, and first aid measures.

- Spilled battery acid shall be immediately flushed off the skin with a continuous supply of water. Battery storage or maintenance areas shall have readily accessible eye wash stations.
- Should battery acid get into the eyes, the eyes shall be flushed immediately with copious amounts of water and medical attention shall be sought immediately.

4.9.13 When installing a battery, the battery shall be connected ground post last.

4.9.14 When charging a battery, cell caps shall be loosened prior to charging to permit gas to escape.

4.9.15 When charging a battery, the power source shall be turned off to the battery before either connecting or disconnecting charger loads to the battery posts.

4.9.16 To avoid battery explosions, the cells shall be filled with electrolytes. A flashlight (not an open flame) shall be used to check water electrolyte levels. Avoid creating sparks around batteries by shorting across a battery terminal. Lighted smoking materials and flames shall be kept at least a minimum of 35 feet (10.7 meters) away from battery-charging stations.

5.0 Records

5.1 Inspection, maintenance, service and repair records shall be maintained with the equipment.

6.0 Attachments

6.1 S3AM-309-ATT1 Brokk180 Safety Card

6.2 S3AM-309-ATT2 Operator Line of Sight

6.3 S3AM-309-FM1 Approval of Machinery & Mechanized Equipment

6.4 S3AM-309-FM2 Heavy Machinery Pre-Operation Checklist

6.5 S3AM-309-FM3 Rubber Tire Backhoe Operator Skill Evaluation

6.6 S3AM-309-FM4 Scraper Operator Skill Evaluation

6.7 S3AM-309-FM5 Bull Dozer Operator Skill Evaluation

6.8 S3AM-309-FM6 Dump Truck Operator Skill Evaluation

6.9 S3AM-309-FM7 Roller Compactor Operator Skill Evaluation

6.10 S3AM-309-FM8 Front End Loader Operator Skill Evaluation

6.11 S3AM-309-FM9 Grader Operator Skill Evaluation

6.12 S3AM-309-FM 10 Excavator Operator Skill Evaluation

6.13 S3AM-309-FM11 Water Truck Operator Skill Evaluation

6.14 S3AM-309-FM12 Heavy Equipment Maintenance Inventory

6.15 S3AM-309-FM13 Heavy Equipment Inspection Report

Americas

Approval of Machinery and Mechanized Equipment S3AM-309-FM1

1.0 General Guidelines

1.1 Subcontractor equipment shall comply with all applicable legislative requirements, local, State, Federal, Provincial, Territorial for motor vehicles and material handling heavy equipment.

1.2 Approval shall be obtained for all subcontractor machinery and mechanized equipment within seven calendar days of use on the project site.

1.3 As applicable, all machinery and mechanized equipment must be certified and tested at appropriate intervals as required by the manufacturer and/or regulatory requirements.

1.4 Heavy equipment includes, but is not limited to, drill rigs, front-end loaders, backhoes, trackhoes, bulldozers, forklifts, and similar equipment used for the implementation of the project Statement of Work.

2.0 Equipment Safety Inspections

2.1 The following presents general guidelines for certifying equipment is in safe operating condition before activities commence at the site and during site operations. The following guidelines are not meant to be all-inclusive.

2.1.1 All machinery and mechanized equipment will be approved to be in safe operating condition (using the attached form) by a competent individual within seven calendar days in advance of operation on a new site or project. This approval is valid for one year for the given site or project.

2.1.2 Equipment will be inspected on a daily basis by the owner/operator and daily logs will be maintained. All discrepancies shall be corrected prior to placing the equipment in service.

2.1.3 Inspections shall include, but are not limited to, all hydraulic lines and fittings for wear and damage, all cable systems and pull ropes for damage and proper installation, exhaust systems, brake systems, and drill controls, etc.

2.1.4 Drill rigs and related support equipment and vehicles shall be inspected by the driller in charge on a daily basis. These inspections shall be recorded on the Daily Drill Rig Checklist or on equivalent subcontractor forms.

2.1.5 Preventive maintenance shall be conducted for all equipment according to manufacturer recommendations and/or the subcontractor's internal policies, schedules, and equipment Standard Operating Procedures.

2.1.6 Only designated qualified persons shall operate and inspect machinery and mechanized equipment.

2.1.7 The contractor shall maintain records of tests and inspections at the site and shall make the records available upon request of the designated authority; the records shall become part of the official project file.

2.1.8 Equipment found to not be in safe operating condition or to have a deficiency that affects the safe operation of the equipment shall immediately be tagged, taken out of service, and its use prohibited until deficiencies have been corrected to a safe condition.

2.1.9 All equipment shall be kept in the exclusion zone until decontaminated within designated decontamination areas.

2.1.10 Equipment with an obstructed rear view must have an audible alarm that sounds when equipment is moving in reverse.

TO: AECOM

DATE:

FROM:

Project Name: Project Number:

Project Location:

1. This form provides approval of machinery and mechanized equipment to be used on the referenced project for the following work:

Description of equipment work:	
Project site:	
Subcontractor providing equipment: Address:	
Dates (duration) of equipment work:	

2. Inspection and approval of machinery and mechanized equipment, as required by AECOM, has been made within seven calendar days in advance of use on the project site. This approval process shall be repeated for equipment that is used on the project or site for more than one year.

Identification of equipment (make, model, serial no.)		Date of Certification
1		
2		
3		

3. The above listed equipment has been inspected and tested as indicated on this form, and is DECLARED TO BE IN SAFE OPERATING CONDITION BY THE FOLLOWING COMPETENT INDIVIDUAL:

Name		Title
Company		
Signature		Date

4. If there are any questions regarding this certification, please contact the following AECOM representative:

Americas

Heavy Equipment Pre-Operation Checklist

S3AM-309-FM2

Project Name/Location:										**Project #:**					
Equipment # / Name:			**Make/Model:**							**Annual Insp/Cert. Date:**					
Hour meter reading:															
Operator Name/Date															
✓ = Satisfactory; in working order **X** = Unsatisfactory; not in working order/damaged **N/A** = Not Applicable															
Check the following as appropriate	✓	X	N/A	✓	X	N/A	✓	X	N/A	✓	X	N/A	✓	X	N/A
Side Shields/Screens/Grab Handles															
Overhead Guard (ROPS, FOP)															
Horn / Backup Alarm															
Lights															
Gauges / Temperature															
Parking Brake / Service Brakes															
Steering / Controls															
Hydraulic System (full, no leaks)															
Other Fluids (radiator, washer, etc.)															
Blast Shields															
Attachment (bucket, forks, compactor, jib)															
Lift-arm Device															
Tires / Tracks / Treads (visual)															
Seat belt / Operator Seat Bar															
Windows / Mirrors / Wipers															
Exhaust Components															
Fuel System (lines secure/no leaks)															
Electrical Lines															
Fire Extinguisher															
Spark arrestor / Positive air shutoff															
Safety signs															
General condition (exterior clean/intact)															
General condition (interior clean/tidy)															
Quantity of Fuel Added															
Quantity of Oil Added															
Operator Signature															

Comments (including any corrections):

Americas

Rubber Tire Backhoe Operator Skill Evaluation

S3AM-309-FM3

Date _____ Employee Name _____ Evaluator _____

Description:

This equipment is used for primarily for excavation, although it may occasionally be used for other miscellaneous tasks for which crane or stick type equipment is required.

STEPS KEYPOINTS	SATISFACTORY
1) Demonstrated abilities b) Pre-shift inspection check list (*S3AM-309-FM2 Heavy Machinery Pre-Operation Checklist* or equivalent) i) Check equipment for loose bolts, leaks; oil, hydraulic and water ii) Make sure area around the equipment is clear of people and other equipment iii) Check for fire extinguisher iv) Make sure that the following equipment is operational a) Brakes b) Lights c) Back-up alarms d) Hand rails & ladders e) Seat belts f) Tires if applicable g) Glass, wipers h) Gauges, including temperature, oil, and fuel i) Wheel chocks v) Notify supervision of any equipment that is not operational vi) The operator can park a piece of equipment that is unsafe to operate if it poses a danger or hazard to employees or property c) Maintain three points of contact while entering and exiting the equipment	☐ Yes ☐ No
2) Identification of equipment controls	☐ Yes ☐ No
3) Excavating techniques a) Benching, sloping b) Spoil removal from side wall c) Back filling operations d) Aware of surroundings and personnel near the swing radius of boom	☐ Yes ☐ No
4) Can arrange controls and boom for travel	☐ Yes ☐ No
5) Speed in relation to terrain (controlled speed)	☐ Yes ☐ No
6) Stock piling with front end bucket	☐ Yes ☐ No
7) Loading truck bed with bucket	☐ Yes ☐ No
8) Parking and shut down procedures a) Equipment line-up i) Straight line ii) Allow easy access for maintenance and servicing b) Turn off all accessories c) Set all park brakes d) Lower bucket to ground e) Place and position wheel chocks f) Perform a general walk around looking for items for maintenance	☐ Yes ☐ No

Any items checked 'No' require additional training of operator and the skill evaluation to be repeated until the operator successfully achieves a satisfactory status in all skill identified.

Americas

Scraper Operator Skill Evaluation

S3AM-309-FM4

Date _____ Employee Name _____ Evaluator _____

Description:

Drives a tractor to pull a steel bowl-like or box-like scoop (scraper), mounted on wheels, which scrapes up earth and transports it to a designated place; manipulates a series of levers to lower cutting edge of scraper into the ground, to raise cutting edge when scraper is full, to empty scraper

STEPS KEYPOINTS	SATISFACTORY
1. Demonstrated abilities a) Pre-shift inspection check list (*S3AM-309-FM2 Heavy Machinery Pre-Operation Checklist* or equivalent) i) Check equipment for loose bolts and leaks; check oil, air, hydraulic fluids and water ii) Make sure area around the equipment is clear of people and other equipment iii) Check for fire extinguisher iv) Make sure that the following equipment is operational a) Brakes b) Lights c) Back-up alarms d) Hand rails & ladders e) Seat belts f) Tires g) Glass, wipers h) Gauges, including temperature, oil, air and fuel i) Wheel chocks v) Notify supervision of any equipment that is not operational vi) The operator can park a piece of equipment that is unsafe to operate if it poses a danger or hazard to employees or property b) Maintain three points of contact while entering and exiting the equipment	☐ Yes ☐ No
2. Identification of equipment controls	☐ Yes ☐ No
3. Loading techniques a) Use of apron b) Use of cutting edge c) Push loading d) Push/pull loading e) Use of ejector	☐ Yes ☐ No
4. Shifting and hauling	☐ Yes ☐ No
5. Rough cut and fill	☐ Yes ☐ No
6. Spreading material	☐ Yes ☐ No
7. Fine grading	☐ Yes ☐ No
8. Obtaining compaction	☐ Yes ☐ No
9. Parking and shut down procedures a) Equipment line-up i) Straight line ii) Allow easy access for maintenance and servicing b) Turn off all accessories c) Lower apron d) Lower bowl to the ground e) Place and position wheel chocks f) Perform a general walk around looking for maintenance items	☐ Yes ☐ No

Any items checked 'No' require additional training of operator and the skill evaluation to be repeated until the operator successfully achieves a satisfactory status in all skill identified.

Americas

Bull Dozer Operator Skill Evaluation

S3AM-309-FM5

Date _____ Employee Name _____ Evaluator _____

Description:

Operates a large tractor with a concave steel blade or push block mounted in front of the chassis to level, distribute and push earth. This equipment may be used to push earth carrying equipment. A ripper attachment may be used for ripping the earth prior to loading the scraper. Operator regulates height of blade or push block from ground and may help in adjustments to equipment as needed

STEPS KEYPOINTS	SATISFACTORY
1) Demonstrated abilities a) Pre-shift inspection check list (*S3AM-309-FM2 Heavy Machinery Pre-Operation Checklist* or equivalent) i) Check equipment for loose bolts and leaks; check oil, air, hydraulic fluid and water ii) Make sure area around the equipment is clear of people and other equipment iii) Check for fire extinguisher iv) Make sure that the following equipment is operational a) Brakes b) Lights c) Back-up alarms d) Hand rails & ladders e) Seat belts f) Tracks g) Glass, wipers h) Gauges, including temperature, oil, air and fuel i) Audible horn v) Notify supervision of any equipment that is not operational vi) The operator can park a piece of equipment that is unsafe to operate if it poses a danger or hazard to employees or property b) Maintain three points of contact while entering and exiting the equipment	☐ Yes ☐ No
2) Identification of equipment controls	☐ Yes ☐ No
3) Pushing techniques a) Use of push blade b) Loading of push load equipment	☐ Yes ☐ No
4) Use of ripper shanks	☐ Yes ☐ No
5) Rough cut and fill	☐ Yes ☐ No
6) Spreading material	☐ Yes ☐ No
7) Fine grading	☐ Yes ☐ No
8) Obtaining compaction by tracking in material	☐ Yes ☐ No
9) Parking and shut down procedures a) Equipment line-up i) Straight line ii) Allow easy access for maintenance and servicing b) Turn off all accessories c) Lower rippers d) Lower blade to the ground e) Perform a general walk around looking for maintenance items	☐ Yes ☐ No

Any items checked 'No' require additional training of operator and the skill evaluation to be repeated until the operator successfully achieves a satisfactory status in all skill identified.

Americas

Dump Truck Operator Skill Evaluation

S3AM-309-FM6

Date _____ Employee Name _____ Evaluator _____

Description:

Drives a heavy-duty gasoline or diesel-powered truck used in hauling material to fill areas or dump sites. Truck is either tandem rear axle type, or tractor truck, single or tandem axle, pulling a trailer, articulated or fixed axle haul truck. May service and make necessary adjustments for proper operation of equipment.

STEPS KEYPOINTS	SATISFACTORY
1) Demonstrated abilities a) Pre-shift inspection (*S3AM-309-FM2 Heavy Machinery Pre-Operation Checklist* or equivalent) i) Check equipment for loose bolts and leaks; check oil, air, hydraulic fluid and water ii) Make sure area around the equipment is clear of people and other equipment iii) Check for fire extinguisher iv) Make sure that the following equipment is operational (1) Brakes (2) Lights (3) Back-up alarms (4) Hand rails & ladders (5) Seat belts (6) Tires (7) Glass, wipers (8) Gauges, including temperature, oil, air and fuel (9) Wheel chocks v) Notify supervision of any equipment that is not operational vi) The operator can park or side line a piece of equipment that is unsafe to operate if it poses a danger or hazard to employees or property b) Maintain three points of contact while entering and exiting the equipment	☐ Yes ☐ No
2) Identification of equipment controls	☐ Yes ☐ No
3) Truck Weighing a) Tare weights b) Gross Weights	☐ Yes ☐ No
4) Loading Techniques a) Parking into load patterns b) Bed preparation for material c) Remains in cab in loading area and while being loaded	☐ Yes ☐ No
5) Shifting and Hauling	☐ Yes ☐ No
6) Stockpiling	☐ Yes ☐ No
7) Backing with the use of mirrors	☐ Yes ☐ No
8) Dumping/Spreading Material a) Fill material b) Base course material c) Surface materials d) Asphalt e) Lowers truck bed (dump trucks) or dump chutes (belly dumps) f) Follows spotters directions (when applicable)	☐ Yes ☐ No
9) Parking and shut down procedures a) Equipment line-up i) Straight line ii) Allow easy access for maintenance and servicing b) Turn off all accessories c) Use park brake d) Place and position wheel chocks e) Perform a general walk around looking for maintenance items	☐ Yes ☐ No

Any items checked 'No' require additional training of operator and the skill evaluation to be repeated until the operator successfully achieves a satisfactory status in all skill identified.

Americas

Roller / Compactor Operator Skill Evaluation

S3AM-309-FM7

Date _____ Employee Name _____ Evaluator _____

Description:

Operates a self-propelled gasoline or diesel machine, which has pneumatic tires, steel wheels/drums used to compact earth fills, flexible bases and all types of materials. Rollers are also used for compaction to achieve a desired or specified density. Rides on the machine platform and moves lever and pedals or throttles to control and guide machine.

STEPS KEYPOINTS	SATISFACTORY
1) Demonstrated abilities a) Pre-shift inspection check list (*S3AM-309-FM2 Heavy Machinery Pre-Operation Checklist* or equivalent) i) Check equipment for loose bolts and leaks; check oil, air, hydraulic fluid and water ii) Make sure area around the equipment is clear of people and other equipment iii) Check for fire extinguisher iv) Make sure that the following equipment is operational a) Brakes b) Lights c) Back-up alarms d) Hand rails & ladders e) Seat belts f) Tires, if applicable g) Glass, wipers h) Gauges, including temperature, oil, air and fuel i) Wheel chocks v) Notify supervision of any equipment that is not operational vi) The operator can park a piece of equipment that is unsafe to operate if it poses a danger or hazard to employees or property b) Maintain three points of contact while entering and exiting the equipment	☐ Yes ☐ No
2) Identification of equipment controls	☐ Yes ☐ No
3) Rolling techniques to obtain compaction a) Use of controls b) Vibratory controls c) Turns and maneuvers d) Aware of surroundings	☐ Yes ☐ No
4) Rolling patterns a) Staggered patterns with other rollers	☐ Yes ☐ No
5) Parking and shut down procedures a) Equipment line-up i) Straight line ii) Allow easy access for maintenance and servicing b) Turn off all accessories c) Place and position wheel chocks d) Perform a general walk around looking for maintenance items	☐ Yes ☐ No

Any items checked 'No' require additional training of operator and the skill evaluation to be repeated until the operator successfully achieves a satisfactory status in all skill identified.

Americas

Front End Loader Operator Skill Evaluation

S3AM-309-FM8

Date _____ Employee Name _____ Evaluator _____

Description:

Operates rubber tire or crawler type tractor with attached bucket on front end. Moves lever to raise, lower and dump contents of bucket. Machine used to load materials from stockpiles, excavation, loading trucks.

STEPS KEYPOINTS	SATISFACTORY
1) Demonstrated abilities a) Pre-shift inspection check list (*S3AM-309-FM2 Heavy Machinery Pre-Operation Checklist* or equivalent) i) Check equipment for loose bolts and leaks; check oil, air, hydraulic fluid and water ii) Make sure area around the equipment is clear of people and other equipment iii) Check for fire extinguisher iv) Make sure that the following equipment is operational a) Brakes b) Lights c) Back-up alarms d) Hand rails & ladders e) Seat belts f) Tires g) Glass, wipers h) Gauges, including temperature, oil, air and fuel i) Wheel chocks v) Notify supervision of any equipment that is not operational vi) The operator can park a piece of equipment that is unsafe to operate if it poses a danger or hazard to employees or property b) Maintain three points of contact while entering and exiting the equipment	☐ Yes ☐ No
2) Identification of equipment controls	☐ Yes ☐ No
3) Loading techniques a) Use of bucket and controls b) Crowding the pile c) Pump loading, etc. d) Loading patterns e) Loading trucks f) Loading scrapers	☐ Yes ☐ No
4) Control handling of soils	☐ Yes ☐ No
5) Shifting and hauling	☐ Yes ☐ No
6) Stockpiling	☐ Yes ☐ No
7) Mixing and moisture conditioning	☐ Yes ☐ No
8) Feeding crusher	☐ Yes ☐ No
9) Rough cut and fill	☐ Yes ☐ No
10) Spreading material	☐ Yes ☐ No
11) Parking and shut down procedures a) Equipment line-up i) Straight line ii) Allow easy access for maintenance and servicing b) Turn off all accessories c) Lower bucket to the ground d) Place and position wheel chocks e) Perform a general walk around looking for maintenance items	☐ Yes ☐ No

Any items checked 'No' require additional training of operator and the skill evaluation to be repeated until the operator successfully achieves a satisfactory status in all skill identified.

Americas

Grader Operator Skill Evaluation

S3AM-309-FM9

Date _____ Employee Name _____ Evaluator _____

Description:

Rides in cab of grader and moves levers and steering wheel to guide machine and regulate the scraper blade or ripper. Blade is mounted on a carrying and turning circle at the front of the machine. Equipment is used to level or mix soils and aggregates to grade and to lay asphalt and flexible base materials and clean haul roads.

STEPS KEYPOINTS	SATISFACTORY
1) Demonstrated abilities a) Pre-shift inspection check list (*S3AM-309-FM2 Heavy Machinery Pre-Operation Checklist* or equivalent) i) Check equipment for loose bolts and leaks; check oil, air, hydraulic fluid and water ii) Make sure area around the equipment is clear of people and other equipment iii) Check for fire extinguisher iv) Make sure that the following equipment is operational a) Brakes b) Lights c) Back-up alarms d) Hand rails & ladders e) Seat belts f) Tires g) Glass, wipers h) Gauges, including temperature, oil, air and fuel v) Notify supervision of any equipment that is not operational vi) Wheel chocks vii) The operator can park a piece of equipment that is unsafe to operate if it poses a danger or hazard to employees or property b) Maintain three points of contact while entering and exiting the equipment	☐ Yes ☐ No
2) Identification of equipment controls	☐ Yes ☐ No
3) Leveling and scraping techniques a) Use of levers b) Use of cutting edge c) Controlling front wheel tilt d) Controlling crab motion e) Use of ripper	☐ Yes ☐ No
4) Shifting and traveling with loaded moe board	☐ Yes ☐ No
5) Rough cut and fill	☐ Yes ☐ No
6) Spreading material	☐ Yes ☐ No
7) Fine grading	☐ Yes ☐ No
8) Parking and shut down procedures a) Equipment line-up i) Straight line ii) Allow easy access for maintenance and servicing b) Turn off all accessories c) Lower moldboard to the ground d) Place and position wheel chocks e) Perform a general walk around looking for maintenance items	☐ Yes ☐ No

Any items checked 'No' require additional training of operator and the skill evaluation to be repeated until the operator successfully achieves a satisfactory status in all skill identified.

Americas

Excavator Operator Skill Evaluation

S3AM-309-FM10

Date _____ Employee Name _____ Evaluator _____

Description:

Operates a rubber tire or crawler type tractor with an attached bucket on front end. Moves a lever to raise and lower and dump contents of bucket. Machine is used to load materials from stockpiles, excavation, loading trucks.

STEPS KEYPOINTS	SATISFACTORY
1) Demonstrated abilities a) Pre-shift inspection check list (*S3AM-309-FM2 Heavy Machinery Pre-Operation Checklist* or equivalent) i) Check equipment for loose bolts and leaks; check oil, air, hydraulic fluid and water ii) Make sure area around the equipment is clear of people and other equipment iii) Check for fire extinguisher iv) Make sure that the following equipment is operational a) Brakes b) Lights c) Back-up alarms d) Hand rails & ladders e) Seat belts f) Tires g) Glass, wipers h) Gauges, including temperature, oil, air and fuel i) Wheel chocks (for rubber tire type excavators) v) Notify supervision of any equipment that is not operational vi) The operator can park a piece of equipment that is unsafe to operate if it poses a danger or hazard to employees or property b) Maintain three points of contact while entering and exiting the equipment	☐ Yes ☐ No
2) Identification of equipment controls	☐ Yes ☐ No
3) Loading techniques a) Use of bucket and controls b) Crowding the pile c) Pump loading, etc. d) Loading patterns e) Loading trucks f) Loading scrapers	☐ Yes ☐ No
4) Control handling of soils	☐ Yes ☐ No
5) Shifting and hauling	☐ Yes ☐ No
6) Stockpiling	☐ Yes ☐ No
7) Mixing and moisture conditioning	☐ Yes ☐ No
8) Feeding crusher	☐ Yes ☐ No
9) Rough cut and fill	☐ Yes ☐ No
10) Spreading material	☐ Yes ☐ No
11) Parking and shut down procedures a) Equipment line-up i) Straight line ii) Allow easy access for maintenance and servicing b) Turn off all accessories c) Lower bucket to the ground d) Place and position wheel chocks (rubber tire type excavator) e) Perform a general walk around looking for maintenance items	☐ Yes ☐ No

Any items checked 'No' require additional training of operator and the skill evaluation to be repeated until the operator successfully achieves a satisfactory status in all skill identified.

Americas

Water Truck Operator Skill Evaluation

S3AM-309-FM11

Date _____ Employee Name _____ Evaluator _____

Description:

Drives articulated, pull type, single and two axle type water trucks. Waters roads, fills, and cut areas to suppress dust.

STEPS KEYPOINTS	SATISFACTORY
1) Demonstrated abilities a) Pre-shift inspection check list (*S3AM-309-FM2 Heavy Machinery Pre-Operation Checklist* or equivalent or DOT daily inspection if applicable) i) Check equipment for loose bolts and leaks; check oil, air, hydraulic fluid and water ii) Make sure area around the equipment is clear of people and other equipment iii) Check for fire extinguisher iv) Make sure that the following equipment is operational a) Brakes b) Lights c) Back-up alarms d) Hand rails & ladders e) Seat belts f) Tires g) Glass, wipers h) Gauges, including temperature, oil, air and fuel i) Wheel chocks v) Notify supervision of any equipment that is not operational vi) The operator can park a piece of equipment that is unsafe to operate if it poses a danger or hazard to employees or property b) Maintain three points of contact while entering and exiting the equipment	☐ Yes ☐ No
2) Identification of equipment controls	☐ Yes ☐ No
3) Loading Techniques a) Minimizes spillage b) Uses chocks or turns into berm	☐ Yes ☐ No
4) Shifting and Hauling	☐ Yes ☐ No
5) Properly applies water to ramps/corners	☐ Yes ☐ No
6) Backing with the use of mirrors	☐ Yes ☐ No
11) Parking and shut down procedures a) Equipment line-up i) Straight line ii) Allow easy access for maintenance and servicing b) Turn off all accessories c) Use park break d) Place and position wheel chocks e) Perform a general walk around looking for maintenance items	☐ Yes ☐ No

Any items checked 'No' require additional training of operator and the skill evaluation to be repeated until the operator successfully achieves a satisfactory status in all skill identified.

Americas

Heavy Equipment Maintenance Inventory

S3AM-309-FM12

Equipment (*Make, Model, Serial #*)	Equipment Owner	Equipment Status (*On Hire, Active, Decommissioned*)	Frequency of service	Service Type	Manufacturer's Standards	Industry Standards	Legislated Requirements	Location of Equipment

Americas

Heavy Equipment Inspection Report

S3AM-309-FM13

TOOL	DATE	INSPECTED BY	RESULTS	ACTION REQUIRED	ACTION COMPLETED (DATE)

Americas

Brokk 180

S3AM-309-ATT1

1.0 Objective/Overview

1.1 The Brokk 180 is an electric-powered, remote controlled, hydraulic device used for demolishing concrete structures and refractory linings as well as excavating. This machine includes attachments designed exclusively for demolishing work (e.g., grapple, bucket, hydraulic hammer, etc.). By using the remote control unit, an operator can move the machine and attachments in different directions and speeds from afar.

2.0 Potential Hazards



2.1 Flying debris

2.2 Crush/impact/pinch from extendable boom, tracks, and tipping over

2.3 Struck-by

2.4 Electricity (subsurface utilities when excavating)

2.5 Gas lines (subsurface utilities when excavating)

2.6 Noise

3.0 Safe Operating Guidelines

3.1 Prior to use, complete a pre-operation inspection to determine if the unit is in safe working condition.

3.2 Position the unit to safely perform the intended task, then deploy the outriggers to stabilize the unit.

3.3 Confirm that the operator knows what the lifting capacity is; do not exceed the lifting capacity.

3.4 Complete a subsurface utility clearance prior to excavating.

3.5 Operator should define a swing radius area and exclude workers from the area. Establish a minimum 15-foot (4.5-meter) clearance around the unit while operating.

3.6 Do not allow debris to build up around the unit. Maintain good housekeeping practices.

3.7 Prior to removing debris from under the boom, stop, disengage the unit, and position the boom so that the attachment is at rest on the ground.

3.8 Personnel operating the unit with the remote control device will be properly trained and certified by a competent person.

3.9 The operator will be able to maintain line of sight visual contact with the unit at all times to assess hazards and site security.

3.10 Maintenance in excess of preventive maintenance activities (e.g., lubrication, replenishing fluids, etc.) will be performed by manufacturer personnel ONLY.

3.11 All operations will comply with the manufacturer's recommended policies.

4.0 Training Requirements

4.1 Review of applicable Standard Operating Procedures.

4.2 Complete knowledge and understanding of remote control functions.

4.3 Review and follow manufacturers' recommended policies and practices.

5.0 Personal Protective Equipment

5.1 Class II (minimum) American National Standards Institute/Canadian Safety Association Safety Vest

5.2 Hard Hat

5.3 Safety Toe Boots

5.4 Safety glasses with side shields

5.5 Hearing protection (ear plugs and/or ear muffs)

5.6 Leather gloves

6.0 Other Safety Tips

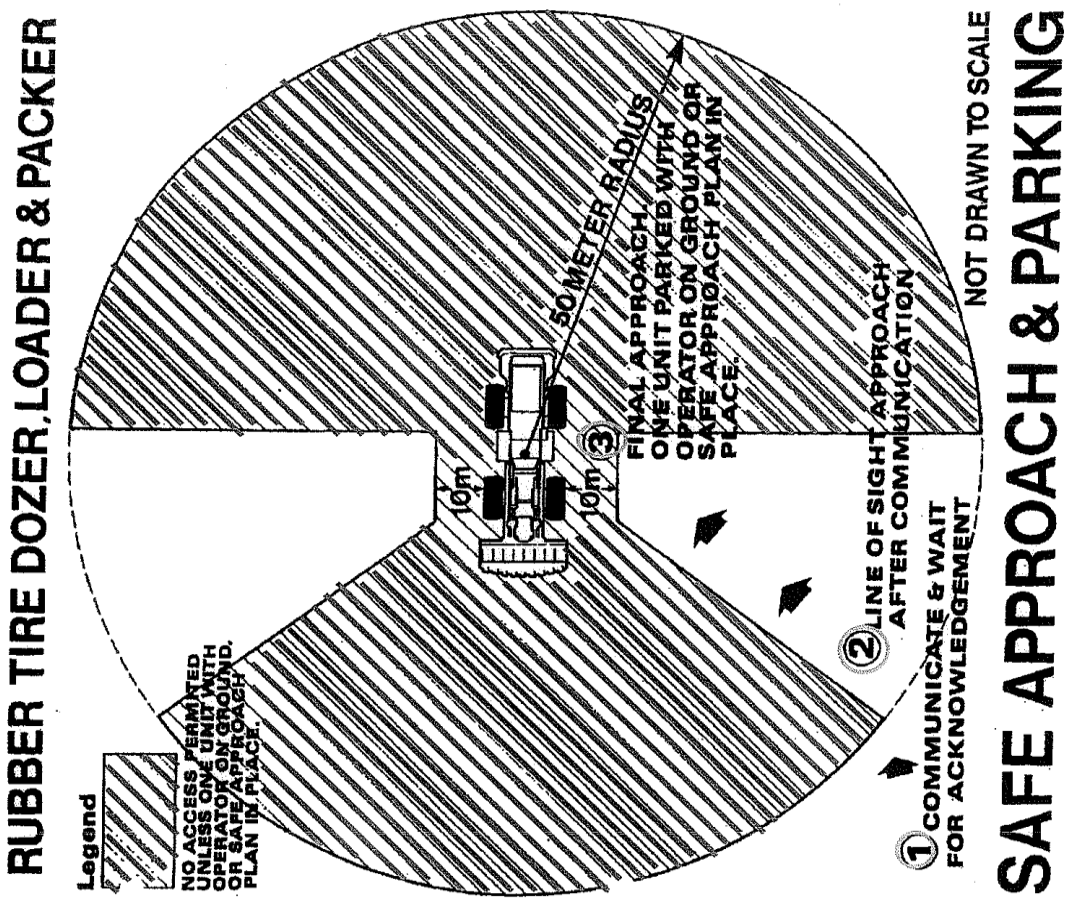
6.1 Never stand under a raised boom.

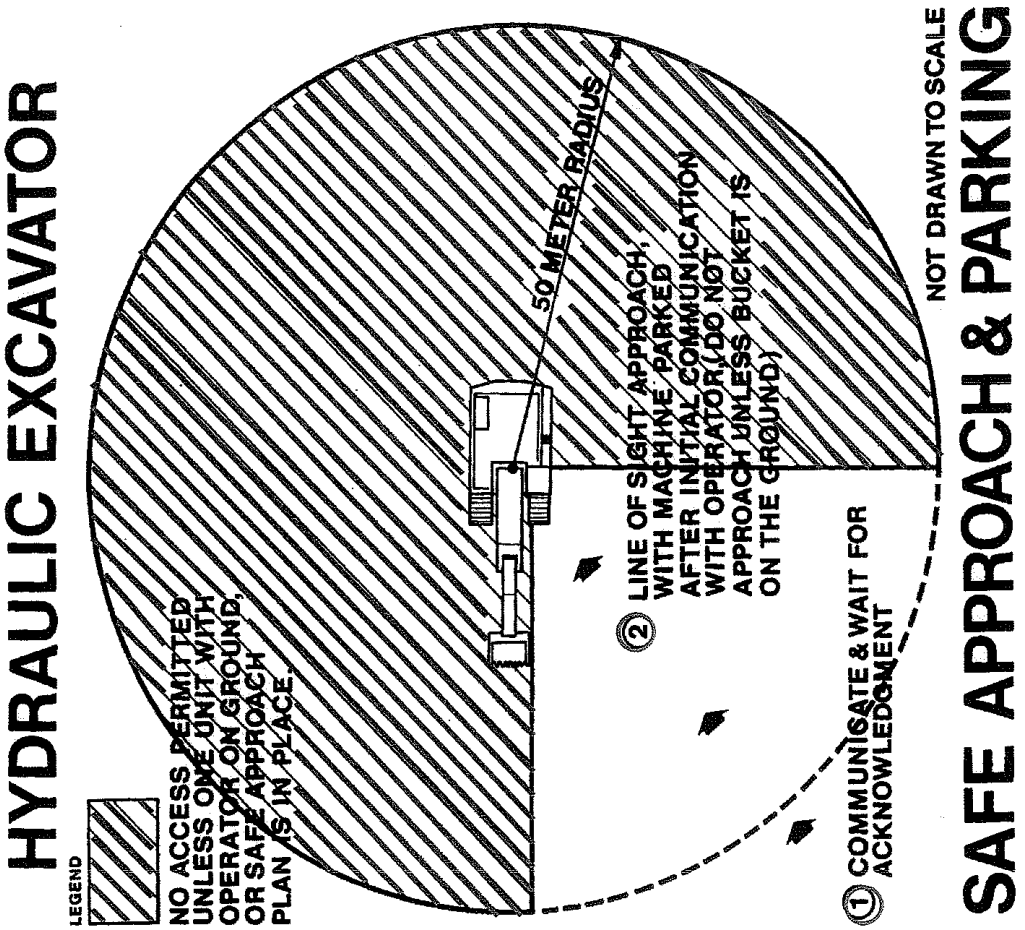
6.2 Pay close attention to power cords for potential tripping hazard and equipment entanglement.

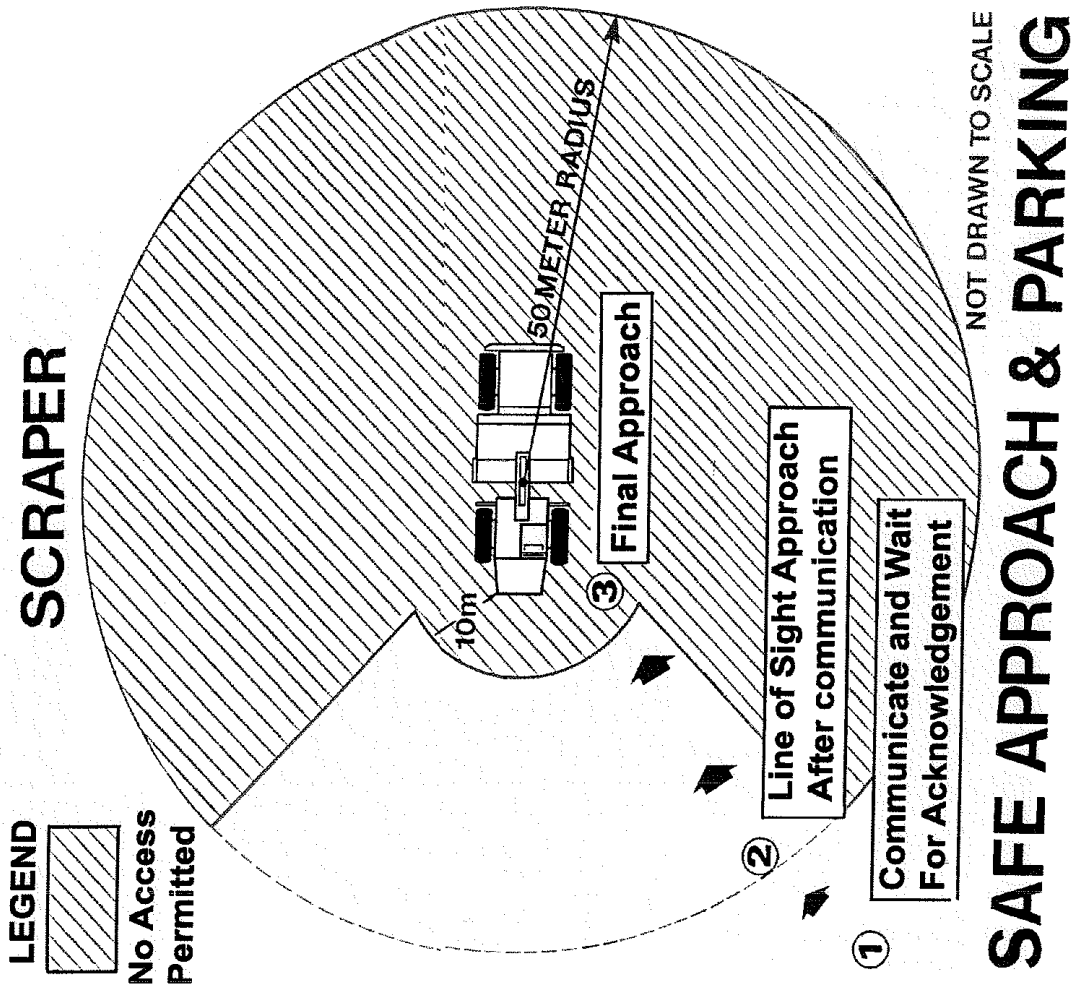
Americas

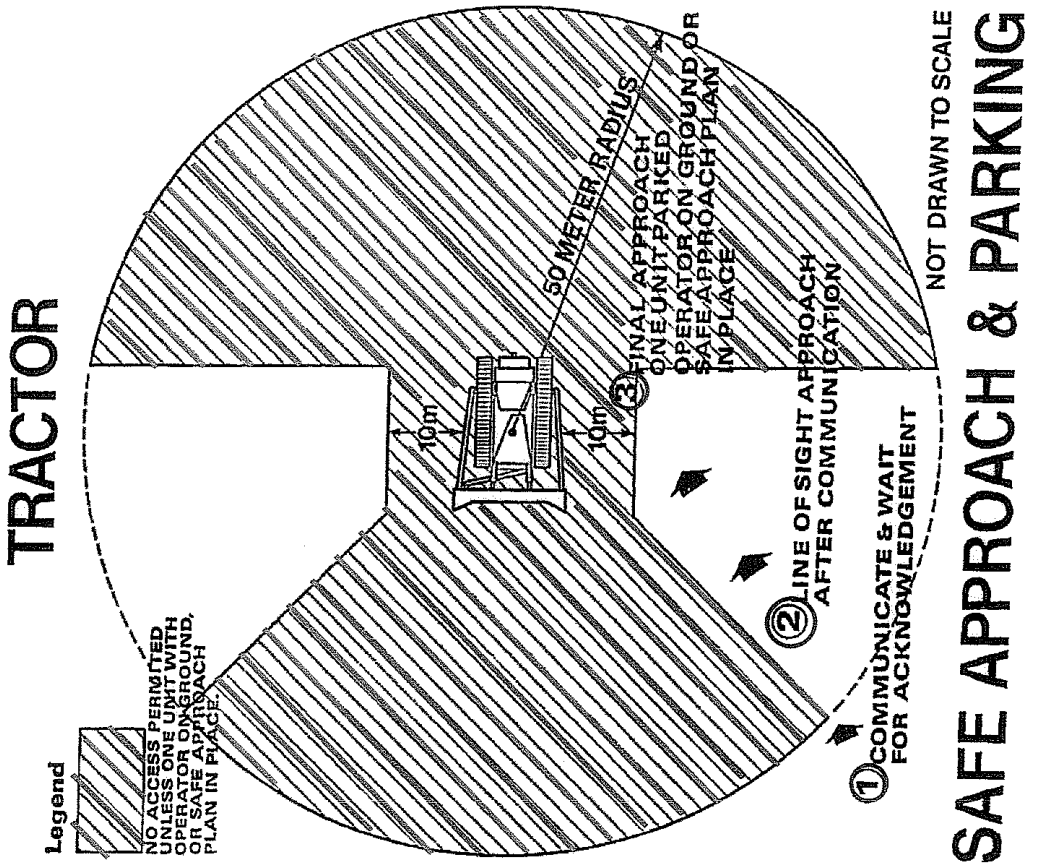
Operator Line of Sight

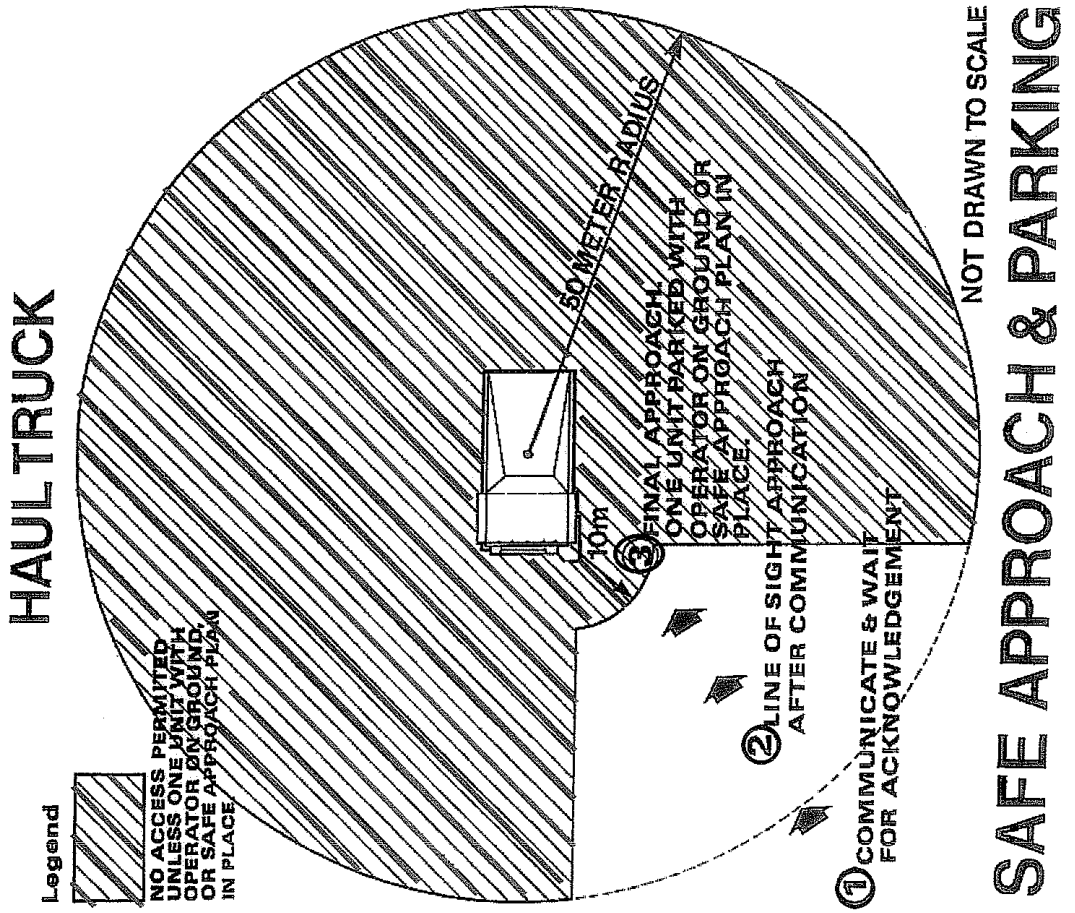
S3AM-309-ATT2

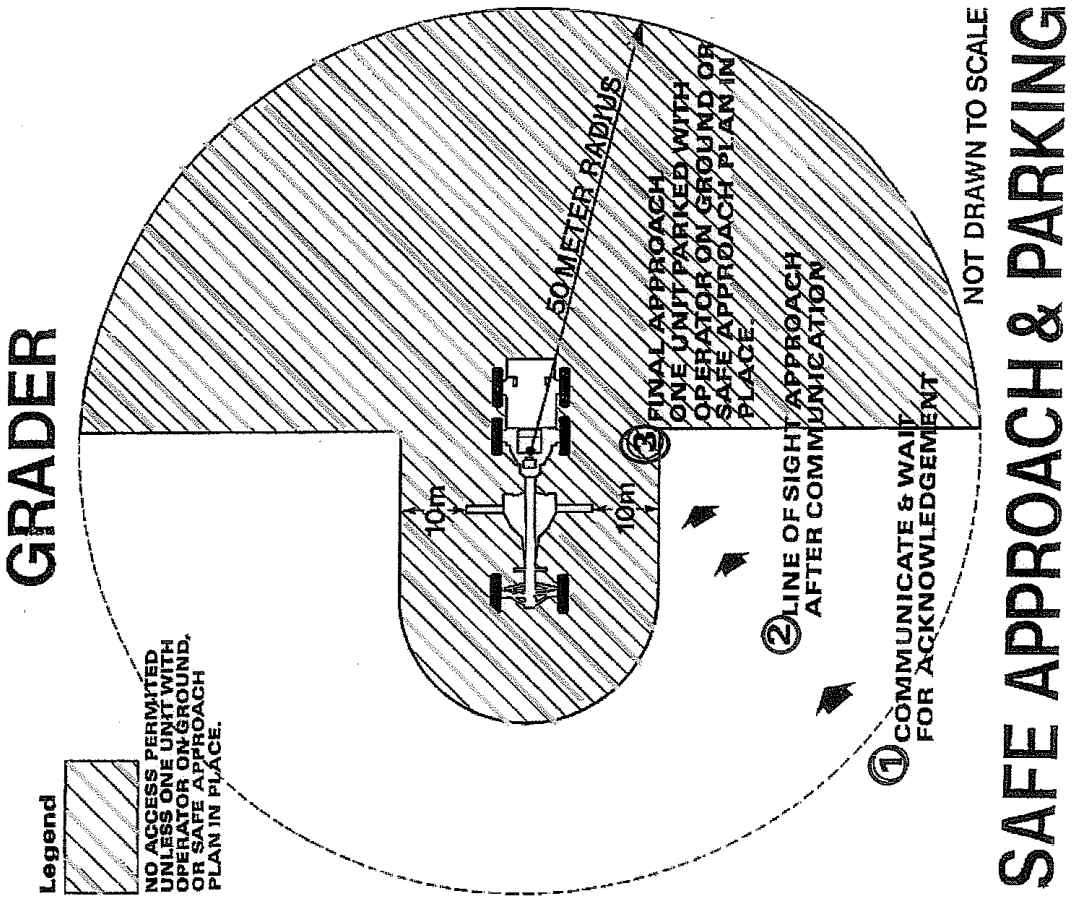



HYDRAULIC EXCAVATOR
LEGEND
NO ACCESS PERMITTED UNLESS ONE UNIT WITH OPERATOR ON GROUND, OR SAFE APPROACH PLAN IS IN PLACE.
50 METER RADIUS
② LINE OF SIGHT APPROACH, WITH MACHINE PARKED AFTER INITIAL COMMUNICATION WITH OPERATOR. DO NOT APPROACH UNLESS BUCKET IS ON THE GROUND.)
① COMMUNICATE & WAIT FOR ACKNOWLEDGMENT
NOT DRAWN TO SCALE
SAFE APPROACH & PARKING


SAFE APPROACH & PARKING
NOT DRAWN TO SCALE
SCRAPER
50 METER RADIUS
10m
1 Communicate and Wait For Acknowledgement
2 Line of Sight Approach After communication
3 Final Approach
LEGEND
No Access Permitted


SAFE APPROACH & PARKING
NOT DRAWN TO SCALE
TRACTOR
50 METER RADIUS
10m
10m
③ FINAL APPROACH ONE UNIT PARKED OPERATOR ON GROUND OR SAFE APPROACH PLAN IN PLACE
② LINE OF SIGHT APPROACH AFTER COMMUNICATION
① COMMUNICATE & WAIT FOR ACKNOWLEDGEMENT
Legend
NO ACCESS PERMITTED UNLESS ONE UNIT WITH OPERATOR ON GROUND, OR SAFE APPROACH PLAN IN PLACE


HAUL TRUCK
Legend
NO ACCESS PERMITTED UNLESS ONE UNIT WITH OPERATOR ON GROUND OR SAFE APPROACH PLAN IN PLACE
50 METER RADIUS
10m
③ FINAL APPROACH, ONE UNIT PARKED WITH OPERATOR ON GROUND OR SAFE APPROACH PLAN IN PLACE.
② LINE OF SIGHT APPROACH AFTER COMMUNICATION
① COMMUNICATE & WAIT FOR ACKNOWLEDGEMENT
NOT DRAWN TO SCALE
SAFE APPROACH & PARKING


SAFE APPROACH & PARKING
NOT DRAWN TO SCALE
GRADER
50 METER RADIUS
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③ FINAL APPROACH ONE UNIT PARKED WITH OPERATOR ON GROUND OR SAFE APPROACH PLAN IN PLACE
② LINE OF SIGHT APPROACH AFTER COMMUNICATION
① COMMUNICATE & WAIT FOR ACKNOWLEDGEMENT
Legend
NO ACCESS PERMITTED UNLESS ONE UNIT WITH OPERATOR ON GROUND, OR SAFE APPROACH PLAN IN PLACE.

SAFE APPROACH & PARKING

Americas

Wildlife, Plants & Insects

S3AM-313-PR1

1.0 Purpose and Scope

1.1 Communicates the requirements and precautions to be taken by AECOM employees to protect against the biological hazards associated with insects, arachnids, snakes, poisonous plants, and other animals referred to herein collectively as “biological hazards”.

1.2 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document’s content.

2.0 Terms and Definitions

2.1 **Field Work –** Any activity conducted at a site that contains brush, overgrown grass, leaf litter, poisonous plants, or is located near mosquito breeding areas and includes work in structures where animals might exist that harbor fleas or ticks or where spiders and mites could be present. Field work includes, but is not limited to, Phase I, Phase II, Operations Monitoring & Maintenance, biological surveys, and other work that meets the definition of field work.

2.2 **Poisonous** – Capable of harming or killing by or as if by poison; toxic or venomous.

2.3 **Phase I Environmental Site Assessment –** Investigation of real property to determine the possibility of contamination, based on visual observation and property history, but no physical testing. Under new Environmental Protection Agency regulations that went into effect on November 1, 2006, a Phase I, as it is called for short, will be mandatory for all investors who wish to take advantage of Comprehensive Environmental Response, Compensation, and Liability Act defenses that will shield them from liability for future cleanup, should that prove necessary. The new Phase I rules, called “All Appropriate Inquiry” or AAI, also require more investigation than previously mandated. Investors can expect to see dramatic price increases over prior experiences.

2.4 **Phase II Environmental Site Assessment** – Investigation of real property through physical samplings and analyses to determine the nature and extent of contamination and, if indicated, a description of the recommended remediation method.

3.0 References

3.1 RS2-001-PR1 Firearms Standard

3.2 S3AM-004-PR1 Incident Reporting, Notifications & Investigation

3.3 S3AM-008-PR1 Fitness for Duty

3.4 S3AM-113-PR1 Heat Stress

3.5 S3AM-208-PR1 Personal Protective Equipment

3.6 S3AM-209-PR1 Risk Assessment & Management

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Managers / Supervisors**

- Responsible for managing field work.

- Work with employees to see that a Task Hazard Analysis (THA) for the work to be conducted has been performed prior to the beginning of the field work and that it includes an assessment of potential biological hazards.
- Implement control measures at the location to reduce the potential for employees to be exposed to injuries and illnesses from biological hazards while working.
- If the exposures cannot be eliminated or managed with engineering controls, approve the use and cost of Personal Protective Equipment (PPE) and protective repellents and lotions and confirm that exposed employees have and use these products.

4.1.2 **SH&E Manager**

- Confirm training and guidance is provided to employees consistent with this procedure.
- During the performance of site visits, assess the precautions being taken against biological hazards for compliance with this procedure.
- Assist AECOM personnel in identifying hazards and selecting appropriate control measures.
- As applicable, review and approve relevant SH&E Plans for locations that have biological hazards.

4.1.3 **Employees**

- Participate in required training related this procedure.
- Participate in the development of THAs for the task, identify control measures to limit exposure and request PPE, repellents, and protective lotions identified by this procedure.
- Update the applicable THA when a new, unaccounted for biological hazard is identified. Employee shall stop work to identify appropriate elimination or control measures (and obtain any necessary guidance) before continuing work.
- Obtain approval from Managers and/or Supervisors to purchase selected PPE prior to purchasing.
- Implement the precautions appropriate to prevent exposure to the hazardous wildlife, insects and plants.
- Observe requirements for reporting (e.g. tick bites, skin irritations, etc.) as detailed within the procedure and attachments.

4.2 Training

4.2.1 Employees shall be trained to recognize organisms that represent a threat in the regions in which they work – experienced field staff shall provide on the job training to assist staff with hazard recognition.

4.2.2 Employees shall be properly trained to the anticipated tasks and the associated required PPE.

4.3 Overview

4.3.1 The procedures discussed below are detailed because these hazards have historically posed the most significant risk to AECOM employees. Note that this discussion is not a fully encompassing list of hazards. As part of the SH&E Plan and THA developed by the AECOM personnel, in accordance with *S3AM-209-PR1 Risk Assessment & Management*, additional consideration shall be given to other biological hazards.

4.3.2 Departments of Public Health local to the worksite, as well as the Centers for Disease Control (CDC) can serve as a resource for identifying biological hazards not discussed in this procedure.

4.3.3 If additional biological hazards are identified, employees should stop work and contact the SH&E Manager to discuss the hazards and identify effective control measures. Those control measures shall be implemented at the location prior to restarting work.

4.4 Employee Sensitivity

4.4.1 Sensitivity to toxins generated by plants, insects and animals varies according to dosage and the ability of the victim to process the toxin; therefore, it is difficult to predict whether a reaction will occur, or how severe the reaction will be. Employees should be aware that there are a large number of organisms capable of causing serious irritations and allergic reactions. Some reactions will only erupt if a secondary exposure to sunlight occurs. Depending on the severity of the reaction, the result can be severe scarring, blindness or even death.

4.4.2 Employees also need to consider whether they are sensitive to the use of insect repellents.

4.5 Planning and Hazard Assessment

4.5.1 AECOM personnel shall confirm that the potential for exposure to specific biological hazards are assessed prior to the commencement of work and that the procedures specified by this procedure are integrated into the THA planning process and conveyed to employees conducting the field work. This information shall be communicated in the location-specific SH&E plan, the THA, pre-project kickoff meetings, and tailgate meetings at the location.

4.5.2 It is important to note that the precautions to be taken by employees to decrease the risk of exposure to biological hazards can directly increase the risk of heat-related illness due to thermal stresses. Therefore, heat stress monitoring and precautions shall be included as a critical component of the task-specific THA in accordance with *S3AM-511-PR1 Heat Stress.*

4.5.3 During the preparation of the location-specific SH&E plan and task specific THA, Managers, Supervisors, and employees shall determine what biological hazards might be encountered during the task or operations and shall prescribe the precautions to be taken to reduce the potential for exposure and the severity of resulting illnesses. Consideration will be given to conditions such as weather, proximity to breeding areas, host animals, and published information discussing the presence of the hazards.

4.5.4 It should be assumed that at least one of the biological hazards exists whenever working on undeveloped property. This can include insect activity any time that local temperatures exceed 40 degrees Fahrenheit (4.5 degrees Celsius) for a period of more than 24 hours. The stubble and roots of poisonous plants can be a hazard any time of year, including when some plants are dormant or mown.

4.5.5 The hazard assessments shall also consider the additional hazards posed by vegetative clearing such as the increased risk of coming in contact with poison ivy, oak or sumac and hazards associated with the use of tools and equipment to remove vegetation.

4.5.6 Employees in the field where biological hazards exist shall not enter the hazard areas unless they are wearing the appropriate protective clothing, repellents, and barrier creams specified below. If the hazard is recognized in the field but was not adequately assessed during the THA, the field staff shall stop work and not proceed until the THA has been amended and approved and protective measures implemented.

4.5.7 Employees who have severe allergic reactions are strongly recommended to notify their Manager, field Supervisor and co-workers of the potential for a reaction and demonstrate what medication they might need, where they keep it and how it is administered.

4.5.8 A decision flow chart and table for determining the potential for biological hazards in the Americas has been provided in *S3AM-313-ATT1 Biological Hazard Assessment Flow Chart.*

4.5.9 Restrictions:

- No firearms or weapons are allowed to be used without express permission by the Region Executive and Chief Resilience Officer, refer to the *RS2-001-PR1 Firearms Standard*.
- No weapons related work shall occur without an assessment that includes appropriate hazard control measures and training.

- Staff with life-threatening reactions shall not undertake work in areas infested with the allergen (e.g., wasps, poison ivy), unless precautions are met which satisfy a medical practitioner's requirements. Refer to *S3AM-008-PR1 Fitness for Duty*.

4.5.10 Precautions

- Be aware of the potential irritants in your area and know how to recognize them.
- Modify activities to avoid encounters (diurnal rhythms, seasonal rhythms).
- Avoid wearing perfume and cologne and strong smelling deodorants, lotions, soaps, and shampoos.
- When working in areas where there may be small insects that "hitchhike" (e.g., ticks, spiders, scorpions), it is recommended that clothes are turned inside out and shaken at the end of day; do not wear same clothes two days in a row.
- Staff should always be aware of where they are placing their hands, or where they are sitting in order to avoid contact with potential toxins. Avoid reaching into areas where visibility is limited.

4.6 Wildlife Hazards (Wild Animals, Reptiles and Birds)

4.6.1 Employees shall not work alone in areas where the risk of an encounter with dangerous wildlife is high. Wildlife handling shall only be completed under direct supervision of an experienced individual. Refer to the following work instructions for more specifics:

- *S3AM-313-ATT13 Alligators*
- *S3AM-313-ATT9 Large Carnivores & Ungulates*
- *S3AM-313-ATT10 Bear Safety*
- *S3AM-313-ATT11 Small Mammals*
- *S3AM-313-ATT12 Snakes & Scorpions*

4.7 Ticks, Spiders and other Insects

4.7.1 Insects for which precautionary measures should be taken include but are not limited to: mosquitoes (potential carriers of disease aside from dermatitis), black flies, wasps, bees, ticks, fire ants and European fire ants.

4.7.2 Employees with known allergies to insect stings should consult their personal physician for advice on any immediate medications that they should carry with them. Epi-pens[1] shall be carried at all times in the field by employees who are aware that anaphylactic shock is a possibility for them AECOM highly recommends that employees with known allergies inform their co-workers of the allergy and the location of the medications they might carry for the allergy.

4.7.3 Habitat Avoidance, Elimination and/or Control

- The most effective method to manage worker safety and health is to eliminate, avoid and/or control hazards. Clearing the location of brush, high grass and foliage reduces the potential for exposure to biological hazards. Clearing will not eliminate the exposure to flying insects and there might be an increased exposure to ticks and spiders during the clearing process.
- Projects such as subsurface environmental assessment or remediation are often candidates for brush and overgrown grass to be cleared. In these instances, the Manager shall either request that the client eliminate vegetation, or request approval from the client to have vegetation clearing added to the scope of work.
    - It should be noted that vegetation clearance may unintentionally serve to spread noxious and poisonous plant materials around the site.

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[1] Epi-pens must be prescribed by a personal physician. Renew epi-pens on a regular schedule to ensure effectiveness and make sure your field companions know where it is and how to use it if you cannot self-administer the dose.

- As applicable, measures should be taken to prevent spread, such as but not limited to, confirming equipment and materials are not placed on affected areas, and equipment is decontaminated after use and before removal from site.

- When work shall be conducted in areas that cannot or may not be cleared of foliage, personal precautions and protective measures shall be prescribed.
- Mosquitoes breed in stagnant water and typically only travel a quarter mile (less than half a kilometer) from their breeding site. Whenever possible, stagnant water should be drained to eliminate breeding areas. Managers and client site managers should be contacted to determine whether water can be drained and the most appropriate method for draining containers, containment areas, and other objects of standing water.
- If water cannot be drained, products similar to Mosquito Dunks® can be placed in the water to control mosquitoes. Once wet, the Mosquito Dunks® kill the immature, aquatic stage of the mosquito. The active ingredient is a beneficial organism that is lethal to mosquito larvae, but harmless to fish, humans, and other animals. Mosquito Dunks® provide long-term protection for 30 days or more.

4.7.4 Ticks

- Ticks can be encountered when walking in tall grass or shrubs. They crawl up clothing searching for exposed skin where they will attach themselves. The most serious concern is a possibility of contracting a disease.
- Data from the CDC indicates that tick-borne diseases have become increasingly prevalent. At the same time, tick repellents have become both safe and effective so it is possible to prevent the vast majority of bites and, therefore, most related illnesses. The use of permethrin is strongly advised.
- The most common and severe tick-borne illnesses in the U.S. are Lyme disease, Ehrlichiosis, and Rocky Mountain spotted fever. A summary table listing CDC informational resources for these diseases is provided in *S3AM-313-ATT2 Ticks* along with a listing of CDC information resources and maps showing the distribution of common tick-borne diseases in the U.S.
- When working in areas where ticks may occur, it is recommended that clothes are turned inside out and shaken at the end of day; do not wear the same clothes two days in a row.
- Employees should conduct a thorough full body tick check upon exiting the field. Shower within two hours of coming indoors to help wash away loose ticks. Clothes should be laundered in hot water or tumble dry clothes in a dryer on high heat for 10 minutes to kill ticks.
- To remove ticks that are embedded in skin, utilize a tick key. Alternatively use tweezers or fingers to carefully grasp the tick as close to the skin as possible and pull slowly upward, avoiding twisting or crushing the tick. Do not try to burn or smother the tick. Cleanse the bite area with soap and water, alcohol, or household antiseptic. Note the date and location of the bite and save the tick in a secure container such as an empty pill vial or film canister. A bit of moistened paper towel placed inside the container will keep ticks from drying out. Follow AECOM incident reporting guidelines to report the tick bite within 4 hours and notify the Manager or Supervisor.
- Familiarize yourself with the characteristic bulls-eye pattern of Lyme disease infection surrounding the bite. If you notice this type of pattern or rash resulting from a tick bite, immediately report the issue to your supervisor and follow the incident reporting requirements for your business group.
- If you experience symptoms such as fever, headache, fatigue, and a skin rash, you should immediately visit a medical practitioner as Lyme disease is treated easily with antibiotics in the early stages, but can spread to the heart, joints, and nervous system if left untreated.

4.7.5 Chiggers

- Chiggers are mite larvae, approximately ½ millimeter in size, and typically invisible to the naked eye. While chiggers are not known to carry infectious diseases, their bites and resulting rashes and itching can lead to dermatitis and a secondary infection.
- Chiggers are typically active from the last hard freeze in the winter or spring to the first hard freeze. They are active all year in the Gulf Coast and tropical areas.

4.7.6 Spiders

- Spiders can be found in derelict buildings, sheltered areas, basements, storage areas, well heads and even on open ground. Spiders can be found year round in sheltered areas and are often present in well heads and valve boxes.
- Most spider bites produce wounds with localized inflammation and swelling. The Black Widow and Brown Recluse spiders in the U.S. and others outside the U.S. inject a toxin that causes extensive tissue damage and intense pain.
- Additional information on spider identification can be found in attachment *S3AM-313-ATT3 Poisonous Spider Identification*.

4.7.7 Mosquitoes

- When a mosquito bites, it injects an enzyme that breaks down blood capillaries and acts as an anticoagulant. The enzymes induce an immune response in the host that results in itching and local inflammation. The tendency to scratch the bite sites can lead to secondary infections.
- CDC data indicates that mosquito-borne illnesses, including the strains of encephalitis, are a health risk. At least one of the Encephalitis strains listed below is known to exist in every area of the U.S. and in many other countries as well:
    - Eastern Equine encephalitis
    - Western Equine encephalitis
    - West Nile Virus
    - St. Louis encephalitis
    - La Crosse encephalitis
- Mosquitoes can transmit the West Nile Virus and other forms of encephalitis after becoming infected by feeding on the blood of birds which carry the virus.
- Most people infected with the virus experience no symptoms or they have flu-like symptoms. Sometimes though, the virus can cause severe illness, resulting in hospitalization and even death, so proper precautions should be taken. Consult a medical practitioner if you suspect you have West Nile Virus. Other diseases including Dengue Fever and Malaria are spread by mosquitoes in the sub-tropic and tropical parts of the world. See *S3AM-313-ATT4 Mosquito Borne Diseases* for information on the locations where mosquito borne diseases are known to be present.

4.7.8 Bees, Wasps and Hornets

- Wasps and bees will cause a painful sting to anyone if they are harassed. They are of most concern for individuals with allergic reactions who can go into anaphylactic shock. Also, instances where an individual is exposed to multiple stings can cause a serious health concern for anyone. These insects are most likely to sting when their hive or nest is threatened.
- Bees, hornets, and wasps may be found in derelict buildings, sheltered areas, behind covers or lids and even on open ground. Other protective measures are not normally effective against aggressive, flying insects. Be aware of the potential areas for these types of insects, approach these locations cautiously. Avoid reaching into areas where visibility is limited.
- If you see a nest in the area you are working in stop work. Contact the Manager or Site Supervisor for procedures to have the nest removed.

- If stung by a wasp, bee or hornet, notify a co-worker or someone who can help should you have an allergic reaction. Stay calm and treat the area with ice or cold water. Follow AECOM incident reporting guidelines to report the sting within 4 hours and notify the Manager or Supervisor immediately. Seek medical attention if you have any reactions to the sting such as developing a rash, excessive swelling or pain at the site of the bite or sting, or any swelling or numbness beyond the site of the bite or sting.

4.7.9 Fire Ants

- The fire ant (southern and western U.S.) and the European fire ant (northeastern U.S. and eastern Canada) is often very abundant where it is established. It is very aggressive and commonly climbs up clothing and stings unprovoked when it comes into contact with skin. Painful irritations will persist for an hour or more.

4.7.10 Personal Protective Equipment (PPE)

- Chemically-treated field clothing, full-length clothing, or Tyvek® coveralls.
- Gloves shall also be worn consistent with the recommendations of the site-specific SWP and/or THA to minimize hand exposure.
- Where ticks, chiggers, and spiders are presumed to exist, the Tyvek® or chemically treated clothing will be taped to the work boots.
- See *S3AM-313-ATT2 Ticks* for configuration of clothing for protection against ticks and insects.
- Application of insect repellent to clothing and/or exposed skin. Oil of lemon eucalyptus, DEET, and Permethrin have been recommended by the CDC for effective protection against mosquitoes that may carry the West Nile virus and related diseases.
- Note that DEET will reduce the effectiveness of Fire Resistance Clothing (FRC) and should not be applied to this clothing. If working in FRC, employees can use Permethrin as it has been shown not to reduce the effectiveness of FRC. Permethrin will need to be applied to FRC well in advance of the planned work. If permethrin is unavailable employees can apply DEET to their skin and let dry prior to putting FRC on.
    - Oil of Lemon Eucalyptus is a plant-based insect repellent on the market as Repel Lemon Eucalyptus. The products have been proven to be effective against mosquitoes, deer ticks, and no-see-ums for up to six hours. Derived from Oil of Lemon Eucalyptus, this non-greasy lotion or spray has a pleasant scent and is not known to be toxic to humans. The spray or lotions will be effective for approximately two to six hours and should be reapplied every two hours to sustain protection. Lemon Eucalyptus products cannot be applied to fire retardant clothing.
    - Permethrin is an insecticide with repellent properties registered with the Environmental Protection Agency and recommended by the CDC.
        - Permethrin is highly effective in preventing tick bites when applied to clothing, but is not effective when applied directly to the skin. Two options are available for Permethrin treatment of clothing worn during field work: 1) pre-treatment of fabric by the clothing manufacturer; or 2) manual treatment of their personal clothing using Permethrin spray in accordance with recommendations manufacturers recommendations. This will likely require treatment at home or the office prior to field mobilization. Caution should be used when applying Permethrin as it is highly toxic to fish and house cats. AECOM strongly recommends the first option (employees obtaining pre-treated clothing) to avoid the time required, potential risk, and housekeeping issues involved with manually treating the clothing with spray. Purchase pre-treated clothing in accordance with *S3AM-208-PR1 Personal Protective Equipment* and with the approval of your Supervisor or Manager.
        - The Permethrin pre-treatment is odorless and retains its effectiveness for approximately 25 washings. After 25 washings, the pre-treated clothing will be

considered no longer effective and removed from service. Clothing that has been manually treated by employees will be considered effective for five wash cycles.

- Also, use of clothing that has been pre-treated with Permethrin offers a reduction in the use and application of other insect repellents that shall be applied directly to the skin. Supervisor or Manager approval is required prior to purchase.
- If the employee opts not to utilize chemically pre-treated clothing while potentially exposed to insects, spiders and/or ticks, they shall either: 1) wear Tyvek® coveralls taped to the boots, or 2) wear full-length clothing consisting of long-legged pants and long-sleeved shirts treated with an insect repellent containing Permethrin, DEET, or an oil of lemon eucalyptus to their work clothing.
- Safety Data Sheets (SDS) for the repellents, lotions, and cleansers discussed in this Procedure are not required because the repellents, lotion, and clothing are consumer products used in the manner intended for the general public. Although not required, a SDS should be obtained for the products used and placed into the office SDS library and site-specific safety plan.

4.8 Poisonous Plants

4.8.1 Habitat Avoidance, Elimination and/or Control

- If poisonous plants are identified in the work area, employees will mark the plants using either flags or marking paint, and discuss what the specific indicator will be to signal to other employees to avoid the designated area. If employees decide to use ground-marking paint to identify poisonous plants, they should discuss this tactic with the Manager (and Client as appropriate) for approval.
- If removal of the plants is considered, it should be subcontracted to a professional landscaping service that is capable and experienced in removing the plant. If herbicides are considered for use, a discussion shall need to occur with the Manager (and Client as appropriate) to determine whether it is acceptable to apply herbicides at the work site. Application of herbicides may require a license.
- Employees shall not attempt to physically remove poisonous plants from the work area unless a clearing procedure, including PPE, is prepared in advance and approved by the SH&E Manager. The clearing procedure should be included in the SH&E Plan and THA and the required PPE specified.

4.8.2 Poisonous plants that employees should recognize and take precautions to avoid include: poison sumac, poison ivy (terrestrial and climbing), poison oak, giant hogweed[2] (or giant cow parsnip), wild parsnip, devil's club and stinging nettle. Many others are extremely poisonous to eat (e.g., poison hemlock; water parsnip) – do not eat anything that has not been identified. Refer to *S3AM-313-ATT5 Plants of Concern* for information on locations where some of these poisonous plants are found in the U.S.

- Of the toxic plants in the cashew family, poison ivy (*Rhus radicans*) is most widespread. It grows in a variety of forms such as a low sprawling shrub, dense ground cover, or a thick woody vine that grows high into the tree canopy. Poison oak (*Rhus diversiloba*) is typically a low shrub in drier soils. Both of these plants have leaves of three and white berries. Poison sumac (*Rhus vernix*) is a tall shrub that is less prolific in distribution. It grows in wet areas, has a compound leaf with a red leaf stem (rachis), and white berries. All of these plants possess urushiol oils in all parts of the plant. Touching the plant causes an itchy skin rash that can show up within 4-72 hours following contact. People have a wide range of reactions including swelling, itching, rash and bumps, patches or blisters.
- Uroshiol oil can also transfer onto clothing and equipment. The oil can remain active on surfaces for up to 5 years and can be transferred to your skin.

[2] Phytodermatisi producer: keep skin covered and wash well after exposure

- Wild parsnip is found throughout the U.S. and contains a poison that produces a rash similar to poison oak and ivy. Unlike poison oak and ivy, the active oil will not be present on unbroken leaves. See *S3AM-313-ATT6 Wild Parsnip Identification* for additional information and photos of wild parsnip.
- Several plants in the carrot family contain toxic sap that causes severe dermatitis if it comes into contact with skin that is then exposed to sunlight. The most serious reaction is caused by the giant hogweed (*Heracleum mantegazzianum*), a plant that is spreading in southern Ontario and is also present in southwestern British Columbia. The plant is enormous, attaining up to 16 feet (5 meters) in height, which it does in one growing season. Contact causes painful blistering that can cause permanent disfigurement. It is to be avoided. Similar but less serious reactions can be caused by meadow parsnip (*Pastinaca sativa*) and cow parsnip (*Heracleum lanatum*). Meadow parsnip can be very abundant on disturbed sites.
- Nettles, particularly stinging nettle (*Urtica dioica*) and wood nettle (*Laportea canadensis*) contain urticating hairs on the leaves and stems that cause sharp pain or itchiness on contact with skin. The irritation is immediate and normally lasts no more than an hour and there are no lasting consequences.
- Some plants contain abundant stiff spines that can present a safety hazard, particularly if one is to fall into them. These include the cactus (*Opuntia spp.*), devils club (*Oplopanax horridum*), and prickly-ash (*Zanthoxylon americanum*).

4.8.3 A large number of plants are not harmful to touch but may contain poisonous berries or foliage that could cause serious complications or death if they are ingested. It goes without saying to not eat any berries or plants if you are unsure of their identity.

- Remember that in the fall and winter the hazard still exists in the form of stubble and roots.

4.8.4 Personal Protective Equipment (PPE)

- Employees conducting clearing, grubbing, or similarly disturbing work activities in areas where poisonous plants exist shall wear long-sleeve clothing or Tyvek® coveralls, and disposable cotton, leather or synthetic gloves. Employees shall not touch exposed skin (neck and face) with potentially contaminated gloves. Tyvek® and gloves worn to protect from exposure to poisonous plants shall be treated as contaminated, removed from the body in a manner that the contamination is not spread, and placed in plastic bags for disposal.
- Personal clothing that has been exposed to poisonous plants shall be decontaminated with a poisonous plant cleanser such as Tecnu® or removed in a careful manner, bagged and washed separately from other clothing to remove urushiol.
- Work boots will be decontaminated with either soap and water or a cleansing agent such as Tecnu® cleanser.
- If foliage is being cleared and includes poisonous plants, exposed skin shall be treated with a dermal barrier cream such as Tecnu®'s Oak 'n Ivy Armor or Enviroderm's Ivy Block and either a full-face respirator or a half-face respirator (with goggles) fitted with a P-100 (HEPA) dust filter.

4.9 Bird Droppings and Biological Soil Hazards

4.9.1 Work in any area where pigeons or other flying animals (e.g. bats) may nest requires a written statement from the client which states the potential for, and extent of, accumulation of excrement on/in the structure from pigeons or other winged animals.

4.9.2 Substantial accumulations of droppings can pose physical and health risks as slippery surfaces (if wet) and if the material is disturbed and becomes airborne, it can be inhaled or ingested if personal hygiene practices are not implemented. Inhalation of airborne droppings can cause diseases such as histoplasmosis. Exposure to surfaces with bird droppings shall be safeguarded by implementing proper work practices, training employees for awareness and using PPE. See *S3AM-313-ATT8 Bird Droppings*.

4.9.3 Tularemia is a problem with contaminated soil in some locations. Tularemia is a disease of animals and humans caused by the bacterium *Francisella tularensis*. Rabbits, hares, and rodents are especially susceptible and often die in large numbers during outbreaks. Workers can contract Tularemia through tick and deer fly bites, but also through inhalation of contaminated aerosols or agricultural dusts. Check work areas for carcasses before disturbing the ground (e.g. mowing, brushing, grubbing, excavation, etc.).

4.10 Personal Hygiene and Body Checks

4.10.1 Tick-borne diseases typically require that the tick be imbedded for four hours to begin disease transfer. The oils from poisonous plants can take up to 4 hours after exposure to penetrate the skin and react with the live proteins under the skin.

4.10.2 It is recommended that exposed skin be checked frequently for the presence of ticks, insects, rashes, or discolorations. External clothing should also be checked for the presence of ticks and insects; these should be retained for identification and to determine if medical treatment is needed.

4.10.3 Employees shall shower as soon as practical after working in the field and examine their bodies for the presence of ticks, insect bites, rashes, or swollen areas. If imbedded ticks are found, they should be removed using the technique described in *S3AM-313-ATT2 Ticks*.

4.11 Employees shall immediately notify their Manager or Supervisor of the presence of an imbedded tick, bee, wasp or hornet sting, other insect bite, rash, or any abnormal reaction. Reporting shall occur within 4 hours for a significant incident and 24 hours for all other SH&E incidents, and in accordance with *S3AM-004-PR Incident Reporting, Notifications & Investigation.*

4.12 The Manager or Supervisor shall forward the report to the SH&E Manager for follow up.

5.0 Records

None

6.0 Attachments

6.1 S3AM-313-ATT1 Biological Hazard Assessment Flow Chart

6.2 S3AM-313-ATT2 Ticks

6.3 S3AM-313-ATT3 Poisonous Spider Identification

6.4 S3AM-313-ATT4 Mosquito Borne Diseases

6.5 S3AM-313-ATT5 Plants of Concern

6.6 S3AM-313-ATT6 Wild Parsnip Identification

6.7 S3AM-313-ATT7 Alligators

6.8 S3AM-313-ATT8 Bird Droppings

6.9 S3AM-313-ATT9 Large Carnivores & Ungulates

6.10 S3AM-313-ATT10 Bear Safety

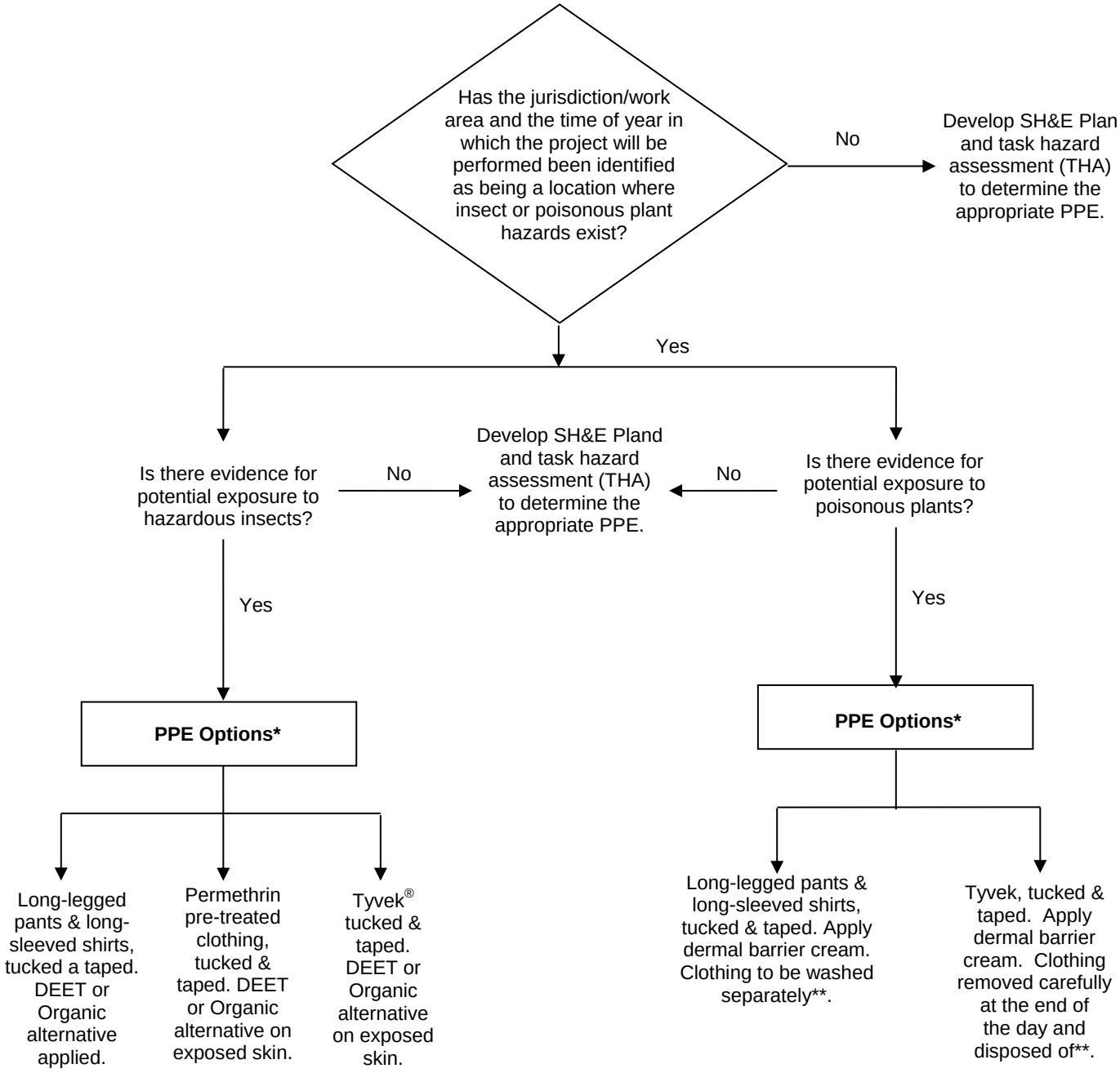
6.11 S3AM-313-ATT11 Small Mammals

6.12 S3AM-313-ATT12 Snakes & Scorpions

Americas

Biological Hazard Assessment Decision Flowchart

S3AM-313-ATT1



* indicates that when both insect and poisonous plant hazards are recognized hazards at a project site, the most conservative combination of the available PPE choices will be selected. Include the selected PPE option in the respective SH&E Plan and THA.

** indicates that clothing that has been known or suspected to have come in contact with poisonous plants must be washed before it can be worn again. Similarly, Tyvek® that has been known or suspected to have come in contact with poisonous plants will be disposed of rather than reused during a subsequent day or project.

Americas

Ticks

S3AM-313-ATT2

1.0 Background

1.1 The Public Health Agency of Canada and the Centers for Disease Control and Prevention work with States and Provinces, health authorities and other experts on research to define and monitor the occurrence of the ticks that carry bacterium that cause disease, including but not limited to:

1.1.1 *Borrelia burgdorferi*, the bacterium that causes Lyme disease.

- In the United States and Canada, the black-legged tick (*Ixodes scapularis*; often referred to as a deer tick) and the western black-legged tick (*Ixodes pacificus*) are the species known to transmit this disease-causing agent, as well as other less common agents.

1.1.2 *Rickettsia rickettsia,* the bacterium that causes Rocky Mountain Spotted Fever.

- In the United States and Canada, the American dog tick (*Dermacentor variabilis*), Rocky Mountain wood tick (*Dermacentor andersoni*), and brown dog tick (*Rhipicephalus sanguineus)* are known to transmit this disease-causing agent.

1.1.3 *Francisella tularensis*, the bacterium that causes Tularemia.

- In the United States, these include the American dog tick (*Dermacentor variabilis*), Rocky Mountain wood tick (*Dermacentor andersoni*), and Lone star tick (*Amblyomma americanum*).

1.1.4 *Ehrlichiosis*, the general name to describe several bacterial diseases that affect animals and humas.

- In the United States, these include the black-legged tick (*Ixodes scapularis*; often referred to as a deer tick) and the western black-legged tick (*Ixodes pacificus*), and Lone star tick (*Amblyomma americanum*).

1.2 Consult local health authorities to determine where tick populations are established or emerging. Locations where distribution may have previously been limited may show evidence of larger populations. Employees working in or adjacent to areas where there are established tick populations may have a greater chance of contact with ticks.

1.3 While there is a higher risk of coming in contact with infected ticks in areas where populations are established, there is also a low risk of tick-borne diseases being contracted almost anywhere in the Americas as migratory birds transport infected ticks over large geographic distances. Take precautions to reduce tick contact.

1.4 Lyme Disease

1.4.1 The rate of infection of ticks with the bacterium that causes Lyme disease varies. Infection rates are typically higher in adult ticks compared to the other stages (nymphs and larvae).

1.4.2 Despite the lower rates of infection, people are most likely to acquire Lyme disease from a nymph because this stage is so small and thus more likely to go unnoticed and feed for a sufficient amount of time for the Lyme disease bacterium to be transmitted (24-36 hours).

1.4.3 Infection rates are often greater in tick populations that have been established for long periods of time compared to newly established ones.

1.4.4 Lyme disease patients are most likely to have illness onset in April through November with onset peaking in June, July, or August and less likely to have illness onset from December through March

2.0 To Remove Attached Ticks



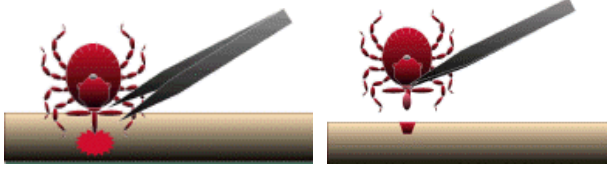
2.1 Use fine-tipped tweezers or notched tick extractor, and protect your fingers with a tissue, paper towel, or latex gloves (see figure). Persons should avoid removing ticks with bare hands.

2.2 Grasp the tick as close to the skin surface as possible and pull upward with steady, even pressure. Do not twist or jerk the tick; this may cause the mouthparts to break off and remain in the skin. (If this happens, remove mouthparts with tweezers. Consult your health care provider if illness occurs.)

2.3 After removing the tick, thoroughly disinfect the bite site and wash your hands with soap and water.

2.4 Do not squeeze, crush, or puncture the body of the tick because its fluids may contain infectious organisms. Skin accidentally exposed to tick fluids can be disinfected with iodine scrub, rubbing alcohol, or water containing detergents.

2.5 Save the tick for identification in case you become ill. This may help your doctor make an accurate diagnosis of potential diseases by determining what type of tick it is. Place the tick in a sealable plastic bag and put it in your freezer. Write the date of the bite on a piece of paper with a pencil and place it in the bag.



3.0 Folklore Remedies Don't Work

3.1 Folklore remedies, such as the use of petroleum jelly or hot matches, do little to encourage a tick to detach from skin. In fact, they may make matters worse by irritating the tick and stimulating it to release additional saliva or regurgitate gut contents, increasing the chances of transmitting the pathogen. These methods of tick removal should be avoided.

4.0 Configuration of Clothing

4.1 Loose-cuff trousers must be tucked into socks, wrapped with duct tape (or equivalent) completely around the cuff of the sock up on to the surface of the pant leg to prevent entry of insects between the sock and pants, and preferably reverse-wrapped with “sticky” side out (see figure below).



Americas

Poisonous Spider Identification

S3AM-313-ATT3

Black Widow Spider





- Found in warm, dry parts of throughout the United States and extend into the southern edge of Canada.
- Prefer to spin their webs in dark, sheltered spots close to the ground
- Abdomen usually shows hourglass marking.
- The female is 1 to 1.5 inches (3-4 centimeters) in diameter.
- Have been found in well casings and flush-mount covers.
- Not aggressive, but more likely to bite if guarding eggs.
- Light, local swelling and reddening of the bite are early signs of a bite, followed by intense muscular pain, rigidity of the abdomen and legs, difficulty breathing, and nausea.
- If bitten, see physician as soon as possible.

Brown Spiders (Recluse)





- Central and South U.S., although in some other areas, as well.
- 0.25-to 0.5-inch (0.6 to 1.3 centimeters)-long body and the size of silver dollar.
- Hides in decaying wood, baseboards, ceilings, cracks, and undisturbed piles of material.
- Bite either may go unnoticed or may be followed by a severe localized reaction, including scabbing, necrosis of affected tissue, and very slow healing.
- If bitten, see physician as soon as possible.

Hobo Spider





- Primarily found in Washington, Oregon, Wyoming, Colorado, Utah, Montana and the Pacific Northwest United States.
- 0.4-to 0.5-inch (1.1 to 1.3 centimeters)-long body and the size of silver dollar.
- Because of its common features and color, it is easily confused with other spider such as Brown Recluse Spiders.
- They rarely climb vertical surfaces and are uncommon above basements or ground level.
- Bite is initially painless. After 24 hours, the bite develops into a blister and after 24-36 hours, the blister breaks open, leaving an open, oozing ulceration.
- If bitten, see physician as soon as possible.

Exercise care when collecting samples and avoid reaching into areas where visibility is limited. If bitten by a spider, attempt to identify the spider, notify a co-worker or someone who can help should the bite site become painful, discolored, or swollen. Stay calm and treat the area with ice or cold water. Seek medical attention if you have any reactions to the sting such as developing a rash, excessive swelling or pain at the site of the bite or any swelling or numbness beyond the site of the bite.

Americas

Mosquito-Borne Diseases

S3AM-313-ATT4

1.0 Background

1.1 Employees working outdoors in the Americas may be exposed to mosquitoes that may transmit illnesses, including Encephalitis and Dengue.

1.2 Dengue is transmitted by the bite of a mosquito infected with one of the four dengue virus serotypes. Dengue is endemic to South America**.**

1.2.1 Dengue is a febrile illness that affects infants, young children and adults with symptoms appearing 3-14 days after the infective bite.

1.2.2 Symptoms range from mild fever, to incapacitating high fever, with severe headache, pain behind the eyes, muscle and joint pain, and rash.

1.2.3 Severe dengue (also known as dengue hemorrhagic fever) is characterized by fever, abdominal pain, persistent vomiting, bleeding and breathing difficulty and is potentially fatal.

1.3 West Nile encephalitis is an infection of the brain that is caused by a virus known as the West Nile virus.

1.3.1 Most individuals infected with WNV remain asymptomatic. West Nile (WN) fever is typically a mild illness lasting 3 to 6 days.

1.3.2 The main symptoms are sudden onset of fever with chills, rash, malaise, headache, backache, arthralgia, myalgia and eye pain. Other non-specific symptoms may include nausea, vomiting, anorexia, diarrhoea, rhinorrhoea, sore throat, and cough.

1.3.3 The main route of infection is via the bite of a mosquito that has been infected by feeding on West Nile Virus infected birds.

1.4 Arboviral encephalitis is a virus that exists in various forms in global distribution. Numerous forms occur in the Americas, including the following four primary forms that can be transmitted by mosquitoes:

1.4.1 Eastern equine encephalitis (EEE) – United States and Canada

1.4.2 Western equine encephalitis (WEE) – United States

1.4.3 St. Louis encephalitis (SLE) – United States and Canada

1.4.4 La Crosse (LAC) encephalitis.all of which are transmitted by mosquitoes – United States

1.5 Mosquitoes are known to breed in standing water; therefore, when standing water is found at a job site, actions should be taken to drain the water. Typically, mosquitoes will fly only a quarter of a mile (400 meters) from their breeding location.

1.6 The local Public Health Department and Center for Disease Control and Prevention (CDC) should be consulted to determine what diseases transmitted by mosquitoes are present and exposure prevention recommendations.

Americas

Plants of Concern

S3AM-313-ATT5

1.0 Background

1.1 Poison ivy, oak and sumac (poisonous plants) pose a significant threat to AECOM employees due to the dermatitis that results from exposure to the oil on these plants, called urushiol.



Poison Oak **Poison Sumac** **Poison Ivy**

1.2 Exposure to urushiol produces a rash that can be irritating and cause the exposed employee to scratch the infected area, increasing susceptibility for an infection to result from the rash.

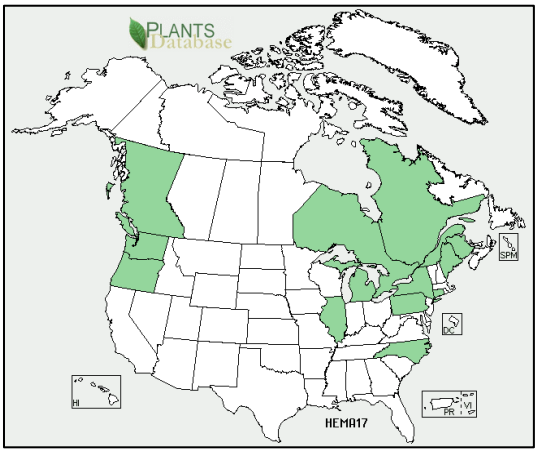
1.3 It should be noted that each time an employee is exposed to urushiol, it increases the severity of the reaction they will have in subsequent exposures.

1.4 Giant Hogweed is a phototoxic plant that causes skin irritation on contact with the sap and, when exposed to sun causes deep blisters.

1.5 Blisters from contact with Giant Hogweed can form black or purplish scars that can last for several years. Even a tiny amount of the sap in the eyes can cause temporary to permanent blindness.



Giant Hogweed



Giant Hogweed Distribution

Image obtained from www.gclandscape.com

2.0 Treatment

2.1 In cases that involve severe rashes, medical treatment may be necessary to control the rash.

2.2 Employees that develop a rash as a result of exposure to poison ivy, oak or sumac should report the exposure immediately to their Supervisor, Project Manager and Region Safety, Health and Environment Manager.

Pacific Poison Oak Distribution



Image obtained from www.cdc.gov

Atlantic Poison Oak Distribution



Image obtained from www.cdc.gov

Poison Sumac Distribution



Image obtained from www.cdc.gov

Western Poison Ivy Distribution



Image obtained from www.cdc.gov

Eastern Poison Ivy Distribution

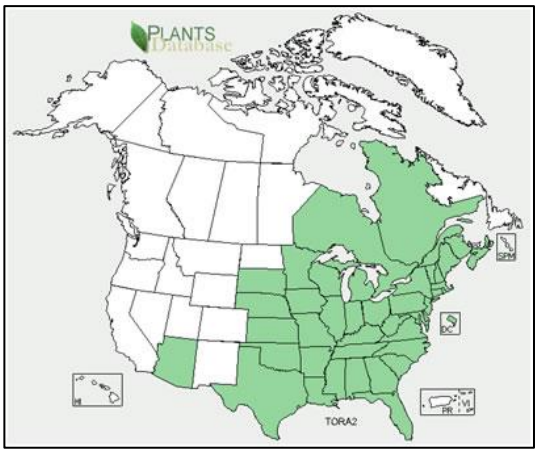


Image obtained from www.cdc.gov

Americas

Wild Parsnip Identification

S3AM-313-ATT6

1.0 Background

1.1 Wild parsnip (also known as poison parsnip) looks similar to a large carrot plant and is found in open places along roadsides and in waste places throughout the United States and Canada.

1.2 This plant produces a compound that causes severe blistering and discoloration after being exposed to sunlight—a condition known as photodermatitis. That is, when the skin comes in contact with this plant's juice and then is exposed to UV light, a severe burn develops.

2.0 Hazard

2.1 Everyone can get burned by wild parsnip. Unlike poison ivy, you don't need to be sensitized by a prior exposure. However, wild parsnip is only dangerous when the juice from broken leaves or stems gets on your skin—therefore, you can touch and brush against the undamaged plant without any danger.

2.2 If one gets some of the sap of hogweed (or meadow parsnip or cow parsnip) in contact with skin, it is critical that they stay out of the sun for 8 hours. If one needs to remove the plant they should be completely covered with overalls, gloves, hat and safety glasses.



Americas

Alligators

S3AM-313-ATT7

1.0 Hazard

1.1 Your chance of encountering an alligator is greatest during the animal's courtship and mating season, which takes place from March through September. This is when male alligators become most dominant and aggressive as they try to intimidate rival males and attract females by their show of power. Some males end up having to travel to find a mate. July through September is when mother alligators are guarding nests.

1.2 Mating season takes up much of the warmer months - a very popular time in the southeastern USA for outdoor activities - and alligators are solar-powered, so-to-speak. The warmth from the sun fires up their metabolism, giving them renewed energy; and renewed energy means great potential for conflict.

2.0 Encounter



2.1 The alligator is naturally wary of humans, and will flee quickly if you get too close to it, or it may utter a very audible and compelling warning hiss. In some cases, however, alligators may charge or attack. Here are some examples of such cases:

2.1.1 An alligator that is accustomed to being fed by humans may not be so shy.

2.1.2 An alligator that is surprised and alarmed by your approach may attack, thinking that it is being attacked itself.

2.1.3 A mother alligator caring for her nest or for live babies. If you see alligator babies, or if you encounter a nest (usually a mound of vegetation mixed with mud), remove yourself to a safe distance, the mother alligator is sure to be close by. If you get close, the mother may sound a very audible and intimidating warning hiss. Such a nest may be difficult to identify for a non-expert, but it is likely the mother will issue you a warning.

2.1.4 Alligator mothers are well-known to be practically fearless when defending their offspring, whether the little ones have hatched or not. A mother alligator was observed leaping, jaws agape, to attack a helicopter as it approached the nest area to land. The helicopter carried biologists studying alligator nests.

2.2 Also be careful near heavy vegetation in or near the water's edge. This is where an alligator likes to enjoy privacy and peace during the daylight hours. If you trudge through there and surprise it, the outcome may not be positive.

2.3 Generally, a good minimum distance to keep between you and an alligator or nest is 15 feet (4.6 meters).

2.4 When trying to get past an alligator, make sure not to walk between the alligator and the water, because if it's spooked, it's going to run to the water.

2.5 If an alligator does approach in a threatening manner, make as much noise and movement as possible. This should show the alligator that he has taken on more than he can handle and he'll back away.

3.0 Alligator Charge

3.1 The alligator is not a natural runner. Those short legs obviously don't serve it like a horse's legs do, and the alligator can actually tire out in a relatively short time. When it charges after a human or animal, it is either

trying to scare it away or seize it. It has a fast and furious burst of energy which serves it well for stealth hunting -- grabbing prey when it doesn't expect it. Furthermore, the reptile is opportunistic, which means, quite simply, it doesn't like to work very hard to get its food if it doesn't have to.

3.2 In the very rare event you are charged or chased by an alligator, move in as straight a line as possible away from it as fast as you reasonably can. In many cases, the vegetation features of the wild will serve to protect you by slowing the alligator down, like trees, bumps, bushes, etc. -- your comparatively long legs usually make it easier for you to maneuver through the trees and brush than an alligator's short legs do.

3.3 Most adult humans can outrun even a fast crocodilian, which has been clocked at a maximum of about 10 miles per hour (mph) (17 kilometers per hour [kph]), compared to a human speed of 15-17 mph (24-27 kph). But this doesn't matter much; an alligator will often give up the chase because it sees that the runner is moving away too quickly, and realizes that too much effort will be required to continue pursuit.

3.4 You may have heard somewhere that the zigzag run (running in a "z" pattern, side-to-side) is a good idea, but this is not only an unnecessary maneuver but probably a very unwise one. Here's why:

3.4.1 Unless you're an Olympic athlete, running zigzag over natural topography increases your risk of tripping and falling over rocks, plants, roots, and the like. And it goes without saying that falling while being pursued by an alligator is not good.

3.4.2 Furthermore, an alligator doesn't have the degree of stereoscopic vision we have. It actually has a small 'blind spot' directly in front of it. Hence, the alligator's vision is most effective in the 'sides' of its field of view. So, running zigzag not only slows your rate of distance from your pursuer, it may clearly indicate to the animal exactly where you are; even this point hardly matters since in many cases the alligator may keep its eyes shut while pursuing so as not to get them hit by twigs, grass stalks and branches in its path.

3.4.3 Finally, an alligator bites very effectively in a side-swiping motion, so if you are trying to run zigzag and are slowed down by plants, rocks, or other obstacles, the backwards flying leg of a running human is an optimal target for side-swiping, chomping jaws (the operative word here is "side").

3.5 Simply put, when faced with an attack, move directly away from the alligator as quickly as possible, navigating the terrain as carefully as possible. The zigzag idea will likely not serve you well.

4.0 Alligator Attack

4.1 If it seizes prey, and the prey fights back hard, the alligator may release it, depending on factors such as its own size relative to that of the victim, its own level of aggression, and its measure of hunger. Merely struggling to break free may not be enough counter-aggression to stop an alligator, and may actually prompt a devastating "death roll" response, in which the reptile furiously spins on its central axis to tear muscle and bone free of the victim's body.

4.2 These armored saurian are among the toughest beasts in the animal kingdom, so an attack victim should channel his or her nervous energy and will to survive and take the offensive by fighting hard. Not struggling...fighting very, very, very hard. Others on hand during such an event may be able to help by fighting the reptile, too. This should include punching the snout, poking the eyes, and even jabbing the ears, which are seen as small slits behind the eyes.

Americas

Bird Droppings Safe Work Practices

S3AM-313-ATT8

1.0 Background

1.1 According to the National Institute for Occupational Safety and Health (NIOSH), histoplasmosis is an infectious disease caused by inhaling spores of a fungus called *Histoplasma capsulatum (*abbreviated *H. capsulatum)* that may inhabit accumulated masses of pigeon droppings and excrement of other birds and flying animals. Its symptoms vary greatly, but the disease primarily affects the lungs. Occasionally, other organs are affected. This form of the disease is called disseminated histoplasmosis, and it can be fatal if untreated. The acute respiratory disease form of histoplasmosisis is characterized by respiratory symptoms, a general ill feeling, fever, chest pains, and a dry or non-productive cough. Distinct patterns may be seen on a chest x-ray. Chronic lung disease resembles tuberculosis and can worsen over months or years. If symptoms occur, they may start within 3 to 17 days of exposure, with an average of 10 days. On a positive note, histoplasmosis is not contagious.

1.2 Psittacosis, although primarily a respiratory disease, can cause a wide variety of clinical manifestations. Generally, about 10 days after infection occurs, the clinical illness begins abruptly with fever, chills, weakness, fatigue, muscle pain, anorexia, nausea, vomiting, excessive sweating and difficulty with breathing, headache, backache, and sensitivity to light.

1.3 Hypersensitivity pneumonitis is also known as pigeon breeder's disease.

2.0 Symptoms

2.1 The acute form of hypersensitivity pneumonitis is clinically characterized by chills, fever, cough, breathlessness without wheezing, and malaise 4-10 hours after exposure. In general, an acute attack subsides after 18 to 24 hours.

3.0 Treatment

3.1 If a person should develop any of the symptoms as noted above, or others, it is important to see a physician and inform him of an exposure to pigeon/bird or bat excrement. A failure to diagnose the preceding conditions could occur if a treating physician is unaware of a patient's exposure to pigeon/bird or bat excrement.

4.0 Prevention

4.1 Prior to work in any area where pigeons or other flying animals may nest, a written statement from the client shall be obtained in regards to the potential for, and extent of, accumulation of excrement on/in the structure from pigeons and other winged animals.

4.2 The client shall be asked to provide appropriate details as to the basis for their statement (e.g., date of last visual survey for pigeon/bird or bat excrement accumulation, date of last excrement removal effort, etc.).

4.3 In no case will an AECOM employee or contract employee be permitted to commence structure inspection procedures without the Project Manager having received and evaluated the aforementioned written statement from the client.

4.4 According to NIOSH, the best way to prevent exposure to *H. capsulatum* spores during survey and inspection work is to avoid situations where excrement and other potentially contaminated material can become airborne and inhaled. Therefore, it is preferable that the efforts to determine if, and to what extent, there is an accumulation of pigeon/bird or bat excrement on/in structures, or the efforts to clean-up/remove/dispose of such contaminated material, be left to the client or subcontracted out.

5.0 Safe Work Practices

5.1 In those cases where AECOM employees or contract employees are contracted by the client to determine the extent of accumulation of animal excrement in/on structures, the following minimum safety and health precautions shall be taken. (NOTE: precautionary measures are based on recommendations and best practices prescribed in the NIOSH 2004 public document titled *Histoplasmosis – Protecting Workers at Risk*).

5.2 All workers shall wear disposable protective clothing (Tyvek® coveralls). Disposable overalls with hoods shall be donned when working in areas where *H. capsulatum* spore-contaminated material is likely to fall from overhead.

5.3 All workers shall wear disposable shoe coverings fitted with ridged soles made of slip-resistant material to reduce the likelihood of slipping on wet or dusty surfaces. Gloves shall be worn.

5.4 All workers shall wear a full facepiece air purifying respirator fitted with P100 (HEPA) cartridges. If entering an enclosed area in which the extent of excrement contamination is unknown, additional protective measures shall be taken such that workers shall wear a powered air-purifying respirator (APR) with full facepiece fitted with P100 (HEPA) cartridges. Any variance from these requirements must be approved by the Region Safety, Health an Environment Manager. Workers donning APRs shall be medically screened, cleared, and trained in their proper use in accordance with AECOM safety program standards.

5.5 If contaminated material must be disturbed for purposes of removal/disposal or during the structure inspect process, it shall be wetted down prior to all work and will be rewetted as necessary to minimize airborne dusting.

5.6 After working in *H. capsulatum* spore-contaminated areas and before removing any respiratory protective equipment, workers shall remove all protective clothing and shoe coverings and seal them in a heavy-duty plastic bag for disposal.

5.7 Workers shall observe a high degree of personal hygiene, even if the exposure is casual. Special care shall be taken to wash hands, face, and other areas of exposed skin thoroughly before eating, drinking or smoking.

Americas

Large Carnivores & Ungulates

S3AM-313-ATT9

1.0 Hazard

1.1 Most wild carnivores in the feline family (cougars, lynx, and bobcat) or the canine family (wolves and coyotes) are more predictable than bears and are not predatory towards humans; however, all wild animals can be dangerous if they feel threatened or if they are sick or starving.

1.2 Most ungulates (deer, moose, elk, and caribou) will avoid humans and will flee as soon as a human is sighted; however, females with young (during May and June) and males during the mating season (September to November) can be very aggressive, especially if provoked.

2.0 Personal Protective Equipment

2.1 Noise makers such as bear bangers, whistles and bells can be used as deterrents for an approaching animal.

2.2 Pepper (bear) spray can be used to ward off an imminent attack.

3.0 Safe Work Practice

3.1 Most negative encounters with ungulates or carnivores can be avoided with a few key preventative measures:

3.1.1 When working in wilderness isolation, always travel in pairs and make lots of noise.

3.1.2 Always store food in air-tight containers away from sleeping areas (if camping) and never carry strong smelling foods which could attract animals.

3.1.3 Keep your eyes open for fresh animal signs which may indicate a dangerous situation:

- Extensive fresh rubbing on branches in the fall might indicate the presence of a rutting male ungulate that may become aggressive to defend a potential mate.
- A fresh kill or carcass which might indicate the presence of a carnivore that may become aggressive to defend its food.

3.2 Maintaining a distance of at least 100 feet (30 meters) allows large animals an escape route. If you notice any signs of aggression or behavioral changes, you should move away to a safe location. Wildlife should not be enticed by reaching out or simulating calls.

3.3 Pets should be kept secure and away from wildlife as their actions can provoke an attack. Moose, deer and other wildlife may appear quite docile; however, if a dog makes them feel threatened, their behavior can become unpredictable.

3.4 **If you are approached by a carnivore (wolf, coyote, or cougar):**

3.4.1 Pick up small children immediately.

3.4.2 Try to appear bigger, hold your arms or an object over your head.

3.4.3 Face the animal and retreat slowly. Do not run or play dead.

3.4.4 Maintain steady eye contact with the animal.

3.4.5 If the animal continues to approach, deter an attack by yelling, waving a stick or throwing rocks.

3.4.6 If you are attacked, fight back. Hit the animal with a heavy stick or rock.

3.5 **If you are approached by an ungulate (moose, elk, deer, bison or caribou):**

3.5.1 An angry moose, elk or deer will face you with its head and ears lowered.

3.5.2 Back away slowly.

3.5.3 Look for something to get behind like a tree or a car. You can go faster around an obstacle than the ungulate can.

3.5.4 An ungulate is more likely to bluff charge but if it continues the charge and you are attacked in the open, curl up in a ball on the ground. Always protect your head with your arms and lie still.

3.5.5 Stay still after the attack until the ungulate moves away.

Americas

Bear Safety

S3AM-313-ATT10

1.0 Hazard

1.1 An encounter with a bear of any species can have a wide variety of outcomes, ranging from a simple sighting, to a false charge, to a serious mauling or even death. Consequently, the risk of a bear encounter must be taken very seriously.

1.2 The hazard or risk associated with a bear encounter varies significantly depending on the location. It is important to research the project area before field work commences to determine the expected probability of encountering a bear. Remoteness from urbanized areas should not be a criterion, as bears have been encountered within city limits, especially near landfills.

1.3 The risk associated with a bear encounter also varies with the species of bear, the season, and the circumstances under which the bear is encountered.

1.4 Preparing staff for any type of encounter is key to managing the risk.

2.0 Personal Protective Equipment

2.1 The best deterrent of a “bad bear encounter” is knowledge: a good understanding of the ecology and the behavior of the bears that will likely be encountered.

2.2 Bear Spray and Bear Bangers

2.2.1 Staff must have hands-on training for the safe use of bear spray (a pre-season practice run is a good use of expired bear spray).

2.2.2 Prior to work commencing, staff must ensure that the bear spray they are carrying is still valid and not past its expiration date.

2.2.3 During travel, bear spray must be sealed in an airtight container or bag and must not travel in the cab of a vehicle, aircraft, or helicopter.

2.3 Firearms

2.3.1 Environments and conditions which pose a high risk of bear encounters, may warrant the use of an armed wildlife monitor. Project managers, in consultation with appropriate project staff and Safety, Health and Environment Management, are responsible for determining the level of risk for their projects and whether or not such measures are required.

2.3.2 A person hired as an armed bear monitor must be properly trained in wildlife monitoring as well as certified in the expert usage of firearms.

2.3.3 The usage of an armed bear monitor is intended only as an additional precautionary measure to be used in specific environments to ensure the protection of field staff; staff should still be equipped and trained appropriately for the risk.

3.0 Restrictions

3.1 Staff must not work alone in areas where there is a medium or high risk of a bear encounter.

3.2 AECOM personnel shall not carry firearms or attempt to function as a wildlife monitor and/or perform their professional duties. For possible exceptions contact the Regional SH&E Manager who will evaluate the potential hazards with Regional Manager and Legal and provide written response. This can only be over-ridden with expressed permission of Region Executive and AECOM Chief Resilience Officer, refer to *WP-001-PR Firearms Standard*.

4.0 Training

4.1 In-house Bear Awareness training must be taken by all field staff who work in bear country every three years at a minimum, or more often as required.

4.2 The Bear Awareness training involves testing and improving the employee's knowledge about bear encounters, watching videos regarding bear awareness and behavior, and participating in group discussions about how to avoid and how to respond to bear encounters.

4.3 Specific considerations are given to black bear, grizzly bear, and polar bear encounters.

5.0 Safe Work Practice

5.1 Staff must be aware of wildlife signs and avoid wildlife encounters.

5.2 Bear Signs

5.2.1 Fresh tracks – It is often better to see the bear's tracks than to see the actual bear. If you can tell the direction that the bear is travelling in, it is prudent to change your course of direction. Bears will travel down the same pathways people or other large animals use. If you have a clear track you can determine which type of bear has passed through the area. If you see more than one track, you can tell that it is possibly a female with cubs. Avoid females with cubs!

5.2.2 Scat – Bear scat will look different depending upon the bear's diet. Close examination of bear scat can sometimes give you an indication of what the bears have been eating at that time of year. If the scat contains remnants of human garbage, there is a human food conditioned bear in the area. These bears associate people with food and can be the most dangerous type of bear to encounter.

5.2.3 Animal carcasses – IF YOU COME ACROSS A CARCASS, LEAVE THE AREA IMMEDIATELY. Grizzly bears will often cover their kills for a few days and let it rot, then come back and eat it. THE BEAR WILL STAY CLOSE BY. Grizzly bears will defend their kill and this is a situation that could prompt a defensive attack by a bear.

5.2.4 Torn-up logs and stumps – Bears will forage for insects in dead logs and rotting trees. You will often see torn up logs and stumps, evidence of their foraging.

5.2.5 Evidence of digging – Holes dug into the ground are often made by grizzly bears digging for roots or ground squirrels. In particular, grizzlies will dig for food in the early spring soon after they leave their dens.

5.2.6 Claw marks on trees – Claw marks can be left on trees by black bears when they have climbed up a tree. Grizzly bears will also leave claw marks on trees and on the ground. Bears will often chew a small tree or a sign-post, so watch for signs of chew marks along the trail.

5.2.7 Hair on trees – Bears will rub against trees, usually trees with rough bark, to scratch themselves. You can find evidence of bears by the hair left in the tree's bark. The higher the hair left on the tree, the bigger the bear. Remember that the bear will often stand on its back legs to scratch its back on the tree.

5.2.8 Daybeds – Bears will be most active in the early morning and in the evening. It would be prudent for field staff to restrict their field activities during the bear's most active foraging times as much as possible. During the heat of the day, bears will rest in daybeds. These can be shallow depressions of piled up leaves in the forest, trampled vegetation, a shallow scrape or a hole. Daybeds are usually located in cool places. Bears will make daybeds along streams and rivers. Daybeds are often associated with feeding places and therefore should be avoided.

5.3 Prevention

5.3.1 Your best defense against bears is to actively practice bear avoidance techniques when working in the field. You can prevent chance encounters by taking the following precautions:

- Know the areas and habitats bears use at different times of the year, and attempt to avoid such areas or be extremely cautious if you have to travel through them.
- Contact the local Fish & Wildlife Office to get current information on the bears in the area. Ask what other camps are in the area and if they are following good bear avoidance practices. (i.e., do they keep a clean camp?) If there are nearby human food sources available, e.g., an open dumpsite, the local bears may not be afraid to approach your camp.
- Always be aware of your surroundings. Stay alert. Watch for signs of bears along your route.
- Use binoculars to look around for bears when you are in open terrain.
- Never approach a bear if you see one feeding in the distance.
- Note the behavior of other wildlife in the area. Flocks of ravens can alert you to a possible animal carcass, and perhaps a bear. The area should be avoided. Bird or squirrel alarm calls might be telling you that a bear is near.
- Whenever possible, travel in daylight and try to avoid areas with restricted visibility, e.g., dense brush.
- Make lots of noise, especially when travelling in dense vegetation. Sing, shout, or talk loudly. You can carry portable air horns or cans of rocks. (Please note that bear bells are not effective – they do not make enough noise to warn a bear that you are approaching. You need to be loud so the bear can hear you coming.) Remember that the noise you make can be masked by loud natural sounds such as the wind or water. Therefore it is possible that the noise you make can go unnoticed by a bear whose attention is focused on feeding. You must make every attempt not to surprise a bear. In areas of loud natural noise, be louder!
- Stay together and travel in groups. Bears are less likely to attack groups of people. When travelling in groups, stay close together. Being in a group doesn't help if the individuals have spread apart along the trail.
- Pets should not accompany you when you are travelling in bear country. If you must take your pet, keep the animal on a short leash at all times. Unleashed dogs will harass bears and once scared, run back to their owner with an angry bear in pursuit.
- Do not wear perfumes or cosmetic products when you are travelling in bear country. Do not mask your human scent.
- All sanitary products should be stored in a similar fashion as food (stored at least 10 feet [3 meters] above site).
- Children should be kept very close by in bear country.
- Carry bear deterrents and know their limitations. Be familiar with how to use the deterrents, how to transport the deterrent safely and under what conditions it is most effective. Carry the deterrent in a belt, out in front and ready to grab at a moment's notice, never in your backpack.

5.4 Field Worker Precautions in Bear Country

5.4.1 Field workers should take extra precautions when working in bear country:

- Make every effort to go out into the field with another person; you should not be working alone in the field. One person can act as a lookout for the other. Keep watch for bear signs.
- Never approach a bear.
- Report where you are going and when you will return every time you leave camp. Have a plan of action if someone does not report back to camp at a specified time.

- Bears do get used to a camp's schedule and you will have fewer surprise encounters if everyone in the camp comes and goes at the same time every day.
- Take a two-way radio with you when you go out into the field.
- Always carry bear deterrents with you in the field and understand each deterrent's limitations. Carry your deterrents on a belt, out in front and ready to use instantly. Do not carry your deterrents in your backpack.
- Keep any food that you take with you sealed in odor-proof/bear-proof containers. Make every attempt to take odorless food with you, not something with a heavy scent.
- Pack out any garbage in odor-proof containers and burn once you return to camp.
- The noise of an ATV or skidoo can scare off a bear. Starting the machine and revving it up can scare off a curious bear. DO NOT CHASE A BEAR WITH AN ATV OR SKIDOO. You may need to drive the ATV around in circles to scare off the bear, but do not chase the bear.
- Take extra precautions when travelling along lakes or stream beds; bears use streams and river beds as travel routes. Be sure to carry noise makers.
- Limit your workday so you are not out in the early morning or evening when bears are most likely to be foraging.
- All **employees** should be proficient in First Aid. Do not go out into the field without first aid training.
- All field camps should have a First Aid Kit.
- All field camps should have means of communication with local ambulance or air ambulance personnel.
- A person's best defense against bears is to avoid them. If this is not possible, then being heard, smelled, or seen may lessen your chances of surprising a bear and/or provoking an attack.
- All wildlife should be respected, avoided, and not harassed at any time.
- Cooking in remote areas should be avoided. Any food should be stored in airtight containers and all garbage should be managed appropriately: "pack it in, pack it out".
- A bear in camp or within human structures is not a chance encounter. If this bear challenges you, you must fight, scream, and do whatever is necessary to live, no matter what species the bear is!
- In general, there are two types of bear encounters: Defensive and Non-defensive for grizzly bears and black bears. Your response will vary based on your assessment of the situation (your training will help you in identifying these situations and the appropriate response).

6.0 Encounters

6.1 General Recommendations When Encountering a Bear

- Consider your surroundings and assess the situation before you act.
- Remain calm. Do not turn your back to a bear.
- DO NOT RUN – Running may trigger the bear's natural pursuit response. Bears are able to reach speeds of 25 miles per hour [40 kilometers per hour], must faster than Olympic sprinters. Bears are also excellent swimmers.

6.2 Bear Encounters in the Field

6.2.1 Your response will depend upon the type of encounter.

6.2.2 Bears are more predictable than once believed and you can determine your best course of action in a confrontation by understanding the bear's characteristics and motivation. There are two pieces of information you should be aware of in any bear encounter:

- The type of bear you are dealing with, and
- The reason for the encounter.

6.2.3 Some people believe that when you stand your ground against a predatory black bear attack, the bear will feel threatened and leave. This has been effective in some cases. HOWEVER, it is not effective against a grizzly bear predatory attack and it is very difficult to know when it will be effective against black bears. Polar bears do not follow the same behavioral patterns as grizzly and black bears; polar bears are almost always aggressive and will not back down. Special considerations must be given to projects where polar bear encounters are anticipated.

6.3 If you can leave undetected:

6.3.1 Leave the area quietly in the same direction that you came from.

6.3.2 Move while the bear's head is down. Stop moving when the bear lifts its head to check its surroundings.

6.3.3 Stay downwind so the bear will not pick up your scent.

6.3.4 When you have moved a safe distance away, you can either watch and wait until the bear leaves or make a wide detour around the bear.

6.3.5 If the bear is unaware of you and approaching, allow the bear the right of way.

6.4 If you cannot leave undetected:

6.4.1 Let the bear know that you are present by smell first; therefore move upwind so they can pick up your scent.

6.4.2 If it is possible, try to keep the bear in your sight. Watch to see if the bear leaves when it smells that a person is nearby.

6.4.3 Attempt to move out of the way without being noticed by the bear. If you cannot do this, talk loudly to let the bear know where you are.

6.5 If the bear is aware of you but in the distance:

- Remain calm.
- Continue walking slowly in the same general direction, but head away from the bear.
- DO NOT RUN.
- If the bear begins to follow you, drop your pack or some article, (not food) to distract the bear. This may distract the bear long enough for you to escape. If you drop food for the bear – you will help the bear associate food with humans and teach it that aggressive behaviour will be rewarded with food.
- If it is a grizzly following you, climb a tree if there is a large tree around. Proper escape up a tree would require sclimbing at least 33 feet (10 m), however this is applicable only to Grizzly encoutners. Black bears are excellent climbers. Tree climbing should be last resort.

6.6 If the bear is aware of you and close:

- A bear will feel threatened in a close confrontation. The bear's natural tendency will be to reduce or to remove the threat. Assist the bear by acting as non-threatening as possible.
- Do not make direct eye contact with the bear.
- Do not make any sudden moves.
- Do not run!

- The bear needs to identify you as a person, so talk in low tones and slowly wave your arms over your head.
- Attempt to give the bear an opportunity to leave. Be sure the bear has an open escape route. Do not corner a wild animal.
- Try to back away slowly and/or climb a tree if appropriate.
- Attempt to deter the bear if you are in a safe position.

6.7 If the bear is close and threatening:

- If you have a deterrent such as a bear banger or bear spray, be prepared to use it depending on how close the bear is. Try to scare the bear off.
- If you do not have a deterrent, or if using the deterrent is not successful, act as non-threatening as possible.
- Talk to the bear in a calm authoritative tone of voice.
- Do not startle or provoke the bear by making sudden moves.
- Never imitate the bear's aggressive sounds, signals or posture. The bear is attempting to establish dominance and imitating its moves is a challenge to its dominance.
- Back slowly away from the bear and drop a pack or some other article in order to distract the bear momentarily.
- Remember that the bear may be defending cubs that you have not yet seen or they have a food cache nearby. Attempt to look as non-threatening as possible.

6.8 If the bear is very close and approaching:

- A distance of less than 164 feet (50 meters) in an open area and closer in a forested area.
- If the bear continues to approach, use your deterrent.
- If the bear does not respond to the deterrent you must now STAND YOUR GROUND!
- If the bear continues to approach and is acting aggressive, YOU MAY HAVE TO SHOOT if you are carrying a firearm.

6.9 If the Bear Charges:

- A bear will charge you at high speed down on all four legs and often crouched low to the ground.
- Bears do not charge when standing up on the hind legs.
- Many charges are bluffs and the bear will often stop or veer off just at the last minute. It is difficult to know if the bear is bluff charging or not until it gets very close.
- When faced with a charging bear you have two options:
    - Use your bear deterrent; or
    - Roll into a ball and cover your neck and head with your arms if you are unarmed and have no other choice.

Americas

Small Mammals

S3AM-313-ATT11

1.0 Hazard

1.1 Working in the field either directly or indirectly with small mammals has inherent risks of injury or exposure to zoonotic diseases (infectious diseases that can be transmitted from animals to humans) that all field staff need to protect themselves against.

1.2 The risks are usually higher when there is direct contact with a wild animal, either through a break in the skin (blood), saliva, or excrement; however, there are also risks through air-borne diseases (e.g., Hantavirus).

1.3 Obviously, wildlife biologists directly handling wildlife, dead or alive, or working with wildlife feces or in enclosed habitats (such as caves), have an increased risk of exposure to a wider range of zoonotic diseases and should take extra precautions.

2.0 Personal Protective Equipment

2.1 Full-length clothing (long sleeves and pants)

2.2 Insect repellent

2.3 Respiratory equipment (when directly handling wildlife)

2.4 Gloves (when directly handling wildlife)

3.0 References

3.1 None.

4.0 Restrictions

4.1 Wildlife handling must only be completed under direct supervision of an experienced individual.

5.0 Training

5.1 Any staff that will be handling wildlife must be adequately trained and/or supervised by a wildlife biologist experienced in the job task.

6.0 Safe Work Practice

6.1 Wild animals can carry a variety of diseases that humans can contract: viral, parasitic, bacterial, and protozoal. Basic Personal Protective Equipment such as full-length clothing, gloves and a respiratory mask will greatly reduce the risk of exposure.

6.2 Treat unknown dogs encountered in field activities in the same manner as a wild animal. Be conscious of behaviors that seem to indicate anxiety (tail under the belly), defensiveness or aggressiveness, and attempt to leave the area if these are identified.

6.3 Whenever a wild animal must be handled, the procedure must be accomplished as safely and quickly as possible.

6.4 Proper techniques must be employed to avoid or minimize the risk of personal injury while, at the same time, avoiding or minimizing injury to the animal.

6.5 Gloves, catch sticks, caging, and other appropriate equipment may be necessary when handling a wild animal. Most of these animals will be extremely stressed, resisting every restraint attempt.

6.6 In the unfortunate circumstance that a person is bitten or scratched, he or she should cleanse the wound thoroughly with soap and flush with water immediately, providing for a mechanical removal of potentially infective organisms. This should be followed by cleansing under medical supervision and consultation with a physician to consider the potential exposure to the rabies virus.

7.0 Rabies

7.1 You will not be able to accurately determine if an animal has rabies simply by observation as traditional symptoms of rabies (foaming at the mouth, biting, etc.) do not occur in all animals nor at all stages. There are some mammals that are at a higher risk than others for the rabies virus, such as raccoons, skunks, stray cats and dogs, foxes, coyotes, rodents. and bats; however, any mammal can contract the virus.

7.2 Rabies is contracted by contact of an infected animal's saliva with an open wound – a bite or a scratch.

7.3 Symptoms of rabies in humans usually do not present themselves for a minimum of 10 days to a year or longer (the average is 30 to 50 days). Symptoms are typical of a flu, including malaise, loss of appetite, fatigue, headache, and fever. Over half of all patients have pain (sometimes itching) or numbness at the site of exposure. They may complain of insomnia or depression. Two to ten days later, signs of nervous system damage appear; these include hyperactivity and hypersensitivity, disorientation, hallucinations, seizures, and paralysis.

7.4 Because rabies is so difficult to detect and positively identify, it is very important to consult a physician immediately. If rabies is a possibility, begin treatment with the rabies vaccine as soon as possible (unlike other vaccines, rabies vaccination begins after exposure because the virus takes a comparatively long time to induce disease).

8.0 Hantavirus

8.1 Rodents can carry a variety of diseases; of notable concern is the North American hantavirus which can cause Hantavirus Pulmonary Syndrome (HPS).

8.2 A common host of the hantavirus is deer mouse and related species (*Peromyscus* spp.), which are common throughout much of North America.

8.3 Although infection is rare, it can be fatal and, therefore, it is necessary that risk of exposure be minimized. Infection can be spread to humans when they:

8.3.1 Breathe air contaminated by deer mouse saliva, urine or feces containing infectious hantaviruses; or

8.3.2 Accidentally rub eyes, mouth or broken skin with hantavirus-infected deer mouse saliva, urine or feces.

8.4 The following precautions will be taken for all field operations:

8.4.1 Limit exposure to soils handling and use gloves where appropriate.

8.4.2 Wash or sanitize hands often throughout the day and before meals.

8.4.3 Equipment bags, storage areas, and vehicles will be inspected daily for signs of deer mouse infestation.

8.4.4 Rodent-proof storage containers will be used when practical.

8.4.5 Do not enter buildings infested with deer mice without adequate respiratory protection.

8.4.6 Droppings should never be removed by vacuuming or sweeping. Wetting down an area with a mixture of 1:9 household bleach and water solution will reduce risk of airborne exposure.

8.5 If flu-like symptoms develop three days to six weeks after exposure to rodents, a doctor should be contacted immediately (mechanical ventilation is the primary method of treatment).

9.0 Bubonic Plague

9.1 The bacteria that cause plague, *Yersinia pestis*, maintain their existence in a cycle involving rodents and their fleas.

9.1.1 In urban areas or places with dense rat infestations, the plague bacteria can cycle between rats and their fleas.

9.1.2 Humans may contract the plague bacteria through:

- Infected flea bites.
- Contact with contaminated fluid or tissue of a plague infected animal.
- Infectious droplets from an infected person coughing into the air (very uncommon in the United States, but relatively frequent in developing countries.

9.1.3 Individuals infected develop sudden onset of fever, headache, chills, and weakness and one or more swollen, tender and painful lymph nodes (called buboes).

9.1.4 Immediate medical attention is necessary to prevent complications or death.

9.1.5 Rodent control measures should be employed at AECOM locations.

9.1.6 Wear gloves if handling potentially infected animals to prevent contact between skin and the plague bacteria. Contact the local health department with and questions about disposal of dead animals.

9.1.7 Repellent shall be used if there is potential exposure to rodent fleas. Products containing DEET can be applied to the skin as well as clothing and products containing permethrin can be applied to clothing (always follow instructions on the label).

Americas

Snakes & Scorpions

S3AM-313-ATT12

1.0 Hazard

1.1 Snakes have the ability to inject venom. A bite from a venomous snake, which may inject varying degrees of toxic venom, is rarely fatal but should always be considered a medical emergency.

2.0 Personal Protective Equipment

2.1 Long pants and shirts

2.2 Heavy gloves if staff will be handling debris or be close to the ground

2.3 Rubber boots, or boots that fully cover the foot (not sandals!) and preferably are at least 10 inches (25 centimeters) high

2.4 Snake Chaps that cover at least the shin

2.5 Personal first aid kit

3.0 Restrictions

3.1 Staff must not work alone in areas where the risk of a snake encounter is high.

4.0 Safe Work Practice

4.1 Prior to going into the field, staff should research the area and identify what species are present. Once confirmed, staff should contact local hospitals to identify which carry anti-venom and include that information into the SH&E Plan and THA.

4.2 Staff working in areas known to be inhabited by venomous snakes should take extra precautions, be able to identify the local snake species, and understand the best practices for administering first aid.

4.3 Most snakes in Canada are non-venomous; and most snake bites are not fatal, only painful. Learning to identify snake species will assist you in responding appropriately to an encounter, and will assist medical professionals in determining if antivenin needs to be administered if anyone is bit.

4.4 Most snakes are non-aggressive and will only attack if immediately threatened.

4.5 Prevention

4.5.1 Before venturing out into the wilderness, familiarize yourself with the snakes in your area, both venomous and non-venomous species.

4.5.2 Learn which habitats the venomous species in your region are likely to be encountered in, and use caution when in those habitats.

4.5.3 Try as much as possible not to take a snake by surprise.

4.5.4 Stay on trails where possible, and watch where you place your hands and feet, especially when climbing or stepping over fences, large rocks, and logs, or when collecting firewood. Take care when overturning any objects on the ground when in snake country.

4.5.5 If you see a snake, give it as much room as possible. Most snakes have a strike distance that is only half the length of their body.

4.5.6 If you get very close to a rattlesnake, hold very still until it calms down and starts to move away. Then slowly move backwards until you are at least one snake-body length away.

4.6 Treatment

4.6.1 A bite from a venomous snake should be considered a major medical emergency. Emergency services should be contacted immediately and staff should follow the direction of the medical responders.

4.6.2 Try to keep the snakebite victim still, as movement helps the venom spread through the body.

4.6.3 Keep the injured body part motionless and just below heart level.

4.6.4 Keep the victim warm, calm, and at rest, and transport him or her immediately to medical care.

4.6.5 Do not allow him to eat or drink anything.

4.6.6 If medical care is more than half an hour away, wrap a bandage a few inches above the bite, keeping it loose enough to enable blood flow (you should be able to fit a finger beneath it). Do not cut off blood flow with a tight tourniquet. Leave the bandage in place until reaching medical care.

4.6.7 Identify the snake that caused the bite to determine if it is venomous, and if antivenin needs to be administered. Do not waste time or endanger yourself trying to capture or kill it. Note the shape and color of the snake's head.

4.6.8 If you are alone and on foot, start walking slowly toward help, exerting the injured area as little as possible.

- Note that there are several species of snakes that superficially resemble rattlesnakes. Several species, including Bull, Milk, Fox, and Rat Snakes will even rattle their tails when startled.
- Massasauga Rattlesnake is recognized as a Threatened Species in Ontario and it is an offence to harass, or destroy the habitat of this species.

4.6.9 Workers in scorpion habitat have the potential to be stung.

- Scorpions usually hide during the day and are active at night. They may be hiding under rocks, wood, or anything else lying on the ground. Some species may also burrow into the ground. Most scorpions live in dry, desert areas. However, some species can be found in grasslands, forests, and inside caves.
- Scorpions are found in Southern and Southwestern United States.
- One scorpion species, the Northern Scorpion (*Paruroctonus boreus*) occurs in semi-arid areas of southern British Columbia, Alberta, and Saskatchewan. It carries a stinger on the end of its tail. The sting is painful but not life threatening unless there is an allergic reaction.
- Workers should wear longsleeves and pants. Clothing and shoes should be shaken out before putton on.
- Symptoms of a scorpion sting may include:
  - A stinging or burning sensation at the injection site (very little swelling or inflammation)
  - Convulsions
  - Staggering gait
  - Slurred speech
  - Drooling
  - Muscle twitches
  - Abdominal pain and cramps
- Scorpion stings may be painful, but most are harmless. In the United States, only the Bark Scorpion has venom that can potentially cause severe symptoms.
- Scorpions capable of lethal stings are found predominantly in Mexico and South America.
- If the is any question as to what type of scorpion caused the sting, contact medical services immediately.

5.0 Species

5.1 Venomous Snakes in Canada

Eastern Massasauga Rattlesnake (*Sistrurus catenatus*) found around Wainfleet, Windsor, Bruce Penninsula and eastern Georgian Bay in Ontario.	 Eastern Massasauga Rattlesnake picture by Michael Redmer/Courtesy Lincoln Park Zoo
Northern Pacific Rattlesnake (*Crotalus viridis*) found primarily in Okanagan and Thompson River valleys of southern British Columbia.	
Prairie Rattlesnake (*Crotalus viridis*) found in south eastern Alberta, and south western Saskatchewan.	

5.2 Venomous snakes in the United States

Rattlesnake(*Crotalus cerastes)* found mostly concentrated in the southwestern United States, they extend north, east and south in diminishing numbers and varieties. Every contiguous state has one or more varieties of rattlesnake. The rattlesnake is found in many different biomes ranging from along the coast at sea level, the inland prairies and desert areas to the mountains at elevations of more than 10,000 feet. Species include: Sidewinder, Santa Catalina, Western,	 Western Rattlesnake

Mojave, Red Diamond, Western Diamond, Ridge Nosed, Eastern Diamondback, and Pigmy.	 Eastern Diamondback
Copperhead (*Agkistrodon contortrix*) is the most common venomous snake found in the eastern United States. It can be found in the states of Texas, Oklahoma, Kansas, Missouri, Arkansas, Louisiana, Mississippi, Alabama, Georgia, Florida, South Carolina, North Carolina, Tennessee, Kentucky, Virginia, Illinois, Indiana, Ohio, Iowa, Pennsylvania, Maryland, New Jersey, Delaware, New York, Connecticut, and Massachusetts.	
Cottonmouths (water moccasins) (*Agkistrodon piscivorus)* found in the eastern United States from Virginia, south through the Florida peninsula and west to Arkansas, eastern and southern Oklahoma, and east and central Texas.	
Coral Snake (*Micrurus sp.)* found in the southern range of many temperate United States including North Carolina, Georgia, Alabama, Mississippi, Louisiana, Texas, Arkansas, Kentucky, Arizona, and New Mexico.	 Eastern Coral Snake, *Micrurus fulvius*

Americas

Working Alone

S3AM-314-PR1

1.0 Purpose and Scope

1.1 This procedure establishes the requirements for communication and accountability between personnel at a work site to reduce the potential for incidents occurring to one employee without help readily available and to facilitate the rapid mustering of assistance to employees in the event of an emergency.

1.2 This procedure applies to all AECOM America-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 **Buddy System** – A system of organizing employees at a work site in such a manner that each employee is accompanied by or in communication with at least one other employee or is escorted by a client or contractor representative during work site activities.

2.2 **Controlled Work Areas** – One or more designated work areas on a field project site where hazardous activities and/or strictly defined operations take place. Such controlled work areas include, but are not limited to, remediation or construction sites; a restricted radius where a critical lift operation will take place could be declared a controlled work area. On a HAZWOPER site, the controlled work area is divided into the exclusion zone, the contaminated reduction zone, and the support zone.

2.3 **Working Alone** – Performing work with no line of sight or direct voice communication with another person who is aware of your assignment and capable of initiating emergency response.

3.0 References

3.1 S3AM-005-PR1 Driving

3.2 S3AM-209-PR1 Risk Assessment & Management

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager or Supervisor**

- Establish if employee is permitted to work alone, through evaluation of employee's experience, training and any personal limitations (e.g. life-threatening allergic reactions).
- Provide the resources, communication devices, emergency response plans, and check-in procedures as listed in the Task Hazard Assessment (THA) or SH&E plan, etc. necessary so that employees are not working alone or have a buddy system in place.
- Act as point of contact if employees miss their check-in.

4.1.2 **Employees**

- Complete training as required to prepare for working alone.
- Confirm emergency contacts are provided to the Manager or supervisor in case of an emergency.
- Establish a buddy system and check in procedure in accordance with the THA or SH&E Plan provided by the Manager and Supervisor.

4.1.3 **SH&E Managers**

- Review and approve relevant planning documents entailing employees working alone and on remote travel.

4.2 General

4.2.1 All projects/programs shall conduct a review of all tasks performed by AECOM to establish specific work alone procedural requirements as defined here. They shall have at minimum a THA and SH&E Plan that has been reviewed by the SH&E Manager.

4.2.2 Employees are discouraged from working alone on any site due to the risk of delayed assistance in the event of an incident. If they will be out of contact with other employees, they shall establish a buddy system or check-in procedure with another employee or responsible person.

4.2.3 Employees working alone or in small crews in remote isolation shall have an effective means of communication including cell/radio/satellite phone as well as established check-in times.

4.2.4 When traveling alone, staff shall take appropriate precautions, including notifying someone of their travel plans as well as carrying a communication device and safety equipment, as appropriate. See *S3AM-005-FM1 Journey Management Plan*.

4.3 No employee shall work by themselves or without a buddy system established if they are conducting a hazardous job task.

4.3.1 The following tasks are considered hazardous:

- Working at heights.
- Working in a confined space.
- Working in a trench.
- Lock out/tag out tasks.
- Work on energized equipment.
- Working with electricity.
- Working with hazardous substances or materials.
- Working with material under pressure.
- Working where there is a possible threat of violence, including civil unrest.
- Working in avalanche areas.
- Working on water or ice.
- Working in remote or wilderness isolation.
- Working in a controlled area.
- Extreme heat or cold stress environments.
- Working with power tools/equipment.
- Working with/operating heavy equipment or machinery.
- Working in isolation from first aid services or immediate/emergency assistance.
- Working around mobile equipment.
- Highway and road work.

4.3.2 The following tasks (identified as hazardous) may permit working alone provided it can be demonstrated there is no substantial increased risk associated with working alone:

- Working with power tools/equipment (e.g. power drill versus chainsaw).

- Working with material under pressure (e.g. small air compressor versus compressed gasses).

4.4 Office Work

4.4.1 The supervisor shall have in place and shall communicate as part of location specific orientation, its procedures for the safety and security of an employee working alone in the office. Contact numbers to be used in case of emergency are posted at all common gathering areas or major exits.

4.4.2 Employees working in the office after regular working hours or in situations where they are working alone shall keep the entrance to the office locked.

4.4.3 If the building is monitored by a security service, employees working in the office after regular working hours or working alone shall notify the security guard of their presence and anticipated hours. If the building does not have a security service, the employee working alone shall notify their supervisor or a family member or friend if agreed to by their supervisor.

4.4.4 During all working hours, employees shall stay alert to unauthorized entries into the building and to other suspicious activities and shall report them to security or their supervisor immediately.

4.5 Field Work

4.5.1 Prior to work commencing, a THA shall be prepared for all assignments on which employees are to work alone (in accordance with *S3AM-209-PR1 Risk Assessment & Management*). The THA shall consider travel time, weather, available communications, and the impact of working alone when establishing risk ratings of the hazards associated with the task and work environment.

4.5.2 The THA should also consider whether the employee assigned to work alone has sufficient training and qualifications in the tasks to be performed to allow the employee to work safely alone. The employee's personal medical conditions may be considered if the employee has voluntarily made the medical condition known to the Manager or Supervisor.

4.5.3 The THA should identify the controls required for the safety of employees as applicable to the job task and location. Some controls associated with working alone or in remote isolation include a buddy system, standardized check-in times, what to do if a check-in is missed (e.g. worker in proximity attends site, utilizing secondary communication method, etc.), specialized communication devices, and enhanced emergency supply kits.

4.5.4 The THA is completed in addition to the SH&E plan which details the work activities and the procedures to manage the hazards and in accordance with *S3AM-209-PR1 Risk Assessment & Management*.

4.6 Buddy System

4.6.1 When conducting non-hazardous work, employees shall work with a buddy (another responsible individual) or follow check –in procedures listed in the THA or SH&E Plan.

4.6.2 When conducting hazardous work, employees shall work with a buddy (another responsible individual) at all times.

4.6.3 Once assigned as buddies, personnel shall remain in contact.

4.6.4 When electronic communication devices are used, prior to starting work, a protocol shall be established and agreed to by each buddy to confirm that periodic effective and faultless communications are maintained

4.6.5 When unanticipated conditions develop that do not permit line of sight and direct voice contact, and alternate communication was not established in the THA, Stop Work and notify the Supervisor. If permission from the Supervisor is obtained to continue the work, voice contact shall be achieved using reliable electronic communication devices such as, but not limited to, hand-held radio or cell phone. The THA shall be updated to reflect this change.

4.6.6 If crews will separate once they reach their work site, they shall then be considered to be "working alone". The buddy system or check-in procedures shall be established, as determined by the work being hazardous or non-hazardous and as identified in the THA.

4.6.7 Client or contractor personnel may be substituted for an AECOM employee's buddy only if they are designated by the client or contractor and the AECOM manager or supervisor, and are properly trained to the tasks and the site's emergency response procedures.

4.6.8 A missed communication event shall initiate the applicable missed check-in actions established in the THA (e.g. worker in proximity attends site, utilizing secondary communication method, etc.) and may trigger emergency response procedures. The results of each communication event shall be documented in the program or project files.

4.7 Check-In Procedures

4.7.1 All field crews shall establish check-in procedures as part of the THA or SH&E Plan prior to leaving the office. These procedures shall be reviewed daily as part of the Task Hazard Assessment review or more frequently if there is a change in work arrangements that could adversely affect a worker's well-being or a report that the system is not working effectively. These procedures shall be confirmed with the assigned Check-In Person daily.

4.7.2 The timing and frequency of those check-in procedures schedule shall be established prior to the initiation of field operations and shall vary depending on the task and location of the work.

4.7.3 If communication is lost between buddies or a check-in time is missed, it shall be assumed that an emergency situation exists, and the site's emergency response procedures shall be implemented. Site work shall cease until the emergency is resolved and the Supervisor directs personnel to restart work.

4.7.4 If crews will separate once they reach their field site, they will then be considered to be "working alone" and will establish a buddy system with the other members of the crew.

4.7.5 Employees working alone or in small crews in remote isolation will have an effective means of communication system including cell/radio/satellite phone as well as established check-in times.

4.7.6 The Check-In Procedure will be reviewed daily as part of the THA review or more frequently if there is a change in work arrangements that could adversely affect a worker's well-being or a report that the system is not working effectively.

4.8 Emergency Response Procedures

4.8.1 All field employees and the Check-In Person shall be provided with the location specific Emergency Response Plan (may be included in the THA or SH&E plan, or exist as a separate document).

4.8.2 The Check-In Person shall have access to a route map or understands their anticipated route of travel.

4.8.3 The established contact person shall follow the procedures below, with specifics established in the SWP Plan or THA, if a field employee has missed a check-in:

- First, they shall attempt to make contact with the field employee directly.
- If that fails to provide a response, they shall contact other persons who may have been on site, including client supervisors, or other locations where the field employee might be (e.g., hotel, home, office).
- If the field employee still cannot be located, the emergency contact person notifies the manager or supervisor responsible for the employee.
- Depending on the location and situation, they shall then dispatch another employee, another supervisor, or an appropriate emergency response agency (e.g., police) to travel to the last known location of the field employee.
- If the dispatched responder arrives at the site but cannot locate the field employee, the appropriate public emergency contacts (e.g., police, search and rescue) shall be made and the employee's personal contacts shall be notified by Human Resources.

- If the dispatched responder finds the crew in an emergency situation (medical, environmental, structural, etc.), the appropriate steps shall be taken to isolate the hazard, administer first aid, and contact emergency support services.

4.9 Training

4.9.1 All employees shall receive an initial orientation that includes the hazards and controls associated with working alone.

4.9.2 If working in wilderness, all field employees will be able to orienteer using a map and compass—if not, the basic skills of orienteering will be provided by an experienced employee before work commences. Refer to the *S3AM-314-ATT1 Wilderness Isolation* instruction for more specifics.

4.9.3 Employees working alone should be trained in First Aid. Consideration should be given to Wilderness First Aid training based on the anticipated work environment.

4.9.4 Employees regularly working in remote, isolated wilderness locations will either participate in a wilderness survival course from a qualified provider (one or two day) or will obtain management approval based on their level of experience/competence in wilderness situations.

5.0 Records

5.1 None

6.0 Attachments

6.1 S3AM-314-ATT1 Wilderness Isolation

Americas

Wilderness Isolation

S3AM-314-ATT1

1.0 Planning

1.1 Working in wilderness isolation presents many more potential hazards and should only be conducted by teams with documented experience, safety plans, and equipment appropriate for the tasks and conditions of the work.

1.2 A safety plan and Task Hazard Analysis will be reviewed by the SH&E Manager.

2.0 Safety Equipment

2.1 All field employees should regularly carry the following on their person:

- GPS Unit.
- Compass.
- Lighter, matches, or a "flint' of fire steel.
- A knife or folding saw.
- Map.
- First aid kit.
- Communication device appropriate to the type of coverage anticipated in the area.

2.2 When hiking long distances, it is recommended that a “mini survival kit” that includes the following items be carried in addition to the items listed above:

- Fire starter (tinder). Cotton balls with lip balm work well, or paper egg cartons with cotton balls and paraffin wax; if buying commercial fire starter, test it after several months.
- A whistle.
- Heavy tinfoil (to melt snow, to cook on, or to boil water in).
- Water and/or portable water purification device (e.g. steri-pens®).
- Some high-energy food.
- Cordage or rope (about 50 feet).
- Bear spray and/or bear bangers.

2.3 When using an ATV or helicopter for isolated work, it is recommended that a survival bag or backpack that can be left at a known muster point be put together. This bag should include the following items:

- Additional fire starter (tinder).
- Matches, fire steel.
- A multi-tool (like a Swiss Army knife).
- A folding saw.
- 3-8'x6" tarps plus one 12 X 16" tarp or larger (or a tent).
- 100 " of utility cord or parachute cord.
- A small pot.
- A small stove (a small folding military stoves with trioxethelyne tablets will work well).
- Closed cell foam pads or several square feet of double-wall bubble insulation (the silver sided bubble wrap used in construction) to use as a sleeping pad or for hypothermia treatment.
- Emergency Food.
- Water.
- Sleeping bag with a mylar® bivouac (bivy) sack to be used as a vapor barrier inside.

3.0 Drinking Water

3.1 No surface water can be considered safe for human consumption without treatment. Even the cleanest looking spring water could be polluted. Untreated water may be contaminated with bacteria, viruses, or protozoa.

3.2 On short trips, carry treated water or obtain water from another safe source.

3.3 When field projects take you into remote isolation where there is the potential for not having access to clean drinking water, be sure to take the appropriate tools with you: a water filter, tin foil or a pot for boiling water, or tablets or chemicals for treating the water prior to consumption.

3.4 Generally, the chances of finding safe drinking water in the mountains increase as you gain altitude. Intense sunlight at high altitudes kills undesirable bacteria and viruses but harmful cysts are unaffected.

3.5 Runoff water from streams below glaciers is often cloudy with silt and should be filtered.

3.6 Well water and moving rivers are the best locations to obtain water. Avoid stagnant water, shoreline water, and water close to human habitations and campsites.

3.7 During the winter, it is best to use an open water source or to obtain water through a hole in the ice. Check the safety of the ice first. Melting ice and snow consumes fuel and takes extra time. Eating snow or ice directly can lead to chilling and hypothermia and could also cause stomach cramps and headaches. Beware of colored snow, which indicates the presence of algae that could cause diarrhea if ingested. Even in winter, all water should be purified.

3.8 Water Treatment

3.8.1 Each method of water treatment has its advantages and disadvantages. Use only boiled or treated (filtered and disinfected) water for drinking, brushing teeth, or washing fruits and vegetables that will be eaten raw. Heat is the oldest, safest and most effective method of purifying water. However when boiling is not practical because of time and lack of a heat source, water should be treated by filtration and disinfection .This method may not be as effective as boiling the water.

3.8.2 Use two water containers: one for treating water and the other for carrying purified water. After disinfection, shake the container vigorously. Wait five minutes. Shake it again with the lid loose so that some water leaks out to cleanse the mouth of the container. Then pour the water into a clean container for drinking water.

3.8.3 Boiling. Bring the water to a boil for at least one minute (adding one more minute for each 300 m (1000 ft.) above sea level. If the water is cloudy, filter it before boiling.

3.8.4 Filtration. Water filters for use in the wilderness are available. Avoid filters that allow particles larger than 0.5 microns to pass. Filters with a pore size of 0.1 to 0.3 micron can remove protozoa and some bacteria but may not remove viruses. Filtration alone is insufficient to purify water; hence, it should be combined with disinfection to kill viruses and bacteria.

3.8.5 Disinfection. Disinfect with chlorine or iodine compounds, following the manufacturers instructions. Disinfection alone may not kill some protozoa..

Table 1: Summary of Water Purification Methods

	Boiling	Chlorine	Iodine	Filters
Bacteria	E	E	E	M
Viruses	E	E	E	N
Protozoa	E	M	M	M
Chemicals	M	N	N	N

E = effective M = may be effective (see text) N = not effective

3.8.6 Additional portable water purification devices are available, using methods such as ozone disinfection, ultraviolet purification, or solar water disinfection.

3.8.7 Water treatment methods should be evaluated for suitability to the work environment, the potential water hazards, and limitation of the device.

3.8.8 Some water-borne diseases are difficult to diagnose. If you are not feeling well and have recently drunk water from a source in the wild, inform your doctor that you may have consumed untreated water.

Americas

Material Storage

S3AM-316-PR1

1.0 Purpose and Scope

1.1 This procedure applies to all AECOM Americas-based employees and operations, and any other entity and its personnel contractually required to comply with this document's content, where materials are stored and used. Note that this standard does not address manual material handling (e.g., manual lifting, lowering, pushing, pulling, carrying, holding, or restraining). Information on manual material handling can be found in *S3AM-014-PR1 Manual Lifting*.

1.2 The purpose of this standard is to ensure the safety of AECOM personnel during the storage of materials.

2.0 Terms and Definitions

2.1 None

3.0 References

3.1 S3AM-014-PR1 Manual Lifting

3.2 S3AM-115-PR1 Hazardous Materials Communication

4.0 Procedure

4.1 Implementation of this standard is the responsibility of the Manager directing activities of the facility, site, or project location.

4.2 Employees shall be properly trained and follow the established procedures applicable to the material stored.

4.3 General

4.3.1 Consult additional applicable jurisdictional requirements and AECOM procedures for specific tasks, materials, and equipment involved in material storage operations.

4.3.2 Storage areas should be specifically designated and be clearly marked. Aisles should be clearly marked, be of ample width for the type of storage, and be kept free from obstacles and trash.

4.3.3 Store materials in a manner that prevents damage or deterioration to the material and in a configuration that is safe and provides for the optimal and efficient use of storage space.

4.3.4 Material must not be stacked within 18 inches of the sprinkler heads Material should be kept well clear of light fittings, heating pipes and ceilings.

4.3.5 Ensure that stacks are stable and self-supporting.

- Stack symmetrically.
- Base areas and heights of stacks should be kept as small as circumstances permit. The ratio of height to base dimensions of large stacks should be correctly proportioned so that failure of part or whole of the stack does not occur.
- Experience has shown that the height to base ratio of an unsupported stack should not exceed 3 to 1.
- As most stacks are erected by visual alignment, a slight error in calculation near the base can easily result in a barely noticeable overhang, with a resultant loss of stability.

- Where effective banding and shrink wrapping can be achieved, the ratio of height to base can be safely increased to 4 to 1.
- Stable construction of the stack is entirely dependent upon the following factors:
  - Safe relation of height to dimension of base;
  - Sound interlocking of the material;
  - Contents of the cartons;
  - Shape of articles

4.3.6 Post maximum safe loads for all floors above grade in pounds per square foot.

4.3.7 As applicable, stack, rack, block, interlock, band or shrink-wrap, or otherwise secure all materials to be stored in tiers to prevent sliding, falling, or collapse.

4.3.8 De-stacking is largely the reverse process of stacking. Most accidents involving the collapse of stacked materials occur during de-stacking. The prime cause of this is haphazard removal. All stacking and de-stacking should be carried out under competent supervision. Basic rules for breaking down stacks are:

- One person should be responsible for the manner in which the stack is reduced;
- The stack should be taken down tier by tier and;
- As there is a high tripping hazard in the working area of a stack, tidiness and systematic work methods are essential.

4.3.9 Keep aisles, passageways, and other access ways clear to provide for the free and safe movement of material-handling equipment or employees. Mark all permanent aisles.

4.3.10 Segregate and label non-compatible materials. Refer to *S3AM-117-PR1 Hazardous Materials Communication*.

4.3.11 When loads swing freely, confirm non-compatible materials are segregated. Do not lift loads or swing over the heads of persons; it is not permitted to walk under a load. Wear hardhats in these areas.

4.3.12 Do not place material stored inside buildings under construction within 6 feet (1.8 meters) of any hoistway or inside floor openings, or within 10 feet (3 meters) of any exterior wall lower than the top of the material stored.

4.3.13 Pallets should be of sound construction, and be of adequate strength for the loads and conditions under which they are used. Where pallet loads are stacked tier on tier, the unit loads must be able to support the weight above.

4.3.14 Stacks, shelving and other fixtures for holding or storing materials should be so laid out and designed that there is sufficient access for safe loading and unloading by either manual or mechanical means

4.4 Stacking Frames

4.4.1 Conduct a visual inspection of the stacking frames prior to loading for damage (e.g., bent, twisted, broken or excessive rust). Remove from service any stacking frames that fall into any of these categories.

4.4.2 Several pallets can be loaded on a stacking frame provided they are stable and will not fall.

4.4.3 If more than one (1) pallet is placed on a stacking frame and materials are unstable or appear to be capable of falling, the pallets will be shrink-wrapped or banded together or stored in another storage location.

4.4.4 Do not exceed the maximum load of the stacking frame. Be sure to include the weight of the stacking frame in the maximum load calculation.

4.4.5 Material on a stacking frame will not extend above the top rail if another stacking frame is to be placed on top of the lower frame.

- The highest or top stacking frame may have material that extends above the top rails, but the pallet itself must be below the top rails and the material secured.

4.4.6 Stacking frames will only be stacked high enough for forklift forks to be able to reach and remove one (1) frame at a time. At no time will they be stacked higher than five (5) high regardless of the dimensions of the stacking frame. Material placed on the top rack will be banded or shrink wrapped (if applicable).

4.4.7 Do not mix stacking frames manufactured by different companies (e.g., a UNICOR with a Nestainer or other manufacturer).

- Stacking frames of different colors can be intermingled but will be of the same dimensions and manufacturer (e.g., UNICOR to UNICOR, Nestainer to Nestainer).

4.4.8 The 1st (lowest) stacking frame will have the greatest amount of weight. The subsequent frames will, if possible, have less weight than the frame immediately below it. This is to avoid top heaviness.

4.4.9 When picking up a stacking frame, ensure the MHE forks are securely seated into the two (2) stirrups of the frame. When traveling, maintain a clear field of vision and travel in reverse if vision is obstructed by the load. Sound your horn at all intersections and blind spots.

4.4.10 Transport one (1) loaded stacking frame at a time.

4.4.11 When traveling with a pallet, keep load as low as possible. Do not bulldoze pallets or stacking frames.

4.5 Bagged Materials

4.5.1 Provide bags of cement and lime stacked over ten bags high with restraining walls of appropriate strength.

4.5.2 Stack cement, lime, and similar materials in bags so that the mouths of the outside bags are facing the center of the stack.

4.5.3 During un-stacking, keep the entire top of the stack nearly level, and maintain the necessary setback.

4.5.4 Warn employees handling cement or lime about skin burns, and ensure that goggles, gloves, and clothing that fits snugly about the neck and wrists are worn.

4.5.5 Lime must be stored to prevent a premature slaking action that may cause fire.

4.6 Bricks and Blocks

4.6.1 Brick stacks must not exceed 7 feet (2.1 meters), and they should be tapered back starting at 4 feet (1.2 meters).

4.6.2 Always stack bricks on planks, asphalt, or concrete, and never on uneven or soft surfaces.

4.6.3 Keep the top of brick stacks level and maintain the taper during un-stacking operations.

4.6.4 Stack blocks in tiers on solid, level surfaces, and taper back over the 6-foot (1.8-meter) level.

4.7 Lumber

4.7.1 When stacking lumber, place cross strips on stacks more than 4 feet (1.2 meters) high.

4.7.2 Remove all nails from used lumber before stacking, unless the lumber is to be burned or hauled away without further handling.

4.7.3 Stack lumber on level and solidly supported sills to be stable and self-supporting.

4.7.4 Do not stack lumber more than 16 feet (4.9 meters) high.

4.8 Reinforcing and Structural Steel

4.8.1 Store steel rods in separate stacks according to length and size.

4.8.2 Carefully stack structural steel to prevent the danger of members sliding off, or the stack toppling over.

4.8.3 Never store “I” beams with the webs vertical.

4.9 Foundation Bolts

4.9.1 Stack bolts in separate stacks according to length and size.

4.10 Corrugated and Flat Iron

4.10.1 Stack corrugated and flat iron flat, and not more than 4 feet (1.2 meters) high.

4.10.2 Place spacing strips between bundles.

4.11 Pipes, Poles, and other Cylindrical Material

4.11.1 Stack and block cylindrical material in such a way to keep the material from spreading or toppling.

4.11.2 Do not stack pipes higher than 5 feet (1.5 meters) unless racked.

4.11.3 When removing pipe or other material larger than 2 inches (5 centimeters) in diameter from storage, and where stacked pipe runs in one direction and is more than one pipe high, employees will be instructed to approach the stack from the ends, not from the sides.

4.12 Sand, Gravel, and Crushed Stone

4.12.1 While removing sand, gravel, and crushed stone from stockpiles, ensure there are no overhanging or vertical faces at any time.

4.12.2 Do not store material dumped against walls or partitions to a height that will endanger the stability or exceed the resisting strength of such walls and partitions.

5.0 Records

5.1 No documentation maintenance is required.

6.0 Attachments

6.1 None

Americas

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S3AM-316-PR1

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5.0 Records

5.1 No documentation maintenance is required.

6.0 Attachments

6.1 None

1.0 Purpose and Scope

1.1 This procedure applies to all AECOM Americas based employees and operations and any other entity and its personnel contractually required to comply with this document's content where the potential for hand injuries is present.

1.2 This procedure is intended to protect employees from activities that may expose them to hand injury. This procedure provides information on recognizing those conditions that require personal protective equipment (PPE) or specific work practices to reduce the risk of hand injury.

1.3 All personnel shall have gloves in their immediate possession 100% of the time when in a shop or on a work site. Appropriate gloves shall be worn when employees work with or near any materials or equipment that present the potential for hand injury due to sharp edges, corrosives, flammable and irritating materials, extreme temperatures, splinters, etc.

2.0 Terms and Definitions

2.1 None

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-208-PR1 – Personal Protective Equipment

3.3 S3AM-209-PR1 – Risk Assessment & Management

3.4 S3AM-325-PR1 – Lockout Tagout

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager / Supervisor**

- Implementation of this standard for the applicable facility, site, or project location.
- Confirm employees are familiar with this procedure and have appropriate training.
- Confirm the appropriate hand protection is available on site as necessary.

4.1.2 **Employees**

- Recognize hazards to hands.
- Comply with this procedure as well as client or work location requirements.

4.1.3 **SH&E Manager**

- Advise supervisors and site personnel on matters relating to hand safety.
- Work with the manager / supervisor to confirm that sufficient PPE and equipment are available.
- Maintain contact with manager / supervisor to regularly evaluate site conditions and new information that might require modifications to this procedure.
- Conduct training or briefings, when necessary, and to explain the content of this procedure and site hazards to employees.

- Assist in investigation of incidents that resulted or could have resulted in an injury.

4.2 Hazard Assessment

4.2.1 Perform hazard assessments for those work activities likely to require Personal Protective Equipment (PPE).

- Use the Task Hazard Assessment (THA) to perform the hazard assessment (in accordance with *S3AM-209-PR1 Risk Assessment & Management*). The THA will accompany AECOM personnel at jobsites for use in the event of a job or task change, or
- Use the *Gloves Needs Assessment – S3AM-317-FM1* or equivalent to perform the assessment.
- Re-evaluate completed hazard assessments when the job or task changes.

4.2.2 The hierarchy of controls should be considered during the THA process to minimize or eliminate the need for hand protection PPE or material handling tools. Examples of controls are chemical substitution, machine guarding, and use of different tools.

4.2.3 Select PPE that will protect employees if hazards cannot be eliminated.

- Review Safety Data Sheets for project or task-specific chemicals to determine appropriate PPE. If needed, consult with a SH&E Manager for assistance.
- Review glove manufacturer recommendations for both physical and chemical protection.
- Obtain gloves of the correct size for the employees.
- When both chemical and physical protection is of concern, wear the chemical protection gloves (e.g., nitrile) inside the physical protection gloves (e.g., leather, Kevlar®).
- Nitrile gloves or equivalent chemical resistant shall always be used for protection from hazardous fluids or non-corrosive chemicals.
- Do not wear metal or metal-reinforced gloves when working with electrical equipment or on electrical services. Proper leather and/or rubber gloves designed and tested for this purpose shall be used.
- Refer to *S3AM-208-PR1 – Personal Protective Equipment* for additional information.

4.2.4 Follow glove requirements in the applicable SH&E plan.

4.3 Guidelines for Working With and Around Equipment (Hand Tools, Portable Powered Equipment)

4.3.1 General

- As applicable, employees shall be trained in the use of all tools. Refer to *S3AM-003-PR1 SH&E Training*.
- Keep hand and power tools in good repair and use them only for the task for which they were designed.
- Inspect tools before use and remove damaged or defective tools from service.
- Operate tools in accordance with manufacturer's instructions.
- Do not remove or bypass a guarding device for any reason.
- Keep surfaces and handles clean and free of excess oil to prevent slipping.
- Do not carry sharp tools in pockets.
- Clean tools and return to the toolbox or storage area upon completion of a job.

- Confirm that the wrench is in full contact (fully seated, "flat", not tilted) with the nut or bolt before applying pressure.
    - Place the body in the proper position for optimal balance and bracing to prevent falls if the tool slips.
    - Make sure hands and fingers have sufficient clearance in the event the tool slips.
    - Whenever possible, pull on a wrench and avoid pushing.
- When working with tools overhead, place tools in a holding receptacle when not in use.
- Do not throw tools from place to place or from person to person, or drop tools from heights.
- Inspect all tools prior to start-up or use to identify any defects.
- Powered hand tools shall not be capable of being locked in the ON position.
- Require that all power-fastening devices be equipped with a safety interlock capable of activation only when in contact with the work surface.
- Do not allow loose clothing, long hair, loose jewelry, rings, and chains to be worn while working with power tools or rotating equipment.
- Do not increase the leverage by adding sleeved additions (e.g. a pipe or snipe) to increase tool handle length.
- Make provisions to prevent machines from restarting through proper lockout/tagout (refer to *S3AM-325-PR1 – Lockout Tagout*).

4.3.2 Cutting Tools

- Always use the specific tool designed for the task. Tubing cutters, snips, self-retracting knives, concealed blade cutters, and related tools are task specific and minimize the risk of hand injury. For more information about cutting tools, see *S3AM-317-ATT1 Safe Alternative Tools.*
- Fixed open-blade knives (FOBK) are prohibited from use during the course of AECOM work.
    - Examples of fixed open-blade knives include pocket knives, multi-tools, hunting knives, and standard utility knives.
    - Any exception to this requirement shall require approval of the Manager / Supervisor and SH&E Manager.
- When utilizing cutting tools, personnel will observe the following precautions to the fullest extent possible:
    - Use the correct tool and correct size tool for the job.
    - Cut in a direction away from yourself and not toward other workers in the area.
    - Maintain the noncutting hand and arm toward the body and out of the direction of the cutting tool if it were to slip out of the material being cut.
    - Ensure that the tool is sharp and clean; dirty and dull tools typically cause poor cuts and more hazard than a sharp, clean cutting tool.
    - Store these tools correctly with covers in place or blades retracted, as provided by the manufacturer.
    - On tasks where cutting may be very frequent or last all day (e.g., liner samples), consider Kevlar® gloves in the PPE evaluation for the project.
    - Do not remove guards on paper cutters.
    - In office locations, paper cutters must always be kept in a locked position when not in use.

4.3.3 Moving/Rotating Equipment

- General Requirements for Rotating Equipment (feed augers, chippers, conveyors, etc.)

- Never place hands, fingers, or extremities near hoppers and operational areas of machinery.
- When the equipment is rotating, stay clear of the rotating components and only operate equipment with proper machine guarding in place.
- Never clean a jammed piece of equipment unless the transmission is in neutral and the power source or the engine is off, locked out, and the moving parts of the equipment have stopped rotating. Refer to *S3AM-325-PR1 – Lockout Tagout*.

4.3.4 Other Physical Hazards

- Activities such as drum handling, fencing, work near razor wire, manhole cover removal, and demolition also pose hazards to hands. Use tools instead of hands for high hazard tasks whenever possible.
- Plan work to avoid pinch points for hands when moving drums, moving manhole covers into position, and handling other heavy objects.
- Work handling scrap metal, glass or other sharp edges requires proper hand PPE (Kevlar® or leather gloves).
- Activities involving hoisting, lifting and landing of a load shall be done "hands-free" when possible. Refer to *S3AM-317-ATT2 – Safe Hands-Free Lifting Guidelines*.

4.4 Ergonomics – Hand and Wrist Care

4.4.1 Keep your wrist in neutral. Avoid using your wrist in a bent (flexed), extended, or twisted position for long periods of time. Instead try to maintain a neutral (straight) wrist position. Ergonomic tools may be needed for long-term work.

4.4.2 Watch your grip. Gripping, grasping, or lifting with the thumb and index finger can put stress on your wrist. When practical, use the whole hand and all the fingers to grasp an object.

4.4.3 Minimize repetition. Even simple, light tasks may eventually cause injury. If possible, avoid repetitive movements or holding an object in the same way for extended periods of time.

4.4.4 Reduce speed and force. Reducing the speed with which you do a forceful, repetitive movement gives your wrist time to recover from the effort. Using power tools helps reduce the force.

4.4.5 Rest your hands. Periodically give your hands a break by letting them rest briefly. Or you may be able to alternate easy and hard tasks, switch hands, or rotate work activities.

4.4.6 Consider low vibration or anti- vibration hand power tools when possible.

4.5 Cleaning Hands

4.5.1 Avoid contamination of hands by proper use of gloves when contact with physical, chemical, or biological hazards is possible.

4.5.2 Use soap and water for normal hand cleaning. Do not use solvents for cleaning as they remove essential oils in the skin and may cause dermatitis. Do not use pressure washers for hand cleaning.

4.5.3 If the hands contact a corrosive (e.g., nitric acid), wash the area with water for fifteen minutes and then seek medical attention.

4.5.4 Use antibiotic ointment and skin protection on minor breaks/scratches of the skin.

4.5.5 In some cases barrier creams may be used to provide limited protection for hands exposed to greases and oils.

4.6 Safe Hands Observation Tool

4.6.1 The *Safe Hand Task Review Card S3AM-317-FM2* may be used to supplement and reinforce safe work practices and the requirements of this procedure.

4.6.2 The observer's responsibilities include:

- Two-way conversation with the employees being observed.
- Completing the card and mark the applicable fields on the back of the card.
- Submitting the completed cards to the supervisor.

4.6.3 The supervisor's responsibilities include:

- Reviewing the completed cards.
- Identifying best work practices and any improvements.
- Communicating any changes back the employee(s).

5.0 Records

The following documentation will be maintained:

5.1 Hand tool training records, as applicable.

6.0 Attachments

6.1 S3AM-317-FM1 Glove Needs Assessment

6.2 S3AM-317-FM2 Safe Hands Task Review Card

6.3 S3AM-317-ATT1 Safe Alternative Tools

6.4 S3AM-317-ATT2 Safe Hands-Free Lifting Guidelines

Americas

Glove Needs Assessment

S3AM-317-FM1

Mgr. / Supervisor Name: Work Area Name:

Task/Operation Being Evaluated: Date:

1.0 Using the Protection and Performance Needs Assessment Table Below

1.1 Function and performance needs must be evaluated thoroughly. If employees have a strong need for dexterity, tactility, and/or grip this should be identified as a priority. Rank properties in the table below with 1 being the highest priority. Do not assign the same priority more than once. It is only necessary to rank the applicable properties. If all properties are ranked, the lowest priority would be ranked 12.

Protection and Performance Needs Assessment			
Category	**Properties**	**Protection and Performance Needs**	**Priority** (1=Top Priority)
Mechanical	Cut Resistance	Protection from sharp edges, blades, and other cutting hazards	
	Puncture Resistance	Protection from sharp objects like nails, pins, needles, wire	
	Abrasion Resistance	Durability and resistance to abrasive objects or materials	
	Shielding	Protection from impact, ricochet, small projectiles.	
Chemical	Degradation & Absorption Resistance	Durability and resistance to breaking down and/or permeating the glove from exposure to chemicals. Refer to the chemical's Safety Data Sheet for the appropriate glove choice.	
Thermal	Heat Resistance	Thermal protection from hot objects or materials	
	Cold Resistance	Thermal protection from cold weather, objects, or materials	
Vibration	Anti-Vibration	Vibration reduction from operating certain tools and equipment	
Electrical	Insulation	If performing work on electrical equipment, this must be the top priority	
Function	Dexterity	Ability to manipulate objects and control hands in the desired manner	
	Tactility	Ability to sense objects by touch	
	Grip	Ability to exert pressure on an object when holding it	

1.2 Identify a glove that meets the top protection and performance priorities.

In most cases there are trade-offs between hazard protection and functional performance of a glove. These factors are equally important. The higher the severity of the hazard, the more important hazard protection is. The table below offers additional guidance on key considerations when selecting a glove for certain protection and performance properties.

<table>
<tr><th>Category</th><th>Properties</th><th>Key Considerations and Selection Criteria</th></tr>
<tr><td rowspan="4">Mechanical</td><td>Cut Resistance</td><td>Testing Standard: ASTM F1790 and ASTM F1970-05
There are 5 levels of cut resistance. 5 is the highest.</td></tr>
<tr><td>Puncture Resistance</td><td>Testing Standard: EN 388:2003
This testing measures the force required to pierce the sample with a standard sized point.</td></tr>
<tr><td>Abrasion Resistance</td><td>Testing Standard: ASTM D3389-05 and ASTM D3884-09
Abrasion resistance testing measures how well the glove material resists loss of material from rubbing on rough surfaces.</td></tr>
<tr><td>Shielding</td><td>Some gloves offer thick padding or hard guards around the back of the hand or knuckles. These can offer good protection against impact.</td></tr>
<tr><td>Chemical</td><td>Degradation & Absorption Resistance</td><td>Identify products / chemicals that present potential exposures. Refer to the chemical’s Safety Data Sheet and glove manufacturer’s specifications for the appropriate glove choice.</td></tr>
<tr><td rowspan="2">Thermal</td><td>Heat Resistance</td><td>Testing Standard: ASTM F1060-08
This testing measures the insulation provided by the glove when contacting a hot surface. Higher temperatures reported indicate a glove with greater insulation.</td></tr>
<tr><td>Cold Resistance</td><td>Testing Standard: EN 511:1994 (for ambient temperature)
Testing Standard: ISO 5085:1989-1 (for cold surfaces)
Choosing the right glove depends on whether protection is needed from cold weather or cold surfaces.</td></tr>
<tr><td>Vibration</td><td>Anti-Vibration</td><td>Testing Standard: ANSI S2.73-2002 (R2007)
This testing method measures the vibration transmission of the glove.</td></tr>
<tr><td>Electrical</td><td>Insulation</td><td>Testing Standard: ASTM D120-09
Glove protection depends on the maximum voltage of energized components.
<table>
<tr><td>50 – 480V</td><td>Class 00 with Leather Protectors</td></tr>
<tr><td>480 – 600V</td><td>Class 0 with Leather Protectors</td></tr>
<tr><td>600V and above</td><td>Class 0 or higher (depending on maximum voltage) with Leather Protectors</td></tr>
</table></td></tr>
<tr><td rowspan="3">Function</td><td>Dexterity</td><td>Testing Method: EN 420:2003
Ability to manipulate objects and control hands in the desired manner. This testing method assesses the wearer’s ability to pick up small diameter pins lying on a flat surface with their thumb and forefinger.
If high dexterity is needed, and the hazards are relatively low to the forefinger and thumb, consider a glove that is tip less for those two digits.</td></tr>
<tr><td>Tactility</td><td>Ability to sense objects by touch. There is no standard test. However, a common field test is to determine if the wearer can feel a pulse while wearing the glove. This is affected by the thickness of the glove, presence of liners, glove surface characteristics, and properties of the coating material.</td></tr>
<tr><td>Grip</td><td>Testing Standard: NFPA 1971 (Grip)
Ability to exert pressure on an object when holding it.</td></tr>
</table>

Safe Alternative Tools

S3AM-317-ATT1

1.0 Types of Safety Knives or Alternative Cutting Tools

1.1 Self-retracting utility knives (brands – OLFA, Martor, Allway Tools)



1.2 Guarded utility knives (brands – The Safety Knife Co., Martor)





1.3 Shears, snips, scissors (brands – Ridgid, Craftsman, Wolfcraft)





1.4 Concealed blade cutters (brands – The Safety Knife Co., Martor)







1.5 Pipe cutters (brands – Ridgid, Empire)







1.6 Specialty cutter (brand – Geoprobe)



Americas

Drilling, Boring & Direct Push Probing

S3AM-321-PR1

1.0 Purpose and Scope

1.1 This document provides procedures designed to help prevent injuries to personnel working on the project and pedestrians, property damage, and adverse environmental impact as a result of potential hazards associated with drilling, boring and direct-push probing. These hazards include, but are not limited to, encountering underground utilities, subsurface installations, rotating equipment and potential overhead hazards.

1.2 This procedure provides the minimum requirements to be followed when drilling, boring, and probing work are performed.

1.3 This procedure applies to all Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

1.4 The Manager is responsible for meeting all the requirements in this procedure.

1.5 AECOM's clients may have specific procedures which shall be followed to identify and map utility and subsurface structures on their properties or facilities. Provided the client's procedures meet or exceed those of AECOM, approval shall be obtained from the Manager and the SH&E Manager to follow the client's procedures.

2.0 Terms and Definitions

2.1 **Underground Utilities –** All utility systems located beneath grade level, including, but not limited to, gas, electrical, water, compressed air, sewage, signaling, and communications, etc.

2.2 **Ground Disturbance (GD) –** Any indentation, interruption, intrusion, excavation, construction, or other activity in the earth's surface as a result of work that results in the penetration of the ground.

2.3 **Intrusive Activities –** Examples: Excavation of soil borings, installations of monitoring wells, installation of soil gas sampling probes, excavation of test pits / trenches or other man-made cuts, cavity, trench, or depression in an earth surface formed by earth removal.

2.4 **Subsurface Installations –** Examples: Subterranean tunnels, underground parking garages, and other structures beneath the surface.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-118-PR1 Hearing Conservation

3.3 S3AM-208-PR1 Personal Protection Equipment

3.4 S3AM-209-PR1 Risk Assessment & Management

3.5 S3AM-213-PR1 Subcontractor Management

3.6 S3AM-305-PR1 Hand & Power Tools

3.7 S3AM-306-PR1 Highway and Road Work

3.8 S3AM-322-PR1 Overhead Lines

3.9 S3AM-322-FM1 Overhead Electrical Lines Acknowledgement

3.10 S3AM-325-PR1 Lockout Tagout

3.11 S3AM-326-PR1 Machine Guarding

3.12 S3AM-331-PR1 Underground Utilities

3.13 S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager**

- Confirm the development of the project SH&E Plan and compliance with this procedure.
- Confirm the appropriate equipment and materials are available to conduct the drilling, boring or direct-push operations.
- Confirm compliance with *S3AM-331-PR1 Underground Utilities.*
- Review the *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist* prior to authorizing work to proceed.
- Confirm that employees conducting drilling, boring or direct-push probing possess any required training, registrations or certifications.
- Confirm all employees involved and affected by the task review the SH&E Plan, *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist* and Task Hazard Assessment (THA) prior to work commencing.
- Confirm an equipment maintenance inventory is maintained, schedules adhered to and appropriate inspections of equipment are conducted.
- Provide authorization (with the concurrence of the Site Supervisor and SH&E Manager) for work to resume if interrupted due to unexpected conditions or events.

4.1.2 **Safety, Health & Environment (SH&E) Manager**

- Assist AECOM management as needed by providing guidance and clarification as to issues that may arise.
- Review the project SH&E Plan to confirm compliance with jurisdictional regulations**.** Provide technical guidance as needed when a variance is pursued related to this procedure. Confirm variance process meets requirements identified in *S2-001-SM1 Global SH&E Management System Manual*.

4.1.3 **Employees**

- Maintain training as appropriate to the work to be completed (e.g., ground disturbance, lockout tagout, equipment operation, etc.). Refer to *S3AM-003-PR1 SH&E Training.*
- Review the SH&E Plan, *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist* and Task Hazard Assessment (THA) prior to work commencing.
- As appropriate to the anticipated or encountered hazards and as addressed in the applicable planning documentation, utilize appropriate personal protective equipment (PPE) and applicable training, practices and operating procedures.
- Immediately notify the Manager of any unanticipated conditions or events. If assigned equipment, perform appropriate inspections and confirmations of maintenance and / or repairs.

4.2 Training

4.2.1 All on-site employees involved with drilling, boring, and direct-push probing shall be trained, at a minimum, in these procedures and in the procedures of *S3AM-331-PR1 Underground Utilities*.

4.2.2 All operators and assistants shall have the appropriate safety training based on the SH&E Training Matrix and any additional training assessments developed at the business group**,** and be versed in the equipment to be utilized.

- Refer to *S3AM-003-PR1 SH&E Training.*

- This training may include, but is not limited to, Excavation / Trenching (Ground Disturbance), HAZWOPER, Petroleum Safety Training (or Construction Safety Training), and H2S Alive as appropriate.
- Only qualified personnel shall operate and inspect equipment.

4.2.3 All on-site Employees involved with drilling, boring, and direct-push probing activities shall be provided with on-site orientation of the drill rig and its operation.

4.2.4 All Employees involved with drilling, boring and direct-push probing activities at a client site shall receive the applicable client-required training**.**

4.3 Planning

4.3.1 SH&E Plan – At a minimum, a SH&E plan that includes a pre-job hazard assessment shall be prepared and communicated to all involved personnel prior to any drilling, boring, and direct-push probing activities. Refer to *S3AM-209-PR1 Risk Assessment & Management*.

- Assessment shall include both overhead and subsurface utilities and installations. Refer to *S3AM-322-PR1 Overhead Lines* and *S3AM-331-PR1 Underground Utilities*.
- The SH&E Plan will address any required environmental monitoring including gas monitoring, dust, noise, metals, radiation or other monitoring as may be appropriate for site conditions.
- All SH&E Plan requirements will be followed by the project team.
- The location specific emergency response plan shall be in place, contain procedures applicable to the potential emergencies presented by the operations, and be reviewed with all personnel potentially affected.

4.3.2 A Task Hazard Assessment (THA) shall be completed before every assigned task at the work location. The focus of the analysis shall be on the specific assigned task and the evaluation of risks and assignment of control measures based on actual work conditions.

4.3.3 *S3AM-321- ATT2 Pre-Drilling, Boring & Direct-Push Probing Flow Chart* summarizes the key Pre-Drilling, Boring, and Direct-push probing requirements addressed in this procedure.

4.3.4 Procedures and documentation as detailed in *S3AM-322-PR1 Overhead Lines* and *S3AM-331-PR1 Underground Utilities* shall be completed prior to any intrusive subsurface work.

- The locations of subsurface and overhead utilities and subsurface installations will be investigated, documented, mapped on a site plan and evidenced with appropriate surface markings.
- A site walk shall be conducted by the project team / site Manager and any other appropriate personnel, with the objectives of reviewing all planned intrusive activity locations, the locations of subsurface and overhead utilities and the potential for subsurface installations, to determine the appropriate utility clearance activities, and to observe other physical hazards.
- All proposed subsurface activities will be reviewed in comparison to subsurface and overhead utilities and subsurface installations and adjustments made as necessary.
- Appropriate clearance activities shall confirm location(s) of identified underground utilities and subsurface structures. Review the applicable completed *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist.*
- Site Walks should be repeated as necessary following the clearance of subsurface utilities and installations to confirm hazards are clearly identified.

4.3.5 Confirm drilling location(s) and / or bore entry and bore exit points are adequately identified on the worksite to enable appropriate equipment positioning.

4.4 Permits, Notifications and Access Agreements

4.4.1 Any required notifications shall be provided within the appropriate timeframe to the applicable organization (e.g. owner, agency, governing body, etc.).

4.4.2 All applicable permits (e.g. client, government, working near rail road, etc.) will be identified, obtained, and adhered to.

4.4.3 Access agreements will be obtained and adhered to as necessary.

4.5 Pre-Qualifying and Re-Qualifying Drilling Subcontractors

4.5.1 All drilling subcontractors will be properly pre-qualified in accordance with *S3AM-213-PR1 Subcontractor Management*.

4.5.2 The qualifications of the drilling crew performing the work will be evaluated prior to each mobilization and each day by AECOM's on-site representative to assure that their safety performance, training, qualifications, equipment, processes, and approaches reflect AECOM standards for excellence.

4.5.3 All drilling subcontractor equipment will be properly maintained and properly equipped, and the drilling subcontractor will verify their equipment is fully functional as a normal part of their daily and pre-work routine. Refer to *S3AM-321-FM1 Daily Drilling, Boring & Direct Push Equipment Inspection.*

4.6 General Health and Safety

4.6.1 Personal Protective Equipment – Refer to the *S3AM-208-PR1 Personal Protection Equipment* for best practices. These requirements may be modified or expanded in the SH&E Plan. Clothing shall be close fitting and comfortable without loose ends, straps, draw strings, belts, or otherwise unfastened parts that might catch on some rotating or translating component of the rig.

- Depending upon the hazards present, additional PPE may be required such as fire retardant clothing, specific hearing protection, respiratory protective equipment and chemical protective clothing.
- If the location has potential for underground electrical utilities to be present, workers shall ensure footwear has additional protection of shock resistant soles required (white rectangle with omega symbol).

4.6.2 Hearing Conservation – Hearing conservation program requirements may apply when working around operating equipment. Refer to *S3AM-118-PR1 Hearing Conservation*.

- Each worker shall wear noise-reducing ear protectors around operating equipment or during elevated noise levels. Distance from the elevated noise level is the primary measure of control for non-essential drilling personnel.

4.7 Drilling, Boring and Direct Push Equipment Maintenance and Inspections

4.7.1 All equipment will be inspected prior to the initiation of operations and daily during operations using the *S3AM-321-FM1 Daily Drilling, Boring & Direct-Push Equipment Inspection*. This inspection is the responsibility of the operator who will provide written documentation of the inspection prior to the start of drilling each day.

- Equipment that is deemed defective will immediately be repaired by a qualified person, or, if repair is not practicable, tagged "Out of Service" and sent for repairs or discarded.

4.7.2 Managers shall confirm an accurate inventory of the equipment within their operation requiring scheduled maintenance is developed. Using applicable regulations, industry standards, best practices, and manufacturer's recommendations, a maintenance schedule shall be developed with defined responsibility, required actions, and frequency. Refer to *S3AM-321-FM2 Drilling, Boring, & Direct-Push Equipment Maintenance Inventory.*

4.7.3 The maintenance program for equipment shall:

- Adhere to applicable regulations, standards, and manufacturers' specifications;
- Provide for service by appropriately qualified maintenance personnel; and,
- Require maintenance schedules and records of maintenance.

4.7.4 Employees or operators who are assigned equipment are required to review maintenance schedules for that equipment and will confirm that required maintenance has occurred or see that it is undertaken.

4.8 General Requirements

4.8.1 Excluding geoprobe activities, set up any sample tables and general work areas for employees at a safe distance from the rig.

- The recommended safe distance is the height of the fully extended mast plus 5 feet (1.5 meters), and no less than 30 feet (9.1 meters) from the rig.
- An increase to this distance may be required due to noise exposure hazards. Refer to *S3AM-118-PR1Hearing Conservation.*

4.8.2 Operation of the drilling, boring or direct-push equipment shall be restricted to the designated operator except to activate the emergency shut-off as required.

- All rotary drilling equipment shall have an emergency shut off / kill switch. The location of the switch and operation should be reviewed with all involved Employees.

4.8.3 Sit-on direct push rigs are not permitted on AECOM worksites unless the rig has been modified (in accordance with manufacturer's requirements) to be operated by remote control or the rig has been manufactured with a rollover protection system and seat belt.

4.8.4 Consult jurisdictional regulations as use of J-hooks and cat-heads may be prohibited. Examples:

- 29 CFR 1926 requires derricks and cranes to use hooks with self-closing latches and permits the use of J-hooks only for a task unrelated to this procedure (setting trusses).
- British Columbia and Saskatchewan prohibit the use of friction cat-heads**.**

4.9 Identifying the Work Area

4.9.1 Ensure the work area is adequately identified:

- Including zone around the drilling, boring, or direct push equipment, as well as fluid equipment, entry point, exit point and any excavated areas.
- Utilize barricades, signage, pylons, snow fence, etc. as appropriate.
- Implement traffic control as necessary.
- Coordinate with concurrent operations to identify their associated hazards and controls, and communicate those associated with AECOM tasks.

4.9.2 When operating near public vehicular and pedestrian traffic, the on-site personnel shall take every precaution necessary to see that the work zone is properly established, identified, and isolated from both moving traffic and passer-by pedestrians (refer to *S3AM-306-PR1 Highway and Road Work*).

4.9.3 All traffic control devices shall be installed, placed, and maintained in accordance with a Traffic Control Plan, client specifications, and / or the Manual of Uniform Traffic Control Devices and Manual of Uniform Traffic Control Devices for Canada in Canada. Traffic control devices shall consist of and not be limited to

- Directional and informational signage;
- High visibility barricades, cones, or barrels;
- Lighting; and
- Other equipment and devices as required.

4.10 Clearing Work Areas

4.10.1 In addition to any minimum requirements the drilling subcontractor may have, prior to set up, adequate site clearing and leveling shall be performed to accommodate the rig and supplies and provide a safe working area.

4.10.2 Clearing the site includes clearing the intended drilling area obstacles and of underground utilities in accordance with *S3AM-331-PR1 Underground Utilities*.

4.10.3 Drilling or probing shall not commence when tree limbs, unstable ground, or site obstructions cause unsafe tool handling conditions.

- The cleared / levelled area should be large enough to accommodate the rig and supplies.
- If the rig is positioned on a steep grade and levelling of the ground is impossible or impractical, the wheel of the transport vehicle shall be blocked and other means employed of preventing the rig from moving or toppling over.

4.11 Drilling Activities

4.11.1 Federal / State / Provincial / Territorial regulations that govern drill rig operations and exposed moving parts shall be adhered to.

4.11.2 All applicable client on-site safety procedures shall be understood and adhered to.

4.11.3 Minimum approach distances (MAD) from subsurface and overhead utilities and subsurface installations will be established including 5 feet (1.5 meters) from any subsurface utility, 7 feet (2.1 meters) from the pad surrounding any underground storage tanks, and 10 feet (3 meters) from any overhead energized electrical line (or further depending on line voltage). These approach distances are a minimum; government regulations and utility requirements may dictate a greater set back distance and should be confirmed.

4.11.4 Verify that equipment / energy is isolated when lockout is required:

- Refer to operator's manual and *S3AM-325-PR1 Lockout Tagout*.
- Ensure stop switch is activated.
- Driller is out of the seat.
- Test controls to ensure they do not engage.

4.11.5 In addition to any identified minimum requirements (as applicable, client, drilling subcontractor), the following safety measures shall be taken during drilling, boring or probing operations on site:

- The operator and helper shall be present during all active rig operations.
- Site personnel shall remain within visual contact of the rig operator.
- Hard hats, approved safety boots, safety glasses, and hearing protection shall be worn in the work zone (minimum, the radius around the rig equal to the height of the drill rig mast) of a rig.
- Gas monitoring shall be conducted as appropriate.
- Hands, feet and other body parts shall be kept away from moving parts, (e.g. hoisted, rotating, pushing, etc.) including augers, drill rods and reamers.
- When observing drilling, stand upwind of the drill rig to prevent potential exposure to vapors that may be emitted from the borehole.
- The emergency shut-off switch on the rig shall be identified to site personnel and tested on a daily basis by the operator.
- Unauthorized personnel shall be kept outside of the established work zone.
- Rig crew and other worksite personnel shall not use a cell phone while operating the drill rig or other equipment or within the rig work zone.
- Do not drive the rig from hole to hole with the mast (derrick) in the raised position.
- Before raising the mast (derrick) look up to check for overhead obstructions. Refer to *S3AM-322-PR1 Overhead Lines*.

- Before raising the mast (derrick), all rig personnel (with the exception of the operator) and visitors should be cleared from the areas immediately to the rear and the sides of the mast. All rig personnel and visitors should be informed that the mast is being raised prior to raising it.
- Before the mast (derrick) of a drill rig is raised and drilling is commenced, the drill rig shall be first levelled and stabilized with levelling jacks and / or solid cribbing.
    - The drill rig shall be releveled if it settles after initial set up.
    - Lower the mast (derrick) only when the levelling jacks are down, and do not raise the levelling jack pads until the mast (derrick) is lowered completely.
- After the rig has been positioned to begin drilling, all brakes and / or locks shall be set before drilling begins.
- The operator of a rig shall only operate a drill rig from the position of the controls. The rig shall not be in operation if the operator of the rig leaves the area of the controls.
- Throwing or dropping tools shall not be permitted. All tools shall be carefully passed by hand between personnel or a hoist line should be used.
- If it is necessary to operate the rig within an enclosed area, make certain that exhaust fumes are conducted out of the area.
    - Exhaust fumes can be toxic and some cannot be detected by smell.
    - Air monitoring and, as necessary, noise monitoring shall be conducted.
- Clean mud and grease from boots before mounting a rig platform and use hand holds and railings. Watch for slippery ground when dismounting from the platform.
- During freezing weather, do not touch any metal parts of the rig with exposed flesh. Freezing of moist skin to metal can occur almost instantaneously.
- All unattended bore holes shall be adequately covered or otherwise protected to prevent rig personnel, site visitors, or animals from stepping or falling into the hole. All open bore holes shall be covered, protected, or backfilled adequately and according to Federal / State / Provincial / Territorial or local regulations on completion of the drilling project.
- When using a ladder on a rig, face the ladder and grasp either the side rails or the rungs with both hands while ascending and descending. Always use adequate fall protection and a full body harness when climbing above 6 feet (1.8 meters) of the ground. Do not attempt to use one or both hands to carry a tool while on a ladder. Use a hoist line and a tool “bucket” or a safety hook to raise or lower hand tools.

4.12 Drilling Fluid

4.12.1 Ensure drilling fluid is appropriate to the soil type and conditions to be encountered to enable smooth drilling.

4.12.2 Drilling fluid used in the boring process shall be contained at the entry and, as applicable, exit locations until recycled or removed from the site.

4.12.3 Confirm drilling fluid does not enter roadways, streams, municipal storm or sanitary sewer lines, and / or any other drainage system or body of water.

4.12.4 Monitor drilling equipment and fluid equipment for any leakage or spills. Confirm appropriate containment is in place and adequate spill response supplies are available.

4.12.5 It is important to monitor fluid flow and pressure gauges when drilling with any tooling, but it is essential when drilling with a mud motor (pump placed in the drill string to provide additional power to the bit while drilling).

4.13 Unanticipated Concrete / Debris or Void

4.13.1 The presence of subsurface installations and utilities requires special care when obstructions / refusal and voids are encountered and when unexpected absence of soil recovery occurs during

drilling operations. Other indicators of subsurface installations and utilities are the presence of warning tape, pea gravel, sand, non-indigenous material, bentonite, red concrete (indicative of electrical duct banks) and any departure from native soil or backfill.

4.13.2 If unanticipated concrete / debris is encountered and / or if a void is encountered, drilling will be immediately discontinued and the Manager notified. Drilling may only proceed with Manager or SH&E Manager approval.

4.14 Use of Manual Slide Hammer

4.14.1 The following health and safety procedures should be followed when using a manual slide hammer to install shallow injection points, drive point piezometers, and drill tools:

- Only use a manual slide hammer that either attaches directly to the point / piezometer being driven or that incorporates a cap on the point / piezometer / drill tool that prevents the slide hammer from slipping off the point / piezometer / drill tool.
- Always grasp the manual slide hammer (handles if equipped with handles) with both hands while driving the point / piezometer / drill tool.
- Never allow hands or feet to get between the manual slide hammer and the drive plate or anvil.

4.15 Use of Augers

4.15.1 The following general health and safety procedures should be followed when supervising borings with continuous flight hollow-stem augers:

- Never place hands or fingers under the bottom of an auger section when it is being hoisted over the top of the auger section in the ground or other hard surfaces such as the drill rig platform.
- Never allow feet to get under the auger section that is being hoisted.
- When augers are rotating, stay clear of the rotating auger and other rotating components of the drill rig. Never reach behind or around a rotating auger for any reason.
- Use a long-handled shovel to move auger cuttings away from a rotating auger. Never use hands or feet to move cuttings away from a rotating auger.
- Do not attempt to remove earth from rotating augers. Augers should be cleaned only when the drill rig is in neutral and the augers are stopped from rotating.
- Loud noises may occur while driving split spoons. At minimum hearing protection shall be worn when driving split spoons.
- When pulling / lifting augers, a clevis pin or other closed device shall be used. Use of J-hooks is prohibited.

4.16 Attaching and Breaking Rods

4.16.1 Do not use manual tools (e.g., pipe wrenches) in combination with rotation of the drill stem. Manual tools are not designed for the load, and may break.

- The use of such tools creates a significant impact hazard for those in the work area, because they rotate with the drill stem. Manual tool use in combination with a rotating drill stem to attach or break rods is therefore prohibited.
- Manual tools may be used if the drill stem is isolated / positively disengaged.
- Mechanical means of rod separation that are permitted include:
  - Opposing hydraulic controls.
  - Rod locking devices or machine's power vice.
  - Hydraulic breakout tools.
  - Hydraulic foot clamps.

4.16.2 Rod box changes present severe crushing hazards. Operators shall ensure all crew members are clear of the machine and hoisting equipment while they are changing rod boxes.

4.17 Rotary, Sonic and Core Drilling

4.17.1 In addition to the health and safety procedures identified above, the following general health and safety procedures should be followed when supervising borings with rotary, sonic and core drilling:

- Drill rods should not be braked during lowering into the hole with drill rod chuck jaws. Drill rods should not be held or lowered into the hole with pipe wrenches.
- If a string of drill rods are accidentally or inadvertently released into the hole, do not attempt to grab the falling rods with your hands or a wrench.
- When drill rods are hoisted from the hole, they should be cleaned for safe handling with a rubber or other suitable rod wiper. Do not use hands to clean drilling fluids from drill rods.
- When drill rods are rotating, stay clear of the rotating components of the drill rig. Never reach behind or around a rotating drill rod for any reason.
- Use a long-handled shovel to move cuttings away from the top of the borehole. Never use hands or feet to move cuttings away from the borehole.
- If work shall progress over a portable drilling fluid (mud) pit, do not attempt to stand on narrow sides or cross members. The mud pit should be equipped with rough-surfaced, fitted cover panels of adequate strength to hold drill rig personnel.
- Keep away from area where drill rods are being moved or raised to the rig. Do not stand in the area where a drill rod will fall or slide if it should be dropped.
- Loud noises may occur during drilling. Hearing protection shall be worn.

4.18 Direct-push

4.18.1 The following general health and safety procedures should be followed when supervising drilling borings with direct-push drilling:

- Loud noise may occur during direct-push drilling. Appropriate hearing protection shall be worn.
- When drill rods are hoisted from the hole, they should be cleaned for safe handling with a suitable rod wiper. Do not use hands to clean drilling fluids from drill rods.
- If work shall progress over a portable drilling fluid (mud) pit, do not attempt to stand on narrow sides or cross members. The mud pit should be equipped with rough-surfaced, fitted cover panels of adequate strength to hold drill rig personnel.
- Drill rods should not be lifted and leaned unsecured against the mast. Either provide some method of securing the upper ends of the drill rod sections for safe vertical storage or lay the rods down.

4.19 Horizontal Directional Drilling

4.19.1 During surface to surface operations a 16.4’ (5 meters) safe zone shall be established and identified at both the entry and exit locations; no personnel are permitted to be within this zone unless the drill is locked out and the operator is out of the seat.

4.19.2 Machine shall be locked out before entering an excavation, changing tools, adding or removing drill stem or doing any other work on tools or the drill stem at the exit end of the bore.

4.19.3 A tracking head shall be installed on the drill stem:

4.19.4 Assemble drill head using components appropriate to the soil conditions to be encountered (e.g. nozzle, bit, beacon housing, etc.).

4.19.5 Ensure all personnel are clear of the bore entry point (outside of identified work zone).

4.19.6 At all times two way communication will be maintained at entrance and exit points using two way radios or equally effective communication means. If at any time communication is lost, all work will be stopped until communication is re-established

4.19.7 Locate drill head with tracking device at least every half-length of pipe. Adjust direction as necessary to follow the intended bore path.

4.19.8 Any drilling fluid returning to the surface shall be cleaned up promptly.

4.19.9 Drill pipe should exit the bore at an angle of 5 to 10° from the ground surface.

4.19.10 Turn off fluid flow as soon as drill head emerges.

4.19.11 Lockout machine and remove drill head using appropriate breakout tools.

4.19.12 Select and attach a reamer that allows the return of drilling fluids and cuttings, to reduce frictional pullback forces, and to allow for bend radius of the pipe. Reamer shall be:

- The smaller of 1.5 times the outside diameter (O.D.) or 12 inches (300mm) larger than the diameter of the product pipe.
- A diameter less than 1.5 times the diameter of the product may be necessary in collapsing soil formations.
- Reamed diameter may need to be increased by up to 25% if substantial swelling of the soil is expected to occur.

4.19.13 All personnel shall clear the trench or the designated surface zone (16.4 feet [5 meters]) once the reamer is attached. Operator shall only reverse lockout and commence pullback when communication is received from personnel on exit hole side and operator has confirmed the message.

4.19.14 Personnel on exit hole side shall ensure reamer is pulled the entire way back to the exit hole.

- If rotation is started when drill rod and reamer are away from the exit hole, very fast sideways movement of the rod and reamer can occur.
- Larger reamers and longer lengths of exposed drill rod increase the speed and distance of this movement.

4.19.15 If working with trailing drill stem, swivels shall be verified as lubricated and rotating freely by hand prior to use:

- A freely moving swivel prevents trailing drill stem or product from rotating / whipping.
- If the swivel does not move freely by hand it shall be removed from service and repaired or replaced.
- Only use swivels with limited articulation to prevent whipping or cranking action between the reamer and trailing drill pipe or product.

4.19.16 It is important to clean and lubricate the tool and drill stem joint threads before each use.

4.19.17 Any individual drill pipes that are bent or damaged shall be immediately taken out of service.

4.19.18 Occasionally change the order of the lead drill pipe (i.e. move the lead pipe to the end of the stem, or other pipe rotation procedures) to extend drill stem life.

4.19.19 Operator should avoid stalling the pipe rotation to avoid stress damage from shock loading.

4.20 Drilling at Potential MEC / UXO Sites

4.20.1 If the project site is suspected of containing munitions and explosives of concern (MEC) or unexploded ordnance (UXO), the UXO team will conduct a reconnaissance and MEC / UXO avoidance to provide clear access routes to each site before drilling crews enter the area. The following procedures will be implemented:

- Drilling operations on an MEC / UXO site will not be conducted until a complete plan for the site is prepared and approved by the AECOM UXO Safety Officer. MEC / UXO avoidance shall be conducted during drilling operations on known or suspect MEC / UXO sites.
- The UXO team will identify and distinctly mark the boundaries of a clear approach path for the drilling crews, vehicles, and equipment to enter the site. This path will be, at a minimum, twice the width of the widest vehicle. No personnel will be allowed outside any marked boundary.
- If MEC / UXO is encountered on the ground surface, the UXO team will clearly mark the area where it is found, report it to the proper authorities, and divert the approach path around it.
- The UXO team will conduct an access survey using the appropriate geophysical instrument over the approach path for avoidance of MEC / UXO that may be in the subsurface. If a magnetic anomaly is encountered, it will be assumed to be MEC / UXO, and the approach path will be diverted around the anomaly. UXO personnel only will operate the appropriate geophysical instrument and identify MEC / UXO.
- An incremental geophysical survey of the drill-hole location(s) will be initially accomplished by the UXO team using a hand auger to install a pilot hole. If MEC / UXO is encountered or an anomaly cannot be positively identified as inert material, Hazardous, Toxic, and Radioactive Waste (HTRW) sampling personnel will select a new drill-hole location.
- Once the surface of a drilling site has been cleared and a pilot hole established as described above, the drilling contractor will be notified that the site is available for subsurface drilling.

4.21 Movement and Transport of Drilling, Boring or Direct-Push Equipment

4.21.1 Personnel transporting equipment shall be properly licensed and shall operate the vehicle according to Federal / State / Provincial / Territorial, and local regulations. Refer to *S3AM-005-PR1 Driving* and *S3AM-320-PR1 Commercial Motor Vehicles*.

4.21.2 Confirm the traveling height (overhead clearance), width, length and weight of the equipment with the carrier. Identify highway and bridge load, width and overhead limits, to confirm these limits are not exceeded and with adequate margin.

4.21.3 Allow for overhang of any drilling, boring or direct-push equipment when cornering or approaching other vehicles or structures.

4.21.4 Be aware that the canopies of service stations and motels are often too low for equipment loaded on a trailer to clear

4.21.5 Watch for low hanging electrical lines, particularly at the entrances to drilling sites or restaurants, motels, other commercial sites.

4.21.6 Never travel on a street, road, or highway with any part of the drilling, boring or direct-push equipment in a raised or partially raised position.

4.21.7 Remove all ignition keys if rig is left unattended unless client requirements specify that the keys remain in the ignition switch at all times.

4.21.8 Before moving a rig on location, the operator shall do the following:

- To the extent practical, walk the planned route of travel and inspect it for depressions, gullies, ruts, and other obstacles.
- Check the brakes of the truck / carrier, especially if the terrain along the route of travel is rough or sloped.
- Discharge all passengers before moving on rough or steep terrain.

4.21.9 Engage the front axle (on 4x4, 6x6, etc., vehicles) before traversing rough or steep terrain

4.21.10 Driving drill rigs along the sides of hills or embankments should be avoided; however, if side-hill travel becomes necessary, the operator shall conservatively evaluate the ability of the rig to remain upright while on the hill or embankment. The possibility shall be considered that the presence of

drilling tools on the rig may reduce the ability of the rig to remain upright (raises the center of mass of the rig).

4.21.11 Logs, ditches, road curbs, and other long and horizontal obstacles should be approached and driven over squarely, not at an angle.

4.21.12 When close lateral or overhead clearance is encountered, or when backing up, the driver of the rig shall be guided by another person on the ground.

4.21.13 Loads on the drill rig and truck shall be properly stored while the truck is moving, and the mast shall be in the fully lowered position.

4.22 Loading and Unloading

4.22.1 Consult applicable manufacturer's recommendations for loading and unloading of the equipment.

4.22.2 Use ramps of adequate design that are solid and substantial enough to bear the weight of the rig with carrier, including tools.

4.22.3 Load and unload on level ground.

4.22.4 Use the assistance of someone on the ground as a guide.

4.22.5 Check the brakes on the rig carrier before approaching loading ramps.

4.22.6 Distribute the weight of the rig, carrier, and tools on the trailer so that the center of weight is approximately on the centerline of the trailer and so that some of the trailer load is transferred to the height of the pulling vehicle. Refer to the trailer manufacturer's weight distribution recommendations.

4.22.7 The rig and tools should be secured to the hauling vehicle with ties, chains, and / or load binders of adequate capacity.

5.0 Records

5.1 All employee training files shall be maintained in accordance with *S3AM-003PR1 SH&E Training*.

5.2 Completed inspections and maintenance inventories shall be maintained the site or project files.

6.0 Attachments

6.1 S3AM-321-ATT1 Core Drilling Machine

6.2 S3AM-321-ATT2 Pre-Drilling, Boring, & Direct-Push Probing Flow Chart

6.3 S3AM-321-FM1 Daily Drilling, Boring & Direct-Push Equipment Inspection

6.4 S3AM-321-FM2 Drilling, Boring & Direct-Push Equipment Maintenance Inventory

Americas

Daily Drilling, Boring & Direct-Push Equipment Inspection

S3AM-321-FM1

Site / Project Name _____ Rig Inspector (Name/Company) _____

RIG INFORMATION:

Rig Type Rotary/Auger Drilling Rig ☐ Direct Push Type (DPT) ☐

Owner _____ VIN# _____

Year/Make _____ Mileage _____

Model _____ Drill Hrs _____

INSTRUCTIONS: Each shift shall inspect all applicable items. If an unsatisfactory condition (fail) is observed, suspend operation of the equipment and report the condition to the site supervisor immediately.

Emergency Equipment / Devices / Switches	
Kill switches are located and accessible to workers on both sides of the rotating stem. NOTE: Location and number of switches depend on the rig manufacturer; please refer to owner's manual (DPT typically has one switch on control panel).	☐ Pass ☐ Fail ☐ N/A
Kill switches installed by the manufacturer, alarms and other devices (e.g. positive air shut-off valve) tested and in operable condition. All workers familiar with location and operation of devices. **NEVER BYPASS, DISABLE, OR REMOVE KILL DEVICES.**	☐ Pass ☐ Fail ☐ N/A
First aid kit adequate and on equipment / readily available.	☐ Pass ☐ Fail ☐ N/A
Absorbent materials on equipment / readily available (spill response).	☐ Pass ☐ Fail ☐ N/A
A fire extinguisher of appropriate size is located on drill rig and readily available/accessible for drilling crew (recommended 20 lbs.).	☐ Pass ☐ Fail ☐ N/A
Protective Guards	
Drive shafts, belts, chain drives, and universal joints are guarded to prevent accidental insertion of hands, fingers, or tools.	☐ Pass ☐ Fail ☐ N/A
Cables	
Cables on drill rig free of kinks, frayed wires, birdcages, flat spots, grease, and worn or missing sections.	☐ Pass ☐ Fail ☐ N/A
Cables are terminated at the working end with a proper eye splice; either swaged, coupled, or using cable clamps.	☐ Pass ☐ Fail ☐ N/A
Cable clamps are installed with the saddle on the live or load side. Clamps are not alternated and are of the correct size and number for the cable size.	☐ Pass ☐ Fail ☐ N/A
Wire ropes are not allowed to bend around sharp edges without cushion material.	☐ Pass ☐ Fail ☐ N/A
Pulleys and Cable Winches	
Pulleys are not bent, cracked, or broken.	☐ Pass ☐ Fail ☐ N/A
Pulleys operate smoothly and freely, without resistance.	☐ Pass ☐ Fail ☐ N/A
Motor is mounted in correct location and tightly secured to drill rig.	☐ Pass ☐ Fail ☐ N/A
Winch capable of being placed in the free spool (unwind smoothly) and locked position correctly, demonstrating that the cable is suitable for lifting during drilling operations.	☐ Pass ☐ Fail ☐ N/A
Safety Latches	
Hooks installed on hoist cables are the safety type with a functional latch to prevent accidental separation.	☐ Pass ☐ Fail ☐ N/A
Safety latches are functional and completely span the entire throat of the hook and have positive action to close the throat except when manually displaced for connecting or disconnecting a load.	☐ Pass ☐ Fail ☐ N/A
Flights / Augers / Reamers	
Flights / Augers / Reamers are not bent, cracked, or broken. NOTE: Flights / Augers / Reamers failing inspection must be removed from jobsite.	☐ Pass ☐ Fail ☐ N/A

Flights are blunt to prevent the risks of cuts.	☐ Pass ☐ Fail ☐ N/A
Auger keys are not bent, cracked/fractured, excessively worn, or otherwise damaged.	☐ Pass ☐ Fail ☐ N/A
Auger bolt holes and threads are not damaged.	☐ Pass ☐ Fail ☐ N/A
Inspect flights/augers for metal burns. NOTE: Burrs must be filed to flat surface.	☐ Pass ☐ Fail ☐ N/A
Augers / Reamers lying flat on the ground (avoid stacking).	☐ Pass ☐ Fail ☐ N/A
Augers / Reamers over 50lbs (22.7kg) moved mechanically. (Avoid manual lifting).	☐ Pass ☐ Fail ☐ N/A
Drill String	
Appropriate break out tool(s) available.	☐ Pass ☐ Fail ☐ N/A
Rod box and power vice operating smoothly and freely.	
Drill string are not bent and do not have any cracks/fractures.	☐ Pass ☐ Fail ☐ N/A
Drill string connections (e.g. pins, threads, couplers) are of the proper type, are not bent, have no cracks/fractures, and are not excessively worn.	☐ Pass ☐ Fail ☐ N/A
Swivel connectors (for trailing horizontal drill stem) lubricated and freely rotating.	☐ Pass ☐ Fail ☐ N/A
Mast	
Mast is free of bends, cracks, or broken sections.	☐ Pass ☐ Fail ☐ N/A
All mounting hardware (pins, bolts, etc.) in place.	☐ Pass ☐ Fail ☐ N/A
No moving of drill rig or maintenance/repairs while mast is in vertical position.	☐ Pass ☐ Fail ☐ N/A
Hammering Device	
Hammer free of cracks, fatigue, or other signs of excessive wear.	☐ Pass ☐ Fail ☐ N/A
Hammer connections are secure.	☐ Pass ☐ Fail ☐ N/A
Leveling Devices	
Outriggers move in/out and up/down smoothly and freely while using controls on drill rig, with no hydraulics leaks.	☐ Pass ☐ Fail ☐ N/A
Outriggers are extended prior to and whenever the mast is raised off its cradle. Outriggers must maintain pressure to continuously support and stabilize the drill rig (even while unattended).	☐ Pass ☐ Fail ☐ N/A
Outriggers are properly supported on the ground surface to prevent setting into the soil (use of outrigger support pads).	☐ Pass ☐ Fail ☐ N/A
Controls	
Controls are intact, properly labeled, have freedom of movement, and have no loose wiring or connections.	☐ Pass ☐ Fail ☐ N/A
Controls are not blocked or locked into an operating position.	☐ Pass ☐ Fail ☐ N/A
Installed lights, signals, gauges, and alarms operate properly.	☐ Pass ☐ Fail ☐ N/A
Lifting Devices	
Slings, chokers, and lifting devices (straps, not chains) inspected before using and are in proper working order. NOTE: Damaged units are labeled and removed from jobsite.	☐ Pass ☐ Fail ☐ N/A
Shackles/Clevises are in proper working order with pins/screws in place that is to be used while lifting.	☐ Pass ☐ Fail ☐ N/A
Cables and lifting devices are not operated erratically or with a jerking action to overcome resistance.	☐ Pass ☐ Fail ☐ N/A
Hydraulic System	
Hydraulic lines are secure, in good condition with no signs of excessive wear, and not leaking. NOTE: Check while pressurized.	☐ Pass ☐ Fail ☐ N/A
Hydraulic lines are not in a bent or pinched position causing additional fluid restrictions/pressures.	☐ Pass ☐ Fail ☐ N/A
Hydraulic oil reservoir has appropriate amount of oil and not leaking.	☐ Pass ☐ Fail ☐ N/A
Documentation available to confirm that pressure relief valve was checked during shop maintenance activity and noted on maintenance log.	☐ Pass ☐ Fail ☐ N/A
Pump Lines (water, grout, etc)	
Suction/Discharge hoses, pipes, valves, and fittings are secured and not leaking.	☐ Pass ☐ Fail ☐ N/A
High pressure hoses have a safety chain, cable, or strap at each end to prevent whipping in the event of a failure.	☐ Pass ☐ Fail ☐ N/A

Ladders	
Drill rig has a permanently attached or proper portable ladder to be used for access to drilling platform.	☐ Pass ☐ Fail ☐ N/A
Ladders and platforms not to be used for tool storage- keep ladders and operator platforms clear during drilling.	☐ Pass ☐ Fail ☐ N/A
Tires / Tracks	
Tires / Tracks on rig are not excessively worn and free of any debris or foreign material.	☐ Pass ☐ Fail ☐ N/A
General	
General condition – exterior (no structural damage, no loose bolts, platform tidy, etc.)	
General condition – interior (cab clean, tidy)	
Drill rig meets regulations for transport on state/federal highways (inspection sticker, license plate, etc.).	☐ Pass ☐ Fail ☐ N/A
Rig is of appropriate size to meet job requirements.	☐ Pass ☐ Fail ☐ N/A
Maintenance log available for previous 3 months to confirm proper maintenance/inspection.	☐ Pass ☐ Fail ☐ N/A
Exhaust	
Exhaust system is free from defect and routes engine exhaust away from drill rig workers.	☐ Pass ☐ Fail ☐ N/A
Fuels	
Fuel stored in an approved and properly labeled container.	☐ Pass ☐ Fail ☐ N/A
Fuel transfer lines free from signs of excessive wear and not leaking.	☐ Pass ☐ Fail ☐ N/A
Refueling and transferring of fuel is performed in an approved area with sufficient containment to prevent spillage.	☐ Pass ☐ Fail ☐ N/A
Exclusion/Work Zones	
The exclusion/work zone is centered over the borehole (and if applicable, bore exit point) and the radius equal to or greater than the height of the mast (measured from ground level).	☐ Pass ☐ Fail ☐ N/A
The exclusion/work zone is clear of tripping hazards or the hazards are documented with appropriate controls on the Task Hazard Assessment.	☐ Pass ☐ Fail ☐ N/A
The exclusion/work zone communicated to concurrent/adjacent operations to prevent overlap of work zones or line of fire.	☐ Pass ☐ Fail ☐ N/A
Subsurface Utilities / Installations and Overhead Obstructions	
Subsurface utilities / installations have been confirmed as identified and cleared through site observation and review of the completed *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist.*	☐ Pass ☐ Fail ☐ N/A
Except where electrical distribution and transmission lines have been de-energized and visibly grounded, drill rigs will be operated proximate to under, by, or near power lines in accordance with the Minimum Approach Distance (MAD).	☐ Pass ☐ Fail ☐ N/A
Rig Repairs	
Repairs, when possible, are conducted offsite to reduce the risk of any onsite incidents.	☐ Pass ☐ Fail ☐ N/A
Specialized PPE	
When working at elevated heights, workers are to wear a fall restraining device attached in a manner to restrict falls to less than six feet (1.83 meters).	☐ Pass ☐ Fail ☐ N/A
When working in wet/slippery conditions, all workers have a lug-type sole or similar slip resistant sole, on their safety footwear to prevent slipping.	☐ Pass ☐ Fail ☐ N/A

Comments:

Signature of Inspector: _____ Date: _____

Americas

Drilling, Boring & Direct-Push Equipment Maintenance Inventory

S3AM-321-FM2

Equipment (*Make, Model, Serial #*)	Equipment Owner	Equipment Status (*On Hire, Active, Decommissioned*)	Frequency of service	Service Type	Manufacturer's Standards	Industry Standards	Legislated Requirements	Location of Equipment

Americas

Core Drilling Machine

S3AM-321-ATT1

1.0 Objective / Overview

1.1 Core drilling machines are used on all types of jobs. They can be electrical or gas powered and come with a stand or can be hand held. Caution should be used when operating such a machine. It may look harmless and easy to run, but drilling machines have many hazards.

1.2 Prior to coring activities the location should be checked for buried utilities in accordance with *S3AM-331-PR1 Underground Utilities*.

2.0 Safe Operating Guidelines

2.1 Clean the flanges before mounting the blade.

2.2 Make sure the blade is correct for the material being cut and that the arrow on the blade corresponds with the direction of rotation of the machine spindle.

2.3 Use built-in vacuum or bolt-down anchors depending on the type of surface to be cored. Do not bypass anchoring system.

2.4 Properly manage power cable for electric units to prevent slips, trips or falls by the operator or those nearby.

2.5 Avoid tilting the blade when cutting.

2.6 Use only the machines that have an approved safety guard.

2.7 Remove the diamond blade from the machine during transit to prevent accidental damage.

2.8 Inspect the blades frequently to detect cracks or undercutting of the steel center.

2.9 Do not let excessive heat be generated at the cutting edge of the blade.

2.10 Use adequate water supply to both sides of the blade.

2.11 Follow the manufacturers recommended pulley sizes and operating speeds for specific blade diameters.

2.12 Make sure to tighten drive belts to ensure full available power.

2.13 Don't force the blade on the blade shaft or mount blade on an undersized spindle.



3.0 Potential Hazards

3.1 Utilities

3.2 Electricity

3.3 Flying debris

3.4 Noise exposure

3.5 Inadequate housekeeping

3.6 Fumes or dust

3.7 Pinch points

3.8 Binding/biting – torque control

4.0 Training Requirements

4.1 Review of applicable SOPs (e.g., *S3AM-305-PR1 Hand & Power Tools*; *S3AM-302-PR1 Electrical Safety*).

4.2 Demonstrated knowledge on the use of a coring machine.

4.3 Review and follow manufacturers' operating guidelines.

5.0 Personal Protective Equipment (Level D PPE)

5.1 Hard hat

5.2 Safety Vest

5.3 Leather gloves

5.4 Face shield

5.5 Steel-toed/composite-toed boots

5.6 Hearing protection

5.7 Respirator or dust mask (as applicable to the respiratory hazards)

6.0 Other Safety Tips

6.1 Keep fingers and hands away from the cutting edge.

6.2 Hold handle firmly when operating.

6.3 A subsurface utility clearance shall be performed prior to initiating drilling operations.

6.4 Stand firmly and apply body weight at anchored side of guarded platform.

Americas

Pre-Drilling, Boring & Direct Push Probing Flow Chart

S3AM-321-ATT2

Before Any Drilling, Boring and Direct Push Probing Activities

PERMITS and ACCESS AGREEMENTS

- **Government and Utility/Infrastructure Permits**
- **Client Permits and Procedures**
- **Access Agreements**

KEY POINT: Obtain all permits and sign Access Agreement (if required).

GENERAL HEALTH and SAFETY

KEY POINT: Prepare SH&E Plan, as well as Task Hazard Assessments (THA).

IDENTIFICATION and MAPPING OF UTILITY and SUBSURFACE STRUCTURES

KEY POINT: Generate a comprehensive site map illustrating known locations of overhead/subsurface utilities, subsurface structures, and proposed boring locations.
Review completed *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist*.

SITE WALK

KEY POINT: Perform a site walk utilizing site map and 360 degree view to verify known conditions, including overhead obstructions or hazards, and identify potential issues. Add discovered items/issues to map for use in location confirmation.

PROPOSED SUBSURFACE INVESTIGATION LOCATIONS

KEY POINT: Confirm that locations meet the minimum required set-back distances.

UTILITY CLEARANCE INVESTIGATION LOCATION CONFIRMATION

KEY POINT: Visually verify hand clearance. Review completed *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist*.

DRILL RIG INSPECTIONS

KEY POINT: Drill rig inspected and documented daily by operator prior to drilling.

BEGIN DRILLING, BORING OR DIRECT PUSH PROBING

KEY POINT: Prior to commencing any intrusive subsurface work, *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist* shall be completed.
Upon commencing the work, if unanticipated conditions or events are encountered (e.g. concrete/debris, void encountered, etc.) stop work and notify the Manager. Authorization to proceed shall have the concurrence of the Manager, Site Supervisor and SH&E Manager.

Americas

Underground Utilities

S3AM-331-PR1

1.0 Purpose and Scope

1.1 Provides procedures designed to help prevent injuries to personnel working on the location and pedestrians, property damage, and adverse environmental impact as a result of potential hazards associated with encountering underground utilities, subsurface installations, and potential overhead hazards.

1.2 Provides the minimum requirements to be followed for underground work (e.g., excavations, drilling, boring, and probing work) to ensure that underground installations, and subsurface structures, are identified properly before work commences.

1.3 This procedure applies to all Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

1.4 The Manager is responsible for meeting all the requirements in this procedure.

1.5 AECOM's clients may have specific procedures which shall be followed to identify and map utility and subsurface structures on their properties or facilities. Provided the client's procedures meet or exceed those of AECOM, approval shall be obtained from the Manager and the SH&E Manager to follow the client's procedures.

2.0 Terms and Definitions

2.1 **Underground Utilities –** All utility systems located beneath grade level, including, but not limited to, gas, electrical, water, compressed air, sewage, signaling and communications, etc.

2.2 **Clearance** – includes the following:

- The positive locating of underground utilities or subsurface installations in or near the work area.
- A signed statement by an appropriate representative attesting to the location of underground utilities and/or the positive de-energizing (including lockout) and testing of electrical utilities.

2.3 **Ground Disturbance (GD) –** Any indentation, interruption, intrusion, excavation, construction, or other activity in the earth's surface as a result of work that results in the penetration of the ground.

2.4 **Hand Clearance Zone –** The area on either side of the locate marks of a utility that shall be maintained in order to expose the utility through the use of non-destructive ground disturbance techniques acceptable to the owner of the buried utility. Visual exposure is required before mechanical excavation equipment may be used.

2.5 **Intrusive Activities –** Examples: Excavation of soil borings, installations of monitoring wells, installation of soil gas sampling probes, excavation of test pits/trenches or other man-made cuts, cavity, trench or depression in an earth surface formed by earth removal.

2.6 **Non-Destructive Ground Disturbance Technique –** A safe and acceptable excavation method that is used to visually expose an underground utility without causing damage. Non-destructive ground disturbance techniques may include, but are not limited to:

- Hand digging.
- Use of non-conductive tools.
- Hydro-vacuum.

2.7 **Subsurface Installation –** Examples: Subterranean tunnels, underground parking garages and other structures beneath the surface.

2.8 **Utility Strikes –** Unplanned contact with utilities resulting in damage to the utility or its protective coating.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-303-PR1 Excavation

3.3 S3AM-321-PR1 Drilling, Boring & Direct-Push Probing

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager**

- Administer this procedure and the development of the SH&E Plan.
- Confirm the appropriate equipment and materials are available to conduct the underground utility and/or subsurface installation clearance.
- Confirm all employees involved and affected by the task review the SH&E Plan and Task Hazard Assessment (THA) prior to work commencing
- Authorize work to proceed using the *S3AM-331-FM1 Underground Utility & Subsurface Installation Clearance Checklist*.
- Confirm that employees conducting underground utilities and subsurface clearance processes possess all required training, registrations or certifications.
- Provide authorization (with the concurrence of the Site Supervisor and SH&E Manager) for work to resume if interrupted due to unexpected conditions or events.

4.1.2 **Safety, Health & Environment (SH&E) Manager**

- Assist AECOM management as needed by providing guidance and clarification as to issues that may arise.
- Review the SH&E Plan to confirm compliance with jurisdictional regulations. Provide technical guidance as needed when a variance is pursued related to this procedure.

4.1.3 **Employees**

- Maintain training as appropriate to the work to be completed (e.g. ground disturbance, lockout tagout, equipment operation, etc.). Refer to *S3AM-003-PR1 SH&E Training*.
- Review the SH&E Plan and Task Hazard Assessment (THA) prior to work commencing.
- As appropriate to the anticipated or encountered hazards and as addressed in the applicable planning documentation, utilize appropriate personal protective equipment (PPE) and applicable training, practices and operating procedures.
- Immediately notify the Manager of any unanticipated conditions or events. If assigned equipment, perform appropriate inspections and confirmations of maintenance and/or repairs.

4.2 Training

4.2.1 All on-site employees involved with the underground utility and subsurface identification and associated clearance process shall be trained, at a minimum, in these procedures.

4.2.2 Employees shall complete all required training associated with their tasks in accordance with the SH&E Training Matrix and any training assessments developed at the business group.

- Refer to *S3AM-003-PR1 SH&E Training.*
- This training may include, but is not limited to, Excavation / Trenching (Ground Disturbance), HAZWOPER, Petroleum Safety Training (or Construction Safety Training), and H2S Alive as appropriate.

4.2.3 As applicable, employees shall receive client-required training.

4.3 Planning

4.3.1 Health and Safety Plan – At a minimum, a SH&E Plan and task hazard assessments (THAs) shall be prepared prior to any underground utilities and subsurface installations clearance activities.

- The SH&E Plan will address any required environmental monitoring including gas monitoring, dust, noise, metals, radiation or other monitoring as may be appropriate for site conditions.
- Employees shall comply with all SH&E Plan requirements.
- The location specific emergency response plan shall be in place, contain procedures applicable to the potential emergencies presented by the operations, and be reviewed with all personnel potentially affected.

4.3.2 *S3AM-331-ATT2 Underground Utilities & Subsurface Installation Clearance Flow Chart* provides a summary of the key requirements addressed in this procedure.

4.3.3 Underground utilities and subsurface installations shall be investigated as being present, including the following, but not limited to:

- Steam, gas and electric.
- Sewer and water.
- Subterranean tunnels.
- Fibre optics (note: routine geophysical surveys will not identify fibre optic cables).
- Traffic control cables.

4.3.4 Location of underground utilities and subsurface installations will be confirmed by cross-referencing available information:

- Maps, as-built drawings and issued for construction (IFC) drawings.
- Plot plans, permits, crossing/encroachment agreements.
- One-Call information, locator and provided surveys.
- Private utility information, locator and provided surveys (e.g. ground penetrating radar (GPR), electromagnetic, etc.).
- Owner supplied documentation.
- Site walks.

4.3.5 As applicable, emergency shut-off locations of utilities shall be verified before work activities commence.

4.3.6 Jurisdictional, land owner, client and utility owner requirements shall be consulted to determine the minimum search zone dimensions and appropriate clearance distances.

4.3.7 As necessary and if possible, adjust locations of excavations or intrusive subsurface work away from subsurface utilities and installations

4.3.8 Prior to any excavation or intrusive subsurface work, the *S3AM-331-FM1 Underground Utility & Subsurface Installation Clearance Checklist* shall be completed. The form shall be reviewed and signed by the Manager.

- If the answer to any question in Part 1 of the checklist is “No” or “N/A”, no ground disturbance may take place without review by the Manager, in consultation with SH&E Manager, of the circumstances related to the particular item. The Manager shall initial beside each “No” or “N/A” item to indicate review and authorization.

4.4 Permits, Notifications and Access Agreements

4.4.1 Any required notifications shall be provided within the appropriate timeframe to the applicable organization (e.g. owner, utility company, agency, governing body, etc.).

4.4.2 All applicable permits (e.g. client, government, working near rail road, etc.) will be identified, obtained, and adhered to.

4.4.3 All access agreements will be obtained and adhered to.

4.5 Locating Underground Utilities and Subsurface Installations

4.5.1 Utilize the appropriate call/click-before-you-dig provider. Refer to *S3AM-331-ATT1 One-Call System*.

4.5.2 Federal/State/Provincial/Territorial and other “One Call” providers shall be contacted at least two working days and no more than ten working days prior to commencing the ground disturbance. Jurisdictional requirements shall be consulted to verify the appropriate advance notice. (e.g. 24 hours, two full working days, three to ten business days, etc.).

4.5.3 If the location of proposed excavation or intrusive subsurface work cannot be clearly and adequately identified, the route and/or area of the proposed ground disturbance shall be identified using white flags, paint or stakes prior to the arrival of the locator. Consult jurisdictional requirements as white-lining may be a mandatory requirement on all ground disturbances.

4.5.4 One Call providers shall appropriately identify and mark the subsurface utilities or installations, or otherwise provide written notification they do not have any facilities near the proposed subsurface/intrusive locations.

4.5.5 Confirm all circuits were on during subsurface checks if the checks were for identifying energized lines (e.g. circuits on timers or light sensing switches).

4.5.6 Areas that have a high density of sub-surface facilities may require a secondary locate by another independent locator to verify locations identified by the first locator.

4.6 Private Utility Locating

4.6.1 One Call services may not be available in various non-urban locations. Private utility locating companies shall be utilized to identify and located any underground utilities or subsurface installations.

4.6.2 Be aware urban areas (e.g. city or town) may have subsurface installations (e.g. underground garages) and utilities (e.g. public water, sewer, and gas pipelines) that are not covered by one-call systems.

- These subsurface installations and utilities require additional investigation and diligence beyond the one-call system.
- Additional investigation and diligence beyond the one-call system is also recommended for non-urban areas.

4.6.3 In urban areas, private utility locating companies shall be called to identify and locate, through geophysical surveys and other means, the presence of private utilities installed by the property owner (e.g. irrigation systems) and to verify the presence of public utilities on the properties.

- Hand clearing is required in urban areas.

4.6.4 Hand clearing is also recommended for non-urban areas and may be required by the given jurisdiction.

4.6.5 Warning tape, pea gravel, sand, non-indigenous material, bentonite, red concrete (indicative of electrical duct banks) and any departure from native soil or backfill may be evidence of the presence of subsurface installations and utilities.

4.7 Surface Markings

4.7.1 Once the underground installation has been identified, proper surface markings shall be made in accordance with the guidelines from the One-Call System (refer to S3AM-331-ATT1), guidance contained in this procedure or as contract-specified.

4.7.2 Color-coded surface marks (paints or similar coatings) shall be used to indicate the type, location, and route of buried installations. Additionally, to increase visibility, color-coded vertical markers (temporary stakes or flags) shall supplement surface marks.

4.7.3 All marks and markers shall indicate the name, initials, or logo of the company that owns or operates the installation and the width of the installation if it is greater than 2 inches.

4.7.4 If the surface over the buried installation is to be removed, supplemental offset marking shall be used. Offset markings shall be on a uniform alignment and shall clearly indicate that the actual installation is a specific distance away.

4.7.5 Locate marks shall be re-verified as per jurisdictional requirements or no later than 14 days after the previous locate was completed, whichever interval is shorter. These locate time intervals shall be maintained for the duration of the ground disturbance.

- If the work is interrupted during the determined lifespan or work does not commence during the applicable lifespan, a new locate shall be performed.
- Jurisdictional provisions may allow for an extension to the lifespan of the locate marks, however certain conditions may need to be met. (e.g. activities uninterrupted)
- If locate marks are moved or destroyed the location of the buried facilities shall be re-established.

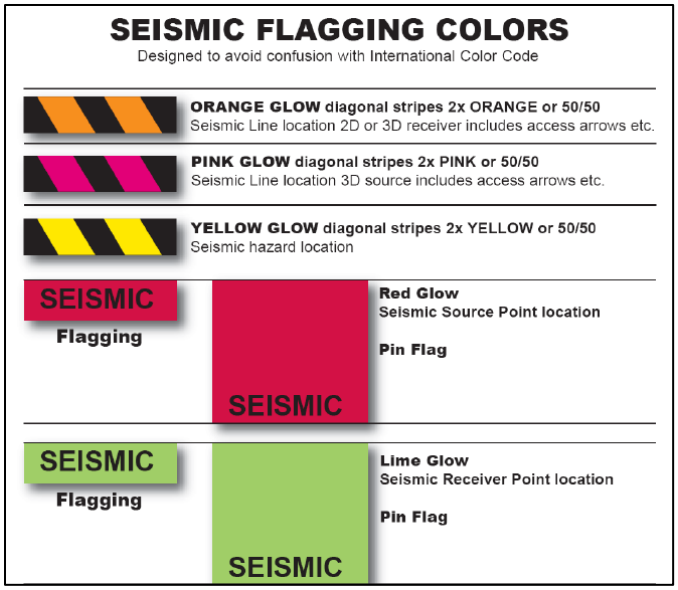
4.8 Uniform Color Coding

4.8.1 The colors and corresponding installation type are as follows unless otherwise contract-specified:

AMERICAN PUBLIC WORKS ASSOCIATION – APWA
Color Coding for Marking of Buried Facilities

White	Proposed Ground Disturbance Area
Pink	Temporary Survey Markings
Red	Electric Power Lines, Cables, Conduit and Lighting Cables
Yellow	Gas, Oil, Steam, Petroleum Lines or Gaseous Materials
Orange	Conduit, Cable, Communication, Alarm or Signal Lines
Blue	Potable Water
Green	Sewer, Storm Sewer and Drain Lines
Purple	Reclaimed Water, Irrigation and Slurry Lines (non-potable)

Canadian Association of Geophysical Contractors



4.9 Identification and Mapping of Utility and Subsurface Structures

4.9.1 The locations of subsurface utilities and subsurface installations shall be investigated, documented, and shown on a site plan (a scaled site plan shall be used when feasible). Refer to *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist.*

4.9.2 Documentation of utility and subsurface installation identification (calling one call, responses from utilities) along with the scaled site plan shall be available on the worksite at all times of intrusive activities.

4.10 Site Walk

4.10.1 A site walk shall be conducted by the AECOM Manager and any other appropriate personnel with the objectives of reviewing all planned intrusive activity locations, the locations of subsurface and overhead utilities, overhead obstructions, and the potential for subsurface installations, to determine the appropriate utility clearance activities, and to observe other physical hazards.

- Walk the area at least 50 feet (15.2 meters) from perimeter of the site to observe physical hazards.
- Walk the area of at least 50 feet (15.2 meters) radius from each proposed subsurface intrusion location.
- If possible, particularly at urban and industrial sites, the client/property owner or an individual knowledgeable about the site and site utilities will attend the site walk.
- Add discovered items/issues to map for use in location confirmation.

4.10.2 The Site Walk further supplements the Identification and Mapping of Utility and Subsurface Structures procedure. Site Walks should be repeated as necessary following the Identification and Mapping of Utility and Subsurface Structures as visual verification of the hazards. Examples include:

- Proposed location(s) does not lie on a line connecting two similar manhole covers (e.g. sanitary sewer or storm drain).
- Proposed subsurface location(s) has not subsided, been excavated and patched, nor gives the appearance it may be covering a former trench (e.g. linear cracks, sagging curbs, linear re-pavements, etc.).
- Proposed subsurface location(s) does not lie on a line with any water, gas, electrical meters, utility cleanouts, or other utility boxes in the surrounding areas.

4.11 Proposed Subsurface Investigation Locations

4.11.1 All proposed subsurface locations will be reviewed in comparison to subsurface and overhead utilities and subsurface installations and adjustments made as necessary.

4.11.2 Minimum set back distances from subsurface and overhead utilities and subsurface installations will be established including 5 feet (1.5 meters) from any subsurface utility, 7 feet (2.1 meters) from the pad surrounding any underground storage tanks, and 10 feet (3 meters) from any overhead energized electrical line (or further depending on line voltage). These set back distances are a minimum; government regulations and utility requirements may dictate a greater set back distance.

4.12 Utility Clearance Investigation Location Confirmation

4.12.1 As applicable, all client on-site safety procedures shall be understood and adhered to.

4.12.2 Hand exposure or non-destructive ground disturbance techniques to expose an underground utility or subsurface installation are necessary to accurately determine size, location and alignment prior to mechanical excavation or intrusive subsurface work in the vicinity of that utility or installation.

4.12.3 Non-destructive ground disturbance techniques shall be acceptable to the owner of the buried utility (i.e. hydro-vacuum temperature or pressure).

4.12.4 Hydro-vacuum or air-knife require proper grounding equipment at sites where the subsurface may contain flammable gases, liquids, or vapors

4.12.5 Jurisdictional, land owner, client and utility owner requirements shall be consulted to determine the distance of the hand exposure zone, and what requirements, when met, may allow mechanical excavation within these zones.

4.12.6 At a minimum, all underground utilities and subsurface installations within a 5 feet (1.5 meter) radius of the work site shall be identified and physically located (seen) before use of mechanical excavation equipment is permitted. Jurisdictional, client, land owner and utility owner requirements shall be consulted as the required hand exposure radius may be larger.

4.12.7 In urban areas, proposed subsurface locations will be hand cleared to 5 feet (1.5 meters) (soil borings and wells) or 12 inches (30 centimeters) (soil gas sampling probes) using non-mechanical methods.

- In non-urban areas, hand clearing should be conducted if possible and shall be conducted as required by the given jurisdiction.
- Hand clearance should be extended if locations of deep utilities and structures are not known.
- Hand exposure or non-destructive ground disturbance techniques should extend a minimum of 24 inches (60 centimeters) below the intended ground disturbance depth to minimize the hazard of mechanical equipment contact with any utility or installation.

4.12.8 Mechanical equipment and attachment dimensions shall be considered when establishing the zone in which all underground utilities and subsurface installations are physically located (seen) prior to the use of that equipment. The radius may require expanding to maintain safe distances when using large equipment.

4.13 Utility Strikes

4.13.1 Utility strikes shall be reported in accordance with *S3AM-004-PR1 Incident Reporting, Notifications & Investigation*.

4.13.2 All damaged utilities shall be repaired by a qualified and/or licensed professional.

5.0 Records

5.1 Retain completed *S3AM-331-FM1 Underground Utility & Subsurface Installation Clearance Checklist* and documents related the clearance process (e.g. Utility Owner communication, etc.) in the site or project files.

5.2 Documentation of employee training completed shall be retained in accordance with *S3AM-003-PR1 SH&E Training*.

6.0 Attachments

6.1 S3AM-331-ATT1 One-Call System

6.2 S3AM-331-ATT2 Underground Utilities & Subsurface Installation Flow Chart

6.3 S3AM-331-FM1 Underground Utility & Subsurface Installation Clearance Checklist

Americas

Underground Utilities & Subsurface Installation Clearance Checklist

S3AM-331-FM1

Location:	Project #:	Date & Time:
Manager:	Contractor (if applicable):	Weather:
Client:	Inspector:	
Notes:		

Part 1

Part 1 and Part 2 shall be completed prior to any intrusive subsurface work. DO NOT DISTURB GROUND if a "No" or "N/A" answer to any of the Part 1 questions has not been initialed as authorized by the AECOM Manager.

Any variance from these procedures requires approval of the Vice President of the applicable business group.

		Yes	No	N/A
I.	**Permits and Access Agreements**			
1.	Have all appropriate permits and agreements been identified and obtained (e.g. client, drilling, encroachment, working near railroads, etc.)?	☐	☐	☐
2.	Have all client requirements been identified and obtained?	☐	☐	☐
3.	If working off-site is (are) site access agreement(s) executed?	☐	☐	☐
II.	**General Health and Safety**			
1.	Has a Health and Safety Plan (HASP) been prepared for AECOM employees?	☐	☐	☐
2.	Do on-site personnel have required-level PPE?	☐	☐	☐
3.	Do on-site personnel have required-level of training?	☐	☐	☐
4.	Is appropriate monitoring equipment as specified in HASP/THAs available at each clearance location?	☐	☐	☐
5.	Has the field screening equipment been calibrated as required by the HASP?	☐	☐	☐
6.	Are calibration gases available at the site?	☐	☐	☐
III.	**Identification and Mapping of Utility and Subsurface Structures**			
1.	Is a Site Plan showing proposed subsurface locations and utility locations attached to this check list?	☐	☐	☐
2.	Have above/below ground utilities & subsurface installations been investigated (Part 2 of this form)?	☐	☐	☐
3.	Have all Federal/State/Provincial/Territorial and other "One Call" providers marked their facilities or otherwise notified they do not have any facilities near the proposed subsurface/intrusive locations?	☐	☐	☐
4.	Have Federal/State/Provincial/Territorial or other "One Call" providers identified what utilities and underground structures are *not* included in their provider system (e.g. underground structures)?	☐	☐	☐
5.	As noted in the exception at the bottom of Section VI of this checklist, has a utility locating contractor performed geophysical and/or other surveys of the proposed subsurface/intrusive locations?	☐	☐	☐

Part 1 and Part 2 shall be completed prior to any intrusive subsurface work. DO NOT DISTURB GROUND if a "No" or "N/A" answer to any of the Part 1 questions has not been initialed as authorized by the AECOM Manager.

Any variance from these procedures requires approval of the Vice President of the applicable business group.

	Yes	No	N/A
6. Visual verification that each of the proposed locations does not lie on a line connecting two similar manhole covers (e.g. sanitary sewer or storm drain)?	☐	☐	☐
7. Visual verification that the ground in the vicinity of each of the proposed subsurface locations has not subsided, been excavated and patched, give the appearance it may be covering a former trench (e.g. linear cracks, sagging curbs, linear re-pavements, etc.) and does not lie on a line with any water, gas, electrical meters, utility cleanouts, or other utility boxes in the surrounding areas?	☐	☐	☐
IV. Site Walk			
1. Has a site walk been performed that includes the following:	☐	☐	☐
a. Reviewing all planned intrusive locations?	☐	☐	☐
b. Adjusting locations away from subsurface utilities and installations?	☐	☐	☐
c. Determining the appropriate utility clearance activities for each location?	☐	☐	☐
d. Determining the presence and location of overhead utilities and obstructions?	☐	☐	☐
e. Walk around perimeter of the site to observe physical hazards?	☐	☐	☐
f. Includes 50 feet (15.2 meters) from perimeter of the site to observe physical hazards and 50 feet (15.2 meters) radius from each proposed subsurface location?	☐	☐	☐
V. Proposed Subsurface Investigation Locations*			
1. Are all of the proposed subsurface locations at least 5 feet (1.5 meters) from any identified subsurface utility?	☐	☐	☐
2. Are all of the proposed subsurface locations at least 7 feet (2.1 meters) from the pad surrounding any underground storage tanks (USTs) shown on the Site Plan?	☐	☐	☐
3. Are all of the proposed subsurface locations at least 5 feet (1.5 meters) from any subsurface utilities shown on the Public Right-of-Way street improvements?	☐	☐	☐
** These set back distances are a minimum; government regulations and utility requirements may dictate a greater set back distance.*			
VI. Utility Clearance Investigation Location Confirmation*			
1. Have the hand clearance / tolerance zones of subsurface locations been observed and utilities exposed through the use of non-destructive techniques as follows? Hand / non-destructive technique clearance should be extended if locations of deep utilities and structures are not known. In non-urban areas hand clearing should be conducted if possible and according to local requirements.	☐	☐	☐
a. For soil borings/monitoring wells; excavated to a minimum of 5 feet (1.5 meters) below ground surface using non-mechanical methods?	☐	☐	☐
b. For soil gas sampling; excavated to 2 foot (0.6 meter) below grade or below the bottom of a concrete floor prior to the installation of soil gas sample probe points?	☐	☐	☐

** Exceptions to requirements of the utility clearance process, as permitted by the applicable jurisdiction, include the following:*

- *Sites where extensive utility mapping (e.g. geophysical survey) has been completed and/or where extensive activities have already been performed.*
- *Locations where facility layout is well documented and understood.*
- *Sites or portions of large sites where utilities are known not to exist currently or to not have ever existed throughout the life of the facility, property or site.*

Part 1 and Part 2 shall be completed prior to any intrusive subsurface work. DO NOT DISTURB GROUND if a "No" or "N/A" answer to any of the Part 1 questions has not been initialed as authorized by the AECOM Manager. *Any variance from these procedures requires approval of the Vice President of the applicable business group.*	**Yes**	**No**	**N/A**
Comments:			
Documentation supplied by one-call or private utility and installation locators, including email or written field confirmation / maps of mark-out requests and status shall accompany this form. If this form is supporting multiple ground disturbance activities, a copy of this completed form should be provided to each activity.			

Part 2

Public Utility Locate (OneCall) Prior Locate Ticket #					
Date Called:		Called By:		Valid Until:	
Ticket Number:		Area Requested To Be Cleared:			

Private Utility Locate Prior Locate Ticket #			
Company Performing Locate:		Date Completed:	
Area(s) Requested To Be Cleared (including distance around marked locations):			
Method(s) Used (e.g., GPR, EM):			
Confirm Area(s) Cleared:			

OneCall Utilities			**Field Observation**
Utility	**Notified by**	**Comments**	**Marked** (mains & services)
Electric (Red)	☐ OneCall ☐ Other		☐ Yes ☐ No ☐ Above
Gas/Petroleum Pipeline (Yellow)	☐ OneCall ☐ Other		☐ Yes ☐ No
Sewer/Drainage (Green)	☐ OneCall ☐ Other		☐ Yes ☐ No
Water (Blue)	☐ OneCall ☐ Other		☐ Yes ☐ No
Communications (Orange)	☐ OneCall ☐ Other		☐ Yes ☐ No ☐ Above
Other	☐ OneCall ☐ Other		☐ Yes ☐ No ☐ Above
Were all circuits on during subsurface checks if the checks were for identifying energized lines (e.g., circuits on timers or light sensing switches)?			☐ Yes ☐ No ☐ N/A

Utilities Not Identified By OneCall (Includes both Public and Private along with Regional and Site Utilities)			**Field Observation**
Utility (Colors may vary)	**Owner / Contact / Phone #**	**Notified**	**Marked**
Communications: (Orange) TV, computer, phone, cell towers, site communication, cameras, security, etc.		☐Yes ☐No	☐ Yes ☐ No ☐ Above
Electricity: (Red) Mains / Supplies / Interior / Exterior (signs, fuel pumps, low voltage security perimeters, gates, property light posts, equipment, substations, etc.)		☐Yes ☐No	☐ Yes ☐ No ☐ Above
Gas: (Yellow) Mains / Supplies / Equipment / Pipelines (Natural, Process, Oil, Crude, Refined (Gas, Diesel, Jet), etc.)		☐Yes ☐No	☐ Yes ☐ No ☐ Above
Steam: (Yellow)		☐Yes ☐No	☐ Yes ☐ No ☐ Above

Structures: Possible horizontally installed facilities, vaults, basements, tunnels, sub-grade structures, foundations, overhead obstructions, etc.		☐Yes ☐No	☐ Yes ☐ No ☐ Above
UST Systems (Tanks / piping / electric)		☐Yes ☐No	☐ Yes ☐ No
Sewer: (Green) Sanitary, storm, combined, septic, drainage (parking, buildings, fields), irrigation		☐Yes ☐No	☐ Yes ☐ No
Water: (Blue) Process, Plant, potable, well, cooling, return/makeup, fire, sprinkler, landscape irrigation, reclaim (Purple) other		☐Yes ☐No	☐ Yes ☐ No ☐ Above
Other: Abandoned lines, invisible dog fences, shopping cart perimeter monitoring, traffic lights		☐Yes ☐No	☐ Yes ☐ No ☐ Above

Manager: _____ _____ _____

Print Sign Date

Americas

One-Call System

S3AM-331-ATT1

1.0 What Is It?

1.1 One-call systems are established across the Americas to provide one telephone number for excavating contractors and the general public to call for notification of their intent to use equipment for excavating, tunneling, demolition, or any other similar work. This one-call system provides the participating members an opportunity to identify and locate their underground facilities.

1.2 As described on their web site (http://www.call811.com), Common Ground Alliance (CGA) was "created specifically to work with all industry stakeholders in an effort to prevent damage to underground utility infrastructure and ensure public safety and environmental protection." CGA also serves as an organization to continuously update best practices amongst the growing underground industry. The CGA web site provides current one-call information for all states and provinces.

2.0 Why Is It Needed?

2.1 Damage to underground facilities increased considerably following the building boom of the 1950s, 1960s, and early 1970s when the trend was to go underground with utilities. Thousands of miles of underground facilities are vulnerable to excavating machines such as backhoes, and the resulting damage can interrupt utility service and threaten life, health, and property.

3.0 How to Get It

3.1 In the United States 811 is the Federally-mandated national "Call Before Your Dig" number that connects directly to the local one-call center. Each state has different rules and regulations governing digging, some stricter than others. The CGA web site provides current contact information to find state-specific information as well as links to submit an online digging request where available. Canadian one-call numbers vary by jurisdiction. One-call services are not available in Canada's Atlantic provinces (New Brunswick, Newfoundland, Nova Scotia) or in the three Northern Territories (Nunavut, Northwest Territories, Yukon).

4.0 Disclaimer

4.1 The purpose of this directory is to illustrate the extent of one-call service available. Some jurisdictions have a list of "Tier 1" subscriber utilities notified by 811, and a "Tier 2" list that the excavator/contractor is responsible for contacting directly. Users shall verify information is current including the extent and limit of service from local sources.

Province/State	One-Call Agency		Number
Canada	www.clickbeforeyoudig.com		
Alberta	Alberta One Call	www.albertaonecall.com	1.800.242.3447
British Columbia	BC One Call	www.bconecall.bc.ca	1.800.474.6886
Manitoba	Click Before You Dig	www.clickbeforeyoudigmb.com	Various – see website
Ontario	Ontario One Call	www.on1call.com	1.800.400.2255
Québec	Info Excavation	www.info-ex.com	1.800.663.9228
Saskatchewan	Sask 1st Call	www.sask1stcall.com	1.866.828.4888

United States	www.call811.com	811
Alabama	Alabama 811	1.800.292.8525
Alaska	Alaska Digline, Inc.	1.800.478.3121
Arizona	Arizona 811	1.800.782.5348
Arkansas	Arkansas One Call	1.800.482.8998
California	(North & Central) USA North 811	1.800.227.2600
	(South) Dig Alert	1.800.227.2600
Colorado	Colorado 811	1.800.922.1987
Connecticut	Call Before You Dig	1.800.922.4455
Delaware	Miss Utility of Delmarva	1.800.282.8555
District of Columbia	District One Call	1.202.265.7177
Florida	Sunshine 811	1.800.432.4770
Georgia	Georgia 811	1.800.282.7411
Hawaii	Hawaii One Call	1.866.423.7287
Idaho	Dig Line, Inc.	1.800.342.1585
	(Bonner/Boundary) Pass Word	1.800.626.4950
	(Kootenai County) Pass Word	1.800.428.4950
	(Shoshone-Benewah) Pass Word	1.800.398.3285
Illinois	(Chicago) Digger -Chicago Utility Alert Network	312.744.7000
	(Outside of Chicago) JULIE	1.800.892.0123
Indiana	Indiana 811	1.800.382.5544
Iowa	Iowa One Call	1.800.292.8989
Kansas	Kansas 811	1.800.344.7233
Kentucky	Kentucky 811	1.800.752.6007
Louisiana	LA One Call	1.800.272.3020
Maine	Dig Safe	1.888.344.7233
Maryland	(West of Chesapeake Bay) Miss Utility of Maryland	1.800.257.7777
	(East of Chesapeake Bay) Miss Utility of Delmarva	1.800.282.8555
Massachusetts	Dig Safe System, Inc.	1.888.344.7233
Michigan	Miss Dig	1.800.482.7171
Minnesota	Gopher State One Call	1.800.252.1166
Mississippi	Mississippi 811	1.800.227.6477

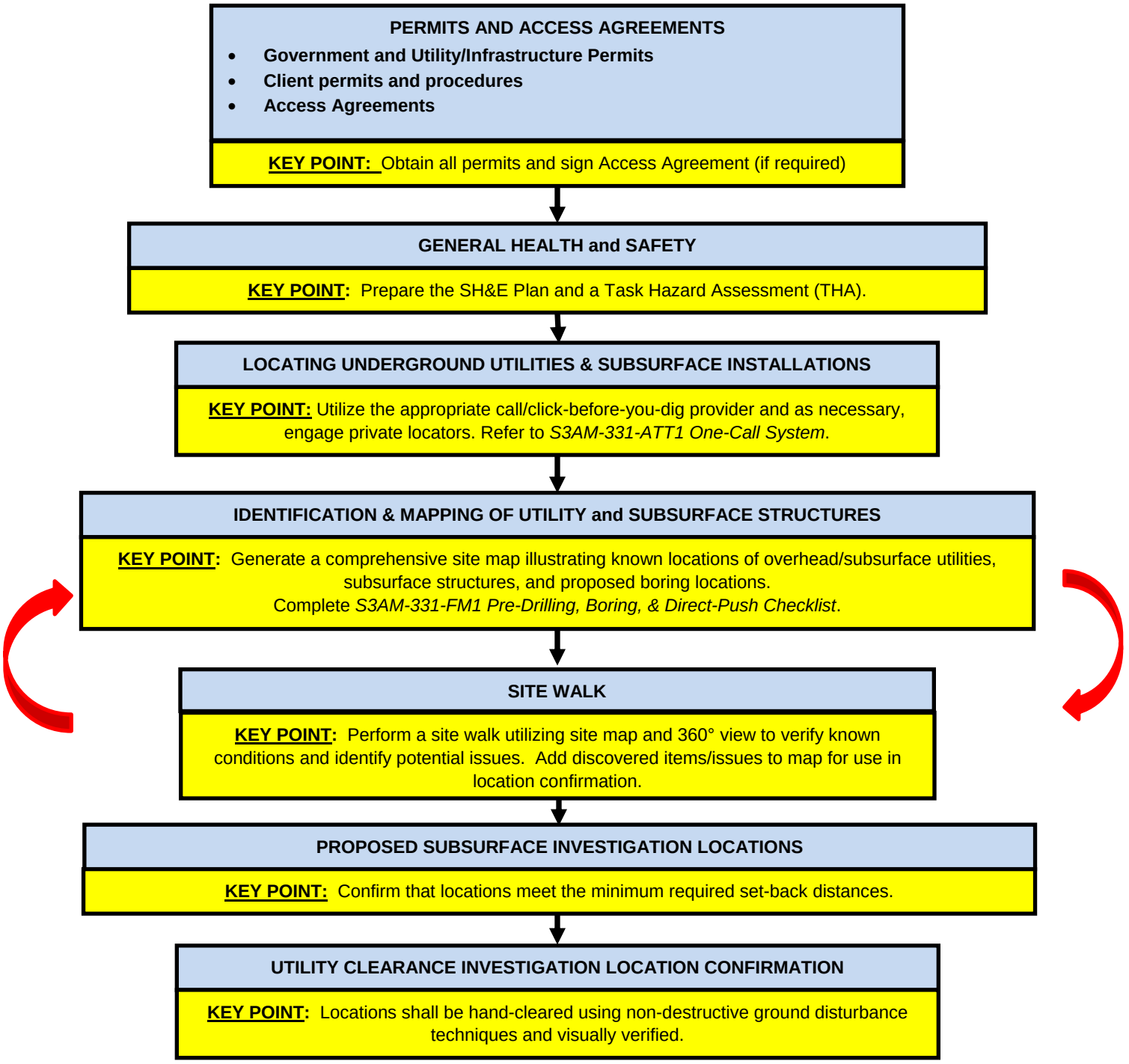
Missouri	Missouri One Call System	1.800.344.7483
Montana	Montana 811	1.800.424.5555
	(Flathead and Lincoln Counties) Montana One Call Center	1.800.551.8344
Nebraska	Nebraska 811	1.800.331.5666
Nevada	USA North 811	1.800.227.2600
New Hampshire	Dig Safe System, Inc.	1.888.344.7233
New Jersey	New Jersey One Call	1.800.272.1000
New Mexico	New Mexico 811	1.800.321.2537
New York	(North of 5 Boroughs) Dig Safely New York	1.800.962.7962
	(5 Boroughs and Long Island) New York 811, Inc.	1.800.272.4480
North Carolina	North Carolina 811	1.800.632.4949
North Dakota	North Dakota One Call	1.800.795.0555
Ohio	Ohio Utilities Protection Service	1.800.362.2764
Oklahoma	Call Okie	1.800.522.6543
Oregon	Oregon Utilities Notification Center	1.800.332.2344
Pennsylvania	Pennsylvania One Call System, Inc.	1.800.242.1776
Puerto Rico	Puerto Rico Public Service Commission 811	
Rhode Island	Dig Safe System, Inc.	1.888.344.7233
South Carolina	South Carolina 811	1.888.721.7877
South Dakota	South Dakota One Call	1.800.781.7474
Tennessee	Tennessee 811	1.800.351.1111
Texas	Texas 811	1.800.545.6005
	Lone Star 811	1.800.669.8344
Utah	Blue Stakes of Utah	1.800.662.4111
Vermont	Dig Safe System, Inc.	1.888.344.7233
Virginia	Virginia 811	1.800.552.7001
Washington	Utility Notification Center	1.800.424.5555
West Virginia	WV 811	1.800.245.4848
Wisconsin	Diggers Hotline	1.800.242.8511
Wyoming	One-Call Of Wyoming	1.800.849.2476

Americas

Underground Utilities & Subsurface Installation Clearance Flow Chart

S3AM-331-PR1

Before Any Underground Utilities and Subsurface Installation Clearance



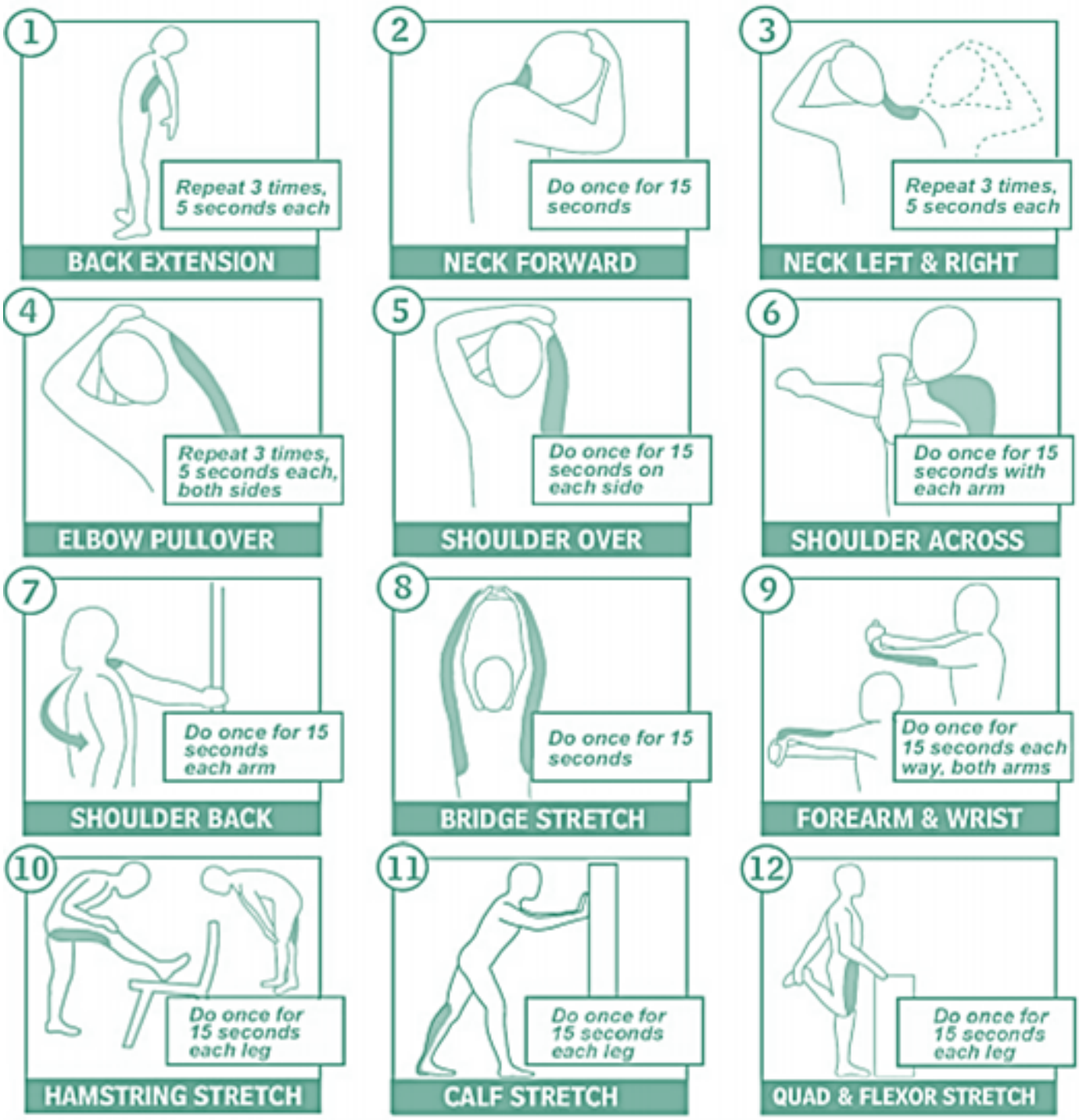
AECOM

Attachment E

Stretch/Flex Poster

Attachment E: Stretch/Flex Poster

Examples of Stretches



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Attachment F

Site Safety Orientation

Attachment F: Site Safety Orientation

AECOM will conduct a site safety briefing for a person's initial visit to the site. The briefing will be conducted:

- Prior to the start of work;
- For any new AECOM or subconsultant personnel;
- For Site Visitors; and
- At each mobilization, or whenever there is a change in task or significant change in task location.

All personnel working on the project who have received the site briefing (including the SWP review) will sign the Personal Acknowledgement located in **Section 18**. Visitors may receive a shortened version to address the hazards specific to their visit.

The following topics, at minimum, will be discussed during the site safety briefing:

- Contents of this SWP;
- The Emergency Response Plan (Table 7-1);
- Contractor SHE Management expectations;
- Injury management, including notification and hospital and occupational clinic locations;
- The AECOM 4-Sight program;
- Stop Work authority;
- The THAs (**Attachment C**) for the activities that will be performed on a given job;
- Types of hazards at the site and means for minimizing exposure to them;
- Instructions for new operations to be conducted, and safe work practices;
- PPE that must be used;
- Lone worker check-in procedures;
- Emergency evacuation routes, muster points, and tornado/storm shelters; and
- Location and use of emergency equipment.
- **These briefings must be documented and maintained in the project files.**

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Attachment G

Safety Data Sheets

Attachment G: Safety Data Sheets

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SAFETY DATA SHEET

Nonflammable Gas Mixture: Isobutylene / Nitrogen / Oxygen

Airgas
an Air Liquide company

Section 1. Identification

GHS product identifier : Nonflammable Gas Mixture: Isobutylene / Nitrogen / Oxygen

Other means of identification : Not available.

Product type : Gas.

Product use : Synthetic/Analytical chemistry.

SDS # : 002103

Supplier's details : Airgas USA, LLC and its affiliates
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

24-hour telephone : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : GASES UNDER PRESSURE - Compressed gas

GHS label elements

Hazard pictograms :



Signal word : Warning

Hazard statements : Contains gas under pressure; may explode if heated.

Precautionary statements

General : Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction.

Prevention : Not applicable.

Response : Not applicable.

Storage : Protect from sunlight. Store in a well-ventilated place.

Disposal : Not applicable.

Hazards not otherwise classified : None known.

Section 3. Composition/information on ingredients

Substance/mixture : Mixture

Other means of identification : Not available.

Product code : 002103

Section 3. Composition/information on ingredients

Ingredient name	%	CAS number
Nitrogen	75 - 80.5	7727-37-9
oxygen	19.5 - 23.5	7782-44-7
Isobutylene	0.0000001 - 1.13	115-11-7

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband. In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : Contact with rapidly expanding gas may cause burns or frostbite.

Inhalation : No known significant effects or critical hazards.

Skin contact : Contact with rapidly expanding gas may cause burns or frostbite.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion : As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.

Specific treatments : No specific treatment.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media : None known.

Specific hazards arising from the chemical : Contains gas under pressure. In a fire or if heated, a pressure increase will occur and the container may burst or explode.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
nitrogen oxides

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill : Immediately contact emergency personnel. Stop leak if without risk.

Large spill : Immediately contact emergency personnel. Stop leak if without risk. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Avoid breathing gas. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.
Avoid contact with eyes, skin and clothing. Empty containers retain product residue and can be hazardous.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Section 7. Handling and storage

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F). Keep container tightly closed and sealed until ready for use. See Section 10 for incompatible materials before handling or use.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
Nitrogen	**ACGIH TLV (United States, 3/2019). Oxygen Depletion [Asphyxiant].**
oxygen	None.
Isobutylene	**ACGIH TLV (United States, 3/2019).** TWA: 250 ppm 8 hours.

Appropriate engineering controls : Good general ventilation should be sufficient to control worker exposure to airborne contaminants.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state : Gas.

Color : Not available.

Odor : Not available.

Odor threshold : Not available.

pH : Not available.

Melting point : -210.01°C (-346°F) This is based on data for the following ingredient: nitrogen. Weighted average: -211.83°C (-349.3°F)

Boiling point : Not available.

Critical temperature : Lowest known value: -146.95°C (-232.5°F) (nitrogen).

Flash point : Not available.

Evaporation rate : Not available.

Flammability (solid, gas) : Not available.

Lower and upper explosive (flammable) limits : Not available.

Vapor pressure : Not available.

Vapor density : Highest known value: 1.1 (Air = 1) (oxygen). Weighted average: 1 (Air = 1)

Gas Density (lb/ft ^{3}) : Weighted average: 0.07

Relative density : Not applicable.

Solubility : Not available.

Solubility in water : Not available.

Partition coefficient: n-octanol/water : Not available.

Auto-ignition temperature : Not available.

Decomposition temperature : Not available.

Viscosity : Not applicable.

Flow time (ISO 2431) : Not available.

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : No specific data.

Incompatible materials : No specific data.

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Isobutylene	LC50 Inhalation Vapor	Rat	550000 mg/m³	4 hours

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : Contact with rapidly expanding gas may cause burns or frostbite.

Inhalation : No known significant effects or critical hazards.

Skin contact : Contact with rapidly expanding gas may cause burns or frostbite.

Ingestion : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Section 11. Toxicological information

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
Nitrogen	0.67	-	low
oxygen	0.65	-	low
Isobutylene	2.34	-	low

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1956	UN1956	UN1956	UN1956	UN1956
UN proper shipping name	COMPRESSED GAS, N.O.S.(Air, Isobutylene)	COMPRESSED GAS, N.O.S.(Air, Isobutylene)	COMPRESSED GAS, N.O.S.(Air, Isobutylene)	COMPRESSED GAS, N.O.S.(Air, Isobutylene)	COMPRESSED GAS, N.O.S.(Air, Isobutylene)
Transport hazard class(es)	2.2 	2.2 	2.2 	2.2 	2.2 
Packing group	-	-	-	-	-
Environmental hazards	No.	No.	No.	No.	No.

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Additional information

TDG Classification : Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2).
Explosive Limit and Limited Quantity Index 0.125
Passenger Carrying Road or Rail Index 75

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to IMO instruments : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption**: Not determined

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Refer to Section 2: Hazards Identification of this SDS for classification of substance.

Section 15. Regulatory information

State regulations

Massachusetts : The following components are listed: NITROGEN; NITROGEN (LIQUIFIED); OXYGEN (LIQUID)

New York : None of the components are listed.

New Jersey : The following components are listed: NITROGEN; OXYGEN

Pennsylvania : The following components are listed: NITROGEN; OXYGEN

California Prop. 65

This product does not require a Safe Harbor warning under California Prop. 65.

International regulations

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol

Not listed.

Stockholm Convention on Persistent Organic Pollutants

Not listed.

Rotterdam Convention on Prior Informed Consent (PIC)

Not listed.

UNECE Aarhus Protocol on POPs and Heavy Metals

Not listed.

Inventory list

Australia : All components are listed or exempted.

Canada : All components are listed or exempted.

China : All components are listed or exempted.

Europe : All components are listed or exempted.

Japan : **Japan inventory (ENCS)**: Not determined.
Japan inventory (ISHL): Not determined.

New Zealand : All components are listed or exempted.

Philippines : All components are listed or exempted.

Republic of Korea : All components are listed or exempted.

Taiwan : All components are listed or exempted.

Thailand : Not determined.

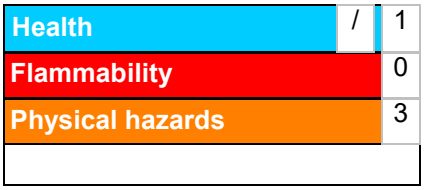
Turkey : Not determined.

United States : All components are active or exempted.

Viet Nam : All components are listed or exempted.

Section 16. Other information

Hazardous Material Information System (U.S.A.)



Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings and the associated label are not required on SDSs or products leaving a facility under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered trademark and service mark of the American Coatings Association, Inc.

Section 16. Other information

The customer is responsible for determining the PPE code for this material. For more information on HMIS® Personal Protective Equipment (PPE) codes, consult the HMIS® Implementation Manual.

National Fire Protection Association (U.S.A.)



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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Classification	Justification
GASES UNDER PRESSURE - Compressed gas	On basis of test data

History

Date of printing : 11/17/2020

Date of issue/Date of revision : 11/17/2020

Date of previous issue : 1/10/2018

Version : 1.02

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

References : Not available.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

Safety Data Sheet

Effective date: 11 May 2020 **Revision** : 11 May 2020

Trade Name: Liquinox®

1 Identification of the substance/mixture and of the supplier

1.1 GHS Product identifier

Trade Name: Liquinox®
Product number: 1201, 1201-1, 1205, 1215, 1230, 1232, 1232-1, 1255

1.2 Application of the substance / the mixture: Cleaning material/Detergent

1.2.1 Recommended dilution ratio: 1 - 2% in water

1.3 Details of the supplier of the Safety Data Sheet

Manufacturer:

Alconox Inc.
30 Glenn St
White Plains, NY 10603
(914) 948-4040

Supplier:

Emergency telephone number:
ChemTel Inc
North America: 1-888-255-3924
International: +1 813-248-0573

2 Hazards identification

2.1 Classification of the substance or mixture:

In compliance with EC regulation No. 1272, 29CFR1910/1200 and GHS requirements.

Hazard-determining components of labeling:
Alcohol ethoxylate
Sodium alkylbenzene sulfonate
Sodium xylenesulphonate
Lauramine oxide

2.2 Label elements:

Eye damage, category 1.
Skin irritation, category 2.

Product at recommended dilution:

Eye irritation, category 2B

Hazard pictograms:



Signal word: Danger

Hazard statements:
H315 Causes skin irritation.
H318 Causes serious eye damage.

Precautionary statements:
P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.

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P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P332+P313 If skin irritation occurs: Get medical advice/attention.
P501 Dispose of contents and container as instructed in Section 13.

Hazardous Elements at Use Dilution:

Hazard pictograms:



Signal word: Warning

Hazard statements:

H320 Causes eye irritation

Precautionary statements:

P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P501 Dispose of contents and container as instructed in Section 13

Additional information: None.

Hazard description

Hazards Not Otherwise Classified (HNOC): May cause surfaces to become slippery. Use caution in areas of foot traffic if on floors.

Information concerning particular hazards for humans and environment:

The product has to be labelled due to the calculation procedure of the "General Classification guideline for preparations of the EU" in the latest valid version.

Classification system:

The classification is according to EC regulation No. 1272, 29CFR1910/1200 and GHS, and extended by company and literature data. The classification is in accordance with the latest editions of international substances lists and is supplemented by information from technical literature and by information provided by the company.

3 Composition/information on ingredients

3.1 Chemical characterization: None

3.2 Description: None

3.3 Hazardous components (percentages by weight)

Identification	Chemical Name	Classification	Wt. %
CAS number: 68081-81-2 or 68411-30-3	Sodium Alkylbenzene Sulfonate	Acute Tox. 4; H303 Skin Irrit. 2 ; H315 Eye Dam. 1; H318	10-25
CAS number: 1300-72-7	Sodium Xylenesulphonate	Eye Irrit. 2;H319	2.5-10
CAS number: 84133-50-6	Alcohol Ethoxylate	Skin Irrit. 2 ; H315 Eye Dam. 1; H318	2.5-10
CAS number: 1643-20-5	Lauramine oxide	Skin Irrit. 2 ; H315 Eye Dam. 1; H318	1-2

Safety Data Sheet

Effective date: 11 May 2020 **Revision** : 11 May 2020

Trade Name: Liquinox®

At use dilution:

CAS number: 68081-81-2 or 68411-30-3	Sodium Alkylbenzene Sulfonate	Eye Irr. 2B; H319	0.1-0.25

3.4 Additional Information: None.

4 First aid measures

4.1 Description of first aid measures

General information: None.

After inhalation:
Maintain an unobstructed airway.
Loosen clothing as necessary and position individual in a comfortable position.

After skin contact:
Wash affected area with soap and water.
Seek medical attention if symptoms develop or persist.

After eye contact:
Rinse/flush exposed eye(s) gently using water for 15-20 minutes.
Remove contact lens(es) if able to do so during rinsing.
Seek medical attention if irritation persists or if concerned.

After swallowing:
Rinse mouth thoroughly.
Seek medical attention if irritation, discomfort, or vomiting persists.

4.2 Most important symptoms and effects, both acute and delayed

None

4.3 Indication of any immediate medical attention and special treatment needed:

No additional information.

First aid measure at recommended dilution:

General information: None.

After inhalation:
Maintain an unobstructed airway.
Loosen clothing as necessary and position individual in a comfortable position.

After skin contact:
Wash affected area with soap and water.

After eye contact:
Rinse/flush exposed eye(s) gently using water for 15-20 minutes.
Remove contact lens(es) if able to do so during rinsing.

After swallowing:
Rinse mouth thoroughly. Seek medical attention if irritation, discomfort, or vomiting develops.

Safety Data Sheet

Effective date: 11 May 2020 **Revision** : 11 May 2020

Trade Name: Liquinox®

5 Firefighting measures

5.1 Extinguishing media

Suitable extinguishing agents:

Use appropriate fire suppression agents for adjacent combustible materials or sources of ignition.

For safety reasons unsuitable extinguishing agents: None

5.2 Special hazards arising from the substance or mixture:

Thermal decomposition can lead to release of irritating gases and vapors.

5.3 Advice for firefighters

Protective equipment:

Wear protective eye wear, gloves and clothing.
Refer to Section 8.

5.4 Additional information:

Avoid inhaling gases, fumes, dust, mist, vapor and aerosols.
Avoid contact with skin, eyes and clothing.

6 Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Ensure adequate ventilation.
Ensure air handling systems are operational.

6.2 Environmental precautions:

Should not be released into the environment.
Prevent from reaching drains, sewer or waterway.

6.3 Methods and material for containment and cleaning up:

Wear protective eye wear, gloves and clothing.

6.4 Reference to other sections: None

7 Handling and storage

7.1 Precautions for safe handling:

Avoid breathing mist or vapor.
Do not eat, drink, smoke or use personal products when handling chemical substances.

7.2 Conditions for safe storage, including any incompatibilities

Store in a cool, well-ventilated area.

7.3 Specific end use(s):

No additional information.

8 Exposure controls/personal protection





8.1 Control parameters :

25322-68-3, Poly(ethylene oxide), AIHA TWA 10 mg/m3 (<0.15% present in concentrate)

Safety Data Sheet

Effective date: 11 May 2020 **Revision** : 11 May 2020

Trade Name: Liquinox®

8.2 Exposure controls

Appropriate engineering controls:
Emergency eye wash fountains and safety showers should be available in the immediate vicinity of use or handling.

Respiratory protection:
Not needed under normal conditions.

Protection of skin:
Select glove material impermeable and resistant to the substance.

Eye protection:
Safety goggles or glasses, or appropriate eye protection.

General hygienic measures:
Wash hands before breaks and at the end of work.
Avoid contact with skin, eyes and clothing.

Exposure Control and Personal Protective Equipment at recommended dilution:

Under normal use and operational conditions, no special personal protective equipment or engineering controls will be necessary. Handle with care.

9 Physical and chemical properties

Appearance (physical state, color):	Pale yellow liquid	**Explosion limit lower**: **Explosion limit upper**:	Not determined or not available. Not determined or not available.
Odor:	Not determined or not available.	**Vapor pressure at 20°C**:	Not determined or not available.
Odor threshold:	Not determined or not available.	**Vapor density**:	Not determined or not available.
pH-value:	8.5 (as is)	**Relative density**:	Not determined or not available.
Melting/Freezing point:	Not determined or not available.	**Solubilities**:	Not determined or not available.
Boiling point/Boiling range:	Not determined or not available.	**Partition coefficient (n-octanol/water)**:	Not determined or not available.
Flash point (closed cup):	Not determined or not available.	**Auto/Self-ignition temperature**:	Not determined or not available.
Evaporation rate:	Not determined or not available.	**Decomposition temperature**:	Not determined or not available.
Flammability (solid, gaseous):	Not flammable	**Viscosity**:	a. Kinematic: Not determined or not available. b. Dynamic: Not determined or not available.
Density at 20°C:	1.08 g/mL		

Safety Data Sheet

Effective date: 11 May 2020 **Revision** : 11 May 2020

Trade Name: Liquinox®

10 Stability and reactivity

10.1 Reactivity: Not determined or not available.
10.2 Chemical stability: Not determined or not available.
10.3 Possibility hazardous reactions: Not determined or not available.
10.4 Conditions to avoid: Not determined or not available.
10.5 Incompatible materials: Not determined or not available.
10.6 Hazardous decomposition products: Not determined or not available.

11 Toxicological information

11.1 Information on toxicological effects:

Acute Toxicity:

Oral:

: LD50 >5000 mg per kg (Rat, Oral) - product.

Chronic Toxicity: No additional information.

Skin corrosion/irritation (raw materials):

Alcohol Ethoxylate: May cause mild to moderate skin irritation.

Sodium Alkylbenzene Sulfonate: Causes skin irritation.

Lauramine oxide: Causes skin irritation.

Serious eye damage/irritation (raw materials):

Sodium Alkylbenzene Sulfonate: Causes serious eye damage.

Alcohol Ethoxylate: Causes moderate to severe eye irritation and conjunctivitis.

Sodium xylenesulphonate: irritating to eyes.

Lauramine oxide: Causes serious eye damage.

Product information at recommended dilution:

Eye irritation may occur upon direct contact with eyes. No specific hazards for skin contact, inhalation, or chronic exposure are expected within normal use parameters.

Respiratory or skin sensitization: No additional information.

Carcinogenicity: No additional information.

IARC (International Agency for Research on Cancer): None of the ingredients are listed.

NTP (National Toxicology Program): None of the ingredients are listed.

Germ cell mutagenicity: No additional information.

Reproductive toxicity: No additional information.

STOT-single and repeated exposure: No additional information.

Additional toxicological information: No additional information.

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12 Ecological information

12.1 Toxicity:

Sodium Alkylbenzene Sulfonate: Fish, LC50 1.67 mg/l, 96 hours.
Sodium Alkylbenzene Sulfonate: Aquatic invertebrates, EC50 Daphnia 2.9 mg/l, 48 hours. Sodium Alkylbenzene Sulfonate: Aquatic Plants, EC50 Algae 29 mg/l, 96 hours.
Lauramine oxide: Fish, LC50 24.3 mg/l, 96h [Killifish (Cyprinodontidae)]
Lauramine oxide: Aquatic invertebrates, (LC50): 3.6 mg/l 96 hours [Daphnia (Daphnia)].
Lauramine oxide: Aquatic plants, EC50 Algae 0.31 mg/l 72 hours [Algae]
Alcohol Ethoxylate: Aquatic invertebrates, (LC50): 4.01 mg/l 48 hours [Daphnia (daphnia)].

12.2 Persistence and degradability: No additional information.

12.3 Bioaccumulative potential: No additional information.

12.4 Mobility in soil: No additional information.

General notes: No additional information.

12.5 Results of PBT and vPvB assessment:

PBT: No additional information.

vPvB: No additional information.

12.6 Other adverse effects: No additional information.

13 Disposal considerations

13.1 Waste treatment methods (consult local, regional and national authorities for proper disposal)

Relevant Information:

It is the responsibility of the waste generator to properly characterize all waste materials according to applicable regulatory entities. (US 40CFR262.11).

14 Transport information

14.1 UN Number: None
ADR, ADN, DOT, IMDG, IATA

14.2 UN Proper shipping name: None
ADR, ADN, DOT, IMDG, IATA

14.3 Transport hazard classes:
ADR, ADN, DOT, IMDG, IATA

Class: None
Label: None
LTD. QTY: None

US DOT
Limited Quantity Exception: None

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Bulk: **RQ (if applicable):** None **Proper shipping Name:** None **Hazard Class:** None **Packing Group:** None **Marine Pollutant (if applicable):** No additional information. **Comments:** None	**Non Bulk:** **RQ (if applicable):** None **Proper shipping Name:** None **Hazard Class:** None **Packing Group:** None **Marine Pollutant (if applicable):** No additional information. **Comments:** None
14.4 Packing group: ADR, ADN, DOT, IMDG, IATA	None
14.5 Environmental hazards:	None
14.6 Special precautions foruser:	None
Danger code (Kemler):	None
EMS number:	None
Segregation groups:	None
14.7 Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code: Not applicable.	
14.8 Transport/Additional information:	
Transport category:	None
Tunnel restriction code:	None
UN "Model Regulation":	None

15 Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture.

North American

SARA

Section 313 (specific toxic chemical listings): None of the ingredients are listed.
Section 302 (extremely hazardous substances): None of the ingredients are listed.

CERCLA (Comprehensive Environmental Response, Clean up and Liability Act)

Reportable Spill Quantity: None of the ingredients are listed.

TSCA (Toxic Substances Control Act):

Inventory: All ingredients are listed as active.
Rules and Orders: Not applicable.

Proposition 65 (California):

Chemicals known to cause cancer: None of the ingredients are listed.

Chemicals known to cause reproductive toxicity for females: None of the ingredients are listed.

Chemicals known to cause reproductive toxicity for males: None of the ingredients are listed.

Chemicals known to cause developmental toxicity: None of the ingredients are listed.

Canadian

Canadian Domestic Substances List (DSL):
All ingredients are listed.

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Asia Pacific

Australia

Australian Inventory of Chemical Substances (AICS): All ingredients are listed.

China

Inventory of Existing Chemical Substances in China (IECSC): All ingredients are listed.

Japan

Inventory of Existing and New Chemical Substances (ENCS): All ingredients are listed.

Korea

Existing Chemicals List (ECL): All ingredients are listed.

New Zealand

New Zealand Inventory of Chemicals (NZOIC): All ingredients are listed.

Philippines

Philippine Inventory of Chemicals and Chemical Substances (PICCS): All ingredients are listed.

Taiwan

Taiwan Chemical Substance Inventory (TSCI): All ingredients are listed.

EU

REACH Article 57 (SVHC): None of the ingredients are listed.

Germany MAK: Not classified.

16 Other information

Abbreviations and Acronyms: None

Summary of Phrases

Hazard statements:

H315 Causes skin irritation.
H318 Causes serious eye damage.

Precautionary statements:

P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P332+P313 If skin irritation occurs: Get medical advice/attention.
P501 Dispose of contents and container as instructed in Section 13.

Manufacturer Statement:

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

NFPA: 1-0-0
HMIS: 1-0-0

At recommended dilution:

NFPA: 1-0-0
HMIS: 1-0-0

Safety Data Sheet

according to Regulation (EC) No. 1907/2006 (REACH)

Ethylbenzene

Version number: GHS 1.0 Date of compilation: 2020-07-02

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Identification of the substance	**Ethylbenzene**
Registration number (REACH)	01-2119489370-35-xxxx
CAS number	100-41-4
Alternative name(s)	ethylbenzene
Article number	A0251309

1.2 Relevant identified uses of the substance or mixture and uses advised against

Relevant identified uses	General use

1.3 Details of the supplier of the safety data sheet

Chemos GmbH & Co. KG
Sonnenring 7
84032 Altdorf
Germany

Telephone: +49 871-966346-0
Telefax: +49 871-966346-13
e-mail: chemos@chemos.de
Website: http://www.chemos.de/

e-mail (competent person)	chemos@chemos.de

1.4 Emergency telephone number

Emergency information service	+49 89 1 92 40

Poison centre

Country	Name	Postal code/ city	Telephone	Telefax
United Kingdom	National Poison Information Centre Medical Toxicology Unit	SE14 5ER London	+44 171 635 91 91	

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008 (CLP)

Section	Hazard class	Category	Hazard class and category	Hazard statement
2.6	flammable liquid	2	Flam. Liq. 2	H225
3.1I	acute toxicity (inhal.)	4	Acute Tox. 4	H332
3.9	specific target organ toxicity - repeated exposure	2	STOT RE 2	H373
3.10	aspiration hazard	1	Asp. Tox. 1	H304
4.1C	hazardous to the aquatic environment - chronic hazard	2	Aquatic Chronic 2	H411

For full text of abbreviations: see SECTION 16.

The most important adverse physicochemical, human health and environmental effects

Delayed or immediate effects can be expected after short or long-term exposure. The product is combustible and can be ignited by potential ignition sources. Spillage and fire water can cause pollution of watercourses.

2.2 Label elements

Labelling according to Regulation (EC) No 1272/2008 (CLP)

- Signal word danger

- Pictograms

GHS02, GHS07, GHS08, GHS09



- Hazard statements

H225	Highly flammable liquid and vapour.
H304	May be fatal if swallowed and enters airways.
H332	Harmful if inhaled.
H373	May cause damage to organs through prolonged or repeated exposure.
H411	Toxic to aquatic life with long lasting effects.

- Precautionary statements

P210	Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P260	Do not breathe dust/fume/gas/mist/vapours/spray.
P301+P310	IF SWALLOWED: Immediately call a POISON CENTER/doctor.
P331	Do NOT induce vomiting.
P370+P378	In case of fire: Use sand, carbon dioxide or powder extinguisher to extinguish.
P403+P235	Store in a well-ventilated place. Keep cool.

2.3 Other hazards

Results of PBT and vPvB assessment

According to the results of its assessment, this substance is not a PBT or a vPvB.

SECTION 3: Composition/information on ingredients

3.1 Substances

Name of substance	Ethylbenzene
Identifiers	
REACH Reg. No	01-2119489370-35-xxxx
CAS No	100-41-4
EC No	202-849-4
Index No	601-023-00-4
Molecular formula	C8H10
Molar mass	106.2 $^{g}/_{mol}$

SECTION 4: First aid measures

4.1 Description of first aid measures

General notes

Do not leave affected person unattended. Remove victim out of the danger area. Keep affected person warm, still and covered. Take off immediately all contaminated clothing. In all cases of doubt, or when symptoms persist, seek medical advice. In case of unconsciousness place person in the recovery position. Never give anything by mouth.

Following inhalation

If breathing is irregular or stopped, immediately seek medical assistance and start first aid actions. Provide fresh air.

Following skin contact

Wash with plenty of soap and water.

Following eye contact

Remove contact lenses, if present and easy to do. Continue rinsing. Irrigate copiously with clean, fresh water for at least 10 minutes, holding the eyelids apart.

Following ingestion

Rinse mouth with water (only if the person is conscious). Do NOT induce vomiting.

4.2 Most important symptoms and effects, both acute and delayed

Symptoms and effects are not known to date.

4.3 Indication of any immediate medical attention and special treatment needed

none

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media

Water spray, BC-powder, Carbon dioxide (CO_2)

Unsuitable extinguishing media

Water jet

5.2 Special hazards arising from the substance or mixture

In case of insufficient ventilation and/or in use, may form flammable/explosive vapour-air mixture. Solvent vapours are heavier than air and may spread along floors. Places which are not ventilated, e.g. unventilated below ground level areas such as trenches, conduits and shafts, are particularly prone to the presence of flammable substances or mixtures.

Hazardous combustion products

Carbon monoxide (CO), Carbon dioxide (CO_2)

5.3 Advice for firefighters

In case of fire and/or explosion do not breathe fumes. Co-ordinate firefighting measures to the fire surroundings. Do not allow firefighting water to enter drains or water courses. Collect contaminated firefighting water separately. Fight fire with normal precautions from a reasonable distance.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

For non-emergency personnel

Remove persons to safety.

For emergency responders

Wear breathing apparatus if exposed to vapours/dust/spray/gases.

6.2 Environmental precautions

Keep away from drains, surface and ground water. Retain contaminated washing water and dispose of it. If substance has entered a water course or sewer, inform the responsible authority.

6.3 Methods and material for containment and cleaning up

Advice on how to contain a spill

Covering of drains

Advice on how to clean up a spill

Wipe up with absorbent material (e.g. cloth, fleece). Collect spillage: sawdust, kieselgur (diatomite), sand, universal binder

Appropriate containment techniques

Use of adsorbent materials.

Other information relating to spills and releases

Place in appropriate containers for disposal. Ventilate affected area.

6.4 Reference to other sections

Hazardous combustion products: see section 5. Personal protective equipment: see section 8. Incompatible materials: see section 10. Disposal considerations: see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Recommendations

- Measures to prevent fire as well as aerosol and dust generation

Use local and general ventilation. Avoidance of ignition sources. Keep away from sources of ignition - No smoking. Take precautionary measures against static discharge. Use only in well-ventilated areas. Due to danger of explosion, prevent leakage of vapours into cellars, flues and ditches. Ground/bond container and receiving equipment. Use explosion-proof electrical/ventilating/lighting/equipment. Use only non-sparking tools.

- Specific notes/details

Places which are not ventilated, e.g. unventilated below ground level areas such as trenches, conduits and shafts, are particularly prone to the presence of flammable substances or mixtures. Vapours are heavier than air, spread along floors and form explosive mixtures with air. Vapours may form explosive mixtures with air.

Advice on general occupational hygiene

Wash hands after use. Do not eat, drink and smoke in work areas. Remove contaminated clothing and protective equipment before entering eating areas. Never keep food or drink in the vicinity of chemicals. Never place chemicals in containers that are normally used for food or drink. Keep away from food, drink and animal feedingstuffs.

7.2 Conditions for safe storage, including any incompatibilities

Managing of associated risks

- Explosive atmospheres

Keep container tightly closed and in a well-ventilated place. Use local and general ventilation. Keep cool. Protect from sunlight.

- Flammability hazards

Keep away from sources of ignition - No smoking. Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Take precautionary measures against static discharge. Protect from sunlight.

- Ventilation requirements

Keep any substance that emits harmful vapours or gases in a place that allows these to be permanently extracted. Use local and general ventilation. Ground/bond container and receiving equipment.

- Packaging compatibilities

Only packagings which are approved (e.g. acc. to ADR) may be used.

7.3 Specific end use(s)

See section 16 for a general overview.

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Occupational exposure limit values (Workplace Exposure Limits)

Country	Name of agent	CAS No	Identifier	TWA [ppm]	TWA [mg/m³]	STEL [ppm]	STEL [mg/m³]	Ceiling-C [ppm]	Ceiling-C [mg/m³]	Notation	Source
EU	ethylbenzene	100-41-4	IOELV	100	442	200	884				2000/39/EC
GB	ethylbenzene	100-41-4	WEL	100	441	125	552				EH40/2005

Notation

Ceiling-C	ceiling value is a limit value above which exposure should not occur
STEL	short-term exposure limit: a limit value above which exposure should not occur and which is related to a 15-minute period (unless otherwise specified)
TWA	time-weighted average (long-term exposure limit): measured or calculated in relation to a reference period of 8 hours time-weighted average (unless otherwise specified)

Human health values

Relevant DNELs and other threshold levels

Endpoint	Threshold level	Protection goal, route of exposure	Used in	Exposure time
DNEL	77 mg/m³	human, inhalatory	worker (industry)	chronic - systemic effects
DNEL	293 mg/m³	human, inhalatory	worker (industry)	acute - local effects
DNEL	180 mg/kg bw/day	human, dermal	worker (industry)	chronic - systemic effects

Environmental values

Relevant PNECs and other threshold levels

Endpoint	Threshold level	Organism	Environmental compartment	Exposure time
PNEC	0.1 mg/l	aquatic organisms	freshwater	short-term (single instance)
PNEC	0.01 mg/l	aquatic organisms	marine water	short-term (single instance)
PNEC	9.6 mg/l	aquatic organisms	sewage treatment plant (STP)	short-term (single instance)
PNEC	13.7 mg/kg	aquatic organisms	freshwater sediment	short-term (single instance)

Relevant PNECs and other threshold levels				
Endpoint	**Threshold level**	**Organism**	**Environmental compartment**	**Exposure time**
PNEC	1.37 $^{mg}/_{kg}$	aquatic organisms	marine sediment	short-term (single instance)
PNEC	2.68 $^{mg}/_{kg}$	terrestrial organisms	soil	short-term (single instance)

8.2 Exposure controls

Appropriate engineering controls

General ventilation.

Individual protection measures (personal protective equipment)

Eye/face protection

Wear eye/face protection.

Skin protection

- Hand protection

Wear suitable gloves. Chemical protection gloves are suitable, which are tested according to EN 374. Check leak-tightness/impermeability prior to use. In the case of wanting to use the gloves again, clean them before taking off and air them well. For special purposes, it is recommended to check the resistance to chemicals of the protective gloves mentioned above together with the supplier of these gloves.

- Other protection measures

Take recovery periods for skin regeneration. Preventive skin protection (barrier creams/ointments) is recommended. Wash hands thoroughly after handling.

Respiratory protection

In case of inadequate ventilation wear respiratory protection.

Environmental exposure controls

Use appropriate container to avoid environmental contamination. Keep away from drains, surface and ground water.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance

Physical state	liquid
Colour	various
Odour	characteristic

Other safety parameters

pH (value)	not determined
Melting point/freezing point	-94.9 °C at 101.3 kPa
Initial boiling point and boiling range	136.1 °C at 1,013 mbar
Flash point	23 °C at 1,013 hPa
Evaporation rate	not determined

Flammability (solid, gas)	not relevant, (fluid)
Explosive limits	not determined
Vapour pressure	9.52 mbar at 20 °C
Density	not determined
Vapour density	this information is not available
Relative density	information on this property is not available

Solubility(ies)

- Water solubility	0.2 $^{g}/_{l}$ at 25 °C

Partition coefficient

- n-octanol/water (log KOW)	3.6 (pH value: 7.84, 20 °C) (ECHA)
Auto-ignition temperature	430 °C at 101.3 kPa (ECHA) (auto-ignition temperature (liquids and gases))

Viscosity

- Kinematic viscosity	0.773 $^{mm^2}/_{s}$ at 20 °C
Explosive properties	none
Oxidising properties	none

9.2 Other information

Surface tension	71.2 $^{mN}/_{m}$ (23 °C) (ECHA)
Solvent content	100 %
Temperature class (EU, acc. to ATEX)	T2 (maximum permissible surface temperature on the equipment: 300°C)

SECTION 10: Stability and reactivity

10.1 Reactivity

Concerning incompatibility: see below "Conditions to avoid" and "Incompatible materials". It's a reactive substance. The mixture contains reactive substance(s). Risk of ignition.

If heated:

Risk of ignition

10.2 Chemical stability

See below "Conditions to avoid".

10.3 Possibility of hazardous reactions

No known hazardous reactions.

10.4 Conditions to avoid

Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.

Hints to prevent fire or explosion

Use explosion-proof electrical/ventilating/lighting/equipment. Use only non-sparking tools. Take precautionary measures against static discharge.

10.5 Incompatible materials

Oxidisers

10.6 Hazardous decomposition products

Reasonably anticipated hazardous decomposition products produced as a result of use, storage, spill and heating are not known. Hazardous combustion products: see section 5.

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Classification according to GHS (1272/2008/EC, CLP)

Acute toxicity

Harmful if inhaled.

GHS of the United Nations, annex 4: May be harmful if swallowed.

- Acute toxicity estimate (ATE)

Inhalation: vapour 11 $^{mg}/_{l}$/4h

Skin corrosion/irritation

Shall not be classified as corrosive/irritant to skin.

Serious eye damage/eye irritation

Shall not be classified as seriously damaging to the eye or eye irritant.

Respiratory or skin sensitisation

Shall not be classified as a respiratory or skin sensitiser.

Germ cell mutagenicity

Shall not be classified as germ cell mutagenic.

Carcinogenicity

Shall not be classified as carcinogenic.

Reproductive toxicity

Shall not be classified as a reproductive toxicant.

Specific target organ toxicity - single exposure

Shall not be classified as a specific target organ toxicant (single exposure).

Specific target organ toxicity - repeated exposure

May cause damage to organs through prolonged or repeated exposure.

Aspiration hazard

May be fatal if swallowed and enters airways.

SECTION 12: Ecological information

12.1 Toxicity

Toxic to aquatic life with long lasting effects.

Aquatic toxicity (chronic)			
Endpoint	**Value**	**Species**	**Exposure time**
LC50	3.6 $^{mg}/_{l}$	aquatic invertebrates	7 d

12.2 Persistence and degradability

Data are not available.

12.3 Bioaccumulative potential

Data are not available.

n-octanol/water (log KOW)	3.6 (pH value: 7.84, 20 °C) (ECHA)
BCF	1 (ECHA)

12.4 Mobility in soil

Data are not available.

12.5 Results of PBT and vPvB assessment

Data are not available.

12.6 Other adverse effects

Data are not available.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Waste treatment-relevant information

Solvent reclamation/regeneration.

Sewage disposal-relevant information

Do not empty into drains. Avoid release to the environment. Refer to special instructions/safety data sheets.

Waste treatment of containers/packagings

It is a dangerous waste; only packagings which are approved (e.g. acc. to ADR) may be used. Completely emptied packages can be recycled. Handle contaminated packages in the same way as the substance itself.

Remarks

Please consider the relevant national or regional provisions. Waste shall be separated into the categories that can be handled separately by the local or national waste management facilities.

SECTION 14: Transport information

14.1	**UN number**	1175
14.2	**UN proper shipping name**	ETHYLBENZENE
14.3	**Transport hazard class(es)**	
	Class	3 (flammable liquids) (environmentally hazardous)
14.4	**Packing group**	II (substance presenting medium danger)
14.5	**Environmental hazards**	hazardous to the aquatic environment

14.6 Special precautions for user

Provisions for dangerous goods (ADR) should be complied within the premises.

14.7 Transport in bulk according to Annex II of MARPOL and the IBC Code

The cargo is not intended to be carried in bulk.

Information for each of the UN Model Regulations

Transport of dangerous goods by road, rail and inland waterway (ADR/RID/ADN)

UN number	1175
Proper shipping name	ETHYLBENZENE
Class	3
Classification code	F1
Packing group	II
Danger label(s)	3, fish and tree



Environmental hazards	yes (hazardous to the aquatic environment)
Excepted quantities (EQ)	E2
Limited quantities (LQ)	1 L
Transport category (TC)	2
Tunnel restriction code (TRC)	D/E
Hazard identification No	33
Emergency Action Code	3YE

International Maritime Dangerous Goods Code (IMDG)

UN number	1175
Proper shipping name	ETHYLBENZENE
Class	3
Marine pollutant	yes (hazardous to the aquatic environment)
Packing group	II
Danger label(s)	3, fish and tree



Special provisions (SP)	-
Excepted quantities (EQ)	E2
Limited quantities (LQ)	1 L
EmS	F-E, S-D
Stowage category	B

International Civil Aviation Organization (ICAO-IATA/DGR)

UN number	1175
Proper shipping name	Ethylbenzene
Class	3
Environmental hazards	yes (hazardous to the aquatic environment)
Packing group	II
Danger label(s)	3



Excepted quantities (EQ)	E2
Limited quantities (LQ)	1 L

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Relevant provisions of the European Union (EU)

Deco-Paint Directive (2004/42/EC)

VOC content	100 %

Directive on industrial emissions (VOCs, 2010/75/EU)

VOC content	100 %

National inventories

Country	Inventory	Status
AU	AICS	substance is listed
CA	DSL	substance is listed
CN	IECSC	substance is listed
EU	ECSI	substance is listed
EU	REACH Reg.	substance is listed
JP	CSCL-ENCS	substance is listed
KR	KECI	substance is listed
MX	INSQ	substance is listed
NZ	NZIoC	substance is listed
PH	PICCS	substance is listed
TR	CICR	substance is listed

Country	Inventory	Status
TW	TCSI	substance is listed
US	TSCA	substance is listed

Legend

AICS	Australian Inventory of Chemical Substances
CICR	Chemical Inventory and Control Regulation
CSCL-ENCS	List of Existing and New Chemical Substances (CSCL-ENCS)
DSL	Domestic Substances List (DSL)
ECSI	EC Substance Inventory (EINECS, ELINCS, NLP)
IECSC	Inventory of Existing Chemical Substances Produced or Imported in China
INSQ	National Inventory of Chemical Substances
KECI	Korea Existing Chemicals Inventory
NZIoC	New Zealand Inventory of Chemicals
PICCS	Philippine Inventory of Chemicals and Chemical Substances
REACH Reg.	REACH registered substances
TCSI	Taiwan Chemical Substance Inventory
TSCA	Toxic Substance Control Act

15.2 Chemical Safety Assessment

No Chemical Safety Assessment has been carried out for this substance.

SECTION 16: Other information

Abbreviations and acronyms

Abbr.	Descriptions of used abbreviations
2000/39/EC	Commission Directive establishing a first list of indicative occupational exposure limit values in implementation of Council Directive 98/24/EC
ADN	Accord européen relatif au transport international des marchandises dangereuses par voies de navigation intérieures (European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways)
ADR	Accord européen relatif au transport international des marchandises dangereuses par route (European Agreement concerning the International Carriage of Dangerous Goods by Road)
BCF	Bioconcentration factor
CAS	Chemical Abstracts Service (service that maintains the most comprehensive list of chemical substances)
Ceiling-C	Ceiling value
CLP	Regulation (EC) No 1272/2008 on classification, labelling and packaging of substances and mixtures
DGR	Dangerous Goods Regulations (see IATA/DGR)
DNEL	Derived No-Effect Level
EC No	The EC Inventory (EINECS, ELINCS and the NLP-list) is the source for the seven-digit EC number, an identifier of substances commercially available within the EU (European Union)
EH40/2005	EH40/2005 Workplace exposure limits (http://www.nationalarchives.gov.uk/doc/open-government-licence/)
EINECS	European Inventory of Existing Commercial Chemical Substances
ELINCS	European List of Notified Chemical Substances
EmS	Emergency Schedule
GHS	"Globally Harmonized System of Classification and Labelling of Chemicals" developed by the United Nations
IATA	International Air Transport Association

Abbr.	Descriptions of used abbreviations
IATA/DGR	Dangerous Goods Regulations (DGR) for the air transport (IATA)
ICAO	International Civil Aviation Organization
IMDG	International Maritime Dangerous Goods Code
index No	The Index number is the identification code given to the substance in Part 3 of Annex VI to Regulation (EC) No 1272/2008
IOELV	Indicative occupational exposure limit value
LC50	Lethal Concentration 50%: the LC50 corresponds to the concentration of a tested substance causing 50 % lethality during a specified time interval
MARPOL	International Convention for the Prevention of Pollution from Ships (abbr. of "Marine Pollutant")
NLP	No-Longer Polymer
PBT	Persistent, Bioaccumulative and Toxic
PNEC	Predicted No-Effect Concentration
ppm	Parts per million
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RID	Règlement concernant le transport International ferroviaire des marchandises Dangereuses (Regulations concerning the International carriage of Dangerous goods by Rail)
STEL	Short-term exposure limit
TWA	Time-weighted average
VOC	Volatile Organic Compounds
vPvB	Very Persistent and very Bioaccumulative
WEL	Workplace exposure limit

Key literature references and sources for data

Regulation (EC) No 1272/2008 on classification, labelling and packaging of substances and mixtures. Regulation (EC) No. 1907/2006 (REACH), amended by 2015/830/EU.

Transport of dangerous goods by road, rail and inland waterway (ADR/RID/ADN). International Maritime Dangerous Goods Code (IMDG). Dangerous Goods Regulations (DGR) for the air transport (IATA).

List of relevant phrases (code and full text as stated in chapter 2 and 3)

Code	Text
H225	Highly flammable liquid and vapour.
H304	May be fatal if swallowed and enters airways.
H332	Harmful if inhaled.
H373	May cause damage to organs through prolonged or repeated exposure.
H411	Toxic to aquatic life with long lasting effects.

Disclaimer

This information is based upon the present state of our knowledge. This SDS has been compiled and is solely intended for this product.

SAFETY DATA SHEET

Creation Date 24-Aug-2009 **Revision Date** 24-Dec-2021 **Revision Number** 7

1. Identification

Product Name **Hydrochloric acid**

Cat No. : **A481-212; A481-212LC; S71942SC; S71943; S71943ND; S80036; S80038; SA49**

Synonyms Muriatic acid; Hydrogen chloride; HCl (Technical/Certified ACS Plus/Optima/NF/FCC)

Recommended Use Laboratory chemicals.
Uses advised against Food, drug, pesticide or biocidal product use.

Details of the supplier of the safety data sheet

Company
Fisher Scientific Company
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Corrosive to metals	Category 1
Skin Corrosion/Irritation	Category 1 B
Serious Eye Damage/Eye Irritation	Category 1
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Respiratory system.	

Label Elements

Signal Word
Danger

Hazard Statements
May be corrosive to metals
Causes severe skin burns and eye damage
May cause respiratory irritation



Precautionary Statements
Prevention
Do not breathe dust/fume/gas/mist/vapors/spray
Wash face, hands and any exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection
Use only outdoors or in a well-ventilated area
Keep only in original container
Response
Immediately call a POISON CENTER or doctor/physician
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Skin
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
Wash contaminated clothing before reuse
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
Ingestion
IF SWALLOWED: Rinse mouth. DO NOT induce vomiting
Spills
Absorb spillage to prevent material damage
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Store in corrosive resistant polypropylene container with a resistant inliner
Store in a dry place
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
None identified

3. Composition/Information on Ingredients

Component	CAS No	Weight %
Water	7732-18-5	62-65
Hydrochloric acid	7647-01-0	35-38

4. First-aid measures

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Immediate medical attention is required.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Immediate medical attention is required.

Inhalation Remove to fresh air. If breathing is difficult, give oxygen. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Immediate medical attention is required.

Ingestion	Do NOT induce vomiting. Call a physician or poison control center immediately.
Most important symptoms and effects	Causes burns by all exposure routes. Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated: Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Substance is nonflammable; use agent most appropriate to extinguish surrounding fire.
Unsuitable Extinguishing Media	No information available
Flash Point	No information available
Method -	No information available
Autoignition Temperature	No information available
Explosion Limits	
Upper	No data available
Lower	No data available
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Corrosive material. Causes burns by all exposure routes. Thermal decomposition can lead to release of irritating gases and vapors.

Hazardous Combustion Products
Hydrogen chloride gas.
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
3	0	0	N/A

6. Accidental release measures

Personal Precautions	Use personal protective equipment as required. Ensure adequate ventilation. Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak. Do not get in eyes, on skin, or on clothing.
Environmental Precautions	Should not be released into the environment. See Section 12 for additional Ecological Information.
Methods for Containment and Clean Up	Soak up with inert absorbent material. Keep in suitable, closed containers for disposal.

7. Handling and storage

Handling	Wear personal protective equipment/face protection. Do not breathe mist/vapors/spray. Do not get in eyes, on skin, or on clothing. Do not ingest. If swallowed then seek immediate medical assistance.
Storage.	Keep containers tightly closed in a dry, cool and well-ventilated place. Corrosives area. Incompatible Materials. Metals. Strong oxidizing agents. Bases. sodium hypochlorite. Amines. Fluorine. Cyanides. Alkaline.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Hydrochloric acid	Ceiling: 2 ppm	Ceiling: 5 ppm Ceiling: 7 mg/m³ (Vacated) Ceiling: 5 ppm (Vacated) Ceiling: 7 mg/m³	IDLH: 50 ppm Ceiling: 5 ppm Ceiling: 7 mg/m³	Ceiling: 2 ppm

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: NIOSH - National Institute for Occupational Safety and Health

Engineering Measures Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	pungent
Odor Threshold	No information available
pH	< 1
Melting Point/Range	-35 °C / -31 °F
Boiling Point/Range	57 °C / 135 °F @ 760 mmHg
Flash Point	No information available
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	125 mbar @ 20 °C
Vapor Density	1.27
Specific Gravity	1.18
Solubility	Soluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	1.8 mPa.s @ 15°C
Molecular Formula	HCl
Molecular Weight	55.55

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability Stable under normal conditions.

Conditions to Avoid Incompatible products. Excess heat.

Incompatible Materials Metals, Strong oxidizing agents, Bases, sodium hypochlorite, Amines, Fluorine, Cyanides, Alkaline

Hazardous Decomposition Products Hydrogen chloride gas

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions Contact with metals may evolve flammable hydrogen gas.

11. Toxicological information

Acute Toxicity

Product Information

Oral LD50 Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.

Dermal LD50 Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.

Vapor LC50 Based on ATE data, the classification criteria are not met. ATE > 20 mg/l.

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Water	-	-	-
Hydrochloric acid	238 - 277 mg/kg (Rat)	> 5010 mg/kg (Rabbit)	1.68 mg/L (Rat) 1 h

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation Causes burns by all exposure routes

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS No	IARC	NTP	ACGIH	OSHA	Mexico
Water	7732-18-5	Not listed	Not listed	Not listed	Not listed	Not listed
Hydrochloric acid	7647-01-0	Not listed	Not listed	Not listed	Not listed	Not listed

IARC (International Agency for Research on Cancer)

IARC (International Agency for Research on Cancer)
Group 1 - Carcinogenic to Humans
Group 2A - Probably Carcinogenic to Humans
Group 2B - Possibly Carcinogenic to Humans

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure Respiratory system

STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and Product is a corrosive material. Use of gastric lavage or emesis is contraindicated.

delayed Possible perforation of stomach or esophagus should be investigated: Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Do not empty into drains. Large amounts will affect pH and harm aquatic organisms.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Hydrochloric acid	-	282 mg/L LC50 96 h Gambusia affinis mg/L LC50 48 h Leucscus idus	-	56mg/L EC50 72h Daphnia

Persistence and Degradability Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its water solubility.

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT

UN-No UN1789
Proper Shipping Name HYDROCHLORIC ACID
Hazard Class 8
Packing Group II

TDG

UN-No UN1789
Proper Shipping Name HYDROCHLORIC ACID
Hazard Class 8
Packing Group II

IATA

UN-No UN1789
Proper Shipping Name Hydrochloric acid
Hazard Class 8
Packing Group II

IMDG/IMO

UN-No UN1789
Proper Shipping Name Hydrochloric acid
Hazard Class 8
Packing Group II

15. Regulatory information

United States of America Inventory

Component	CAS No	TSCA	TSCA Inventory notification - Active-Inactive	TSCA - EPA Regulatory Flags
Water	7732-18-5	X	ACTIVE	-
Hydrochloric acid	7647-01-0	X	ACTIVE	-

Legend:

TSCA US EPA (TSCA) - Toxic Substances Control Act, (40 CFR Part 710)
X - Listed
'-' - Not Listed

TSCA 12(b) - Notices of Export Not applicable

International Inventories
Canada (DSL/NDSL), Europe (EINECS/ELINCS/NLP), Philippines (PICCS), Japan (ENCS), Japan (ISHL), Australia (AICS), China (IECSC), Korea (KECL).

Component	CAS No	DSL	NDSL	EINECS	PICCS	ENCS	ISHL	AICS	IECSC	KECL
Water	7732-18-5	X	-	231-791-2	X	X		X	X	KE-35400
Hydrochloric acid	7647-01-0	X	-	231-595-7	X	X	X	X	X	KE-20189

KECL - NIER number or KE number (http://ncis.nier.go.kr/en/main.do)

U.S. Federal Regulations

SARA 313

Component	CAS No	Weight %	SARA 313 - Threshold Values %
Hydrochloric acid	7647-01-0	35-38	1.0

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Hydrochloric acid	X	5000 lb	-	-

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Hydrochloric acid	X		-

OSHA - Occupational Safety and Health Administration Not applicable

Component	Specifically Regulated Chemicals	Highly Hazardous Chemicals
Hydrochloric acid	-	TQ: 5000 lb

CERCLA This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Hydrochloric acid	5000 lb	5000 lb

California Proposition 65 This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Water	-	-	X	-	-
Hydrochloric acid	X	X	X	X	X

U.S. Department of Transportation
Reportable Quantity (RQ): Y
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security

This product contains the following DHS chemicals:
Legend - STQs = Screening Threshold Quantities, APA = A placarded amount

Component	DHS Chemical Facility Anti-Terrorism Standard
Hydrochloric acid	Release STQs - 15000lb (concentration >=37%) Release STQs - 5000lb (anhydrous) Theft STQs - 500lb (anhydrous)

Other International Regulations

Mexico - Grade No information available

Authorisation/Restrictions according to EU REACH

Component	REACH (1907/2006) - Annex XIV - Substances Subject to Authorization	REACH (1907/2006) - Annex XVII - Restrictions on Certain Dangerous Substances	REACH Regulation (EC 1907/2006) article 59 - Candidate List of Substances of Very High Concern (SVHC)
Hydrochloric acid	-	Use restricted. See item 75. (see link for restriction details)	-

https://echa.europa.eu/substances-restricted-under-reach

Safety, health and environmental regulations/legislation specific for the substance or mixture

Component	CAS No	OECD HPV	Persistent Organic Pollutant	Ozone Depletion Potential	Restriction of Hazardous Substances (RoHS)
Water	7732-18-5	Listed	Not applicable	Not applicable	Not applicable
Hydrochloric acid	7647-01-0	Listed	Not applicable	Not applicable	Not applicable

Component	CAS No	Seveso III Directive (2012/18/EC) - Qualifying Quantities for Major Accident Notification	Seveso III Directive (2012/18/EC) - Qualifying Quantities for Safety Report Requirements	Rotterdam Convention (PIC)	Basel Convention (Hazardous Waste)
Water	7732-18-5	Not applicable	Not applicable	Not applicable	Not applicable
Hydrochloric acid	7647-01-0	25 tonne	250 tonne	Not applicable	Annex I - Y34

16. Other information

Prepared By

Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 24-Aug-2009
Revision Date 24-Dec-2021
Print Date 24-Dec-2021
Revision Summary SDS sections updated. 2. 3. 11.

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

SAFETY DATA SHEET

SDS ID NO.: 0156MAR019 **Revision date** 12/28/2021

1. IDENTIFICATION

Product Name Marathon Petroleum Benzene

Synonym Benzene; Cyclohexatriene
Product code 0156MAR019
Chemical family Petroleum Hydrocarbon

Recommended use Solvent. Chemical intermediate.
Restrictions on use All others.

Manufacturer, Importer, or Responsible Party Name and Address

MARATHON PETROLEUM COMPANY LP
539 South Main Street
Findlay, OH 45840

SDS Information 1-419-421-3070 (M-F; 8-5 EST)

24 Hour Emergency Telephone 1-877-627-5463

2. HAZARD IDENTIFICATION

OSHA Regulatory Status
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Classification

Flammable liquids	Category 2
Skin corrosion/irritation	Category 2
Serious eye damage/eye irritation	Category 2A
Germ cell mutagenicity	Category 1B
Carcinogenicity	Category 1A
Specific target organ toxicity (repeated exposure)	Category 1
Aspiration toxicity	Category 1

Hazards Not Otherwise Classified (HNOC)
Static accumulating flammable liquid

Label Elements

Danger

HIGHLY FLAMMABLE LIQUID AND VAPOR
May accumulate electrostatic charge and ignite or explode
May be fatal if swallowed and enters airways
Causes skin irritation
Causes serious eye irritation
May cause genetic defects
May cause cancer
Causes damage to organs (blood, blood-forming organs, immune system) through prolonged or repeated exposure
Toxic to aquatic life



Appearance Clear Liquid **Physical State** Liquid **Odor** Sweet , Distinct

Precautionary Statements - Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools.
Take precautionary measures against static discharge
Do not breathe dust/fume/gas/mist/vapors/spray
Do not eat, drink or smoke when using this product
Wash hands and any possibly exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection
Avoid release to the environment

Precautionary Statements - Response
IF exposed or concerned: Get medical attention
If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
If eye irritation persists: Get medical attention
If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
If skin irritation occurs: Get medical attention
Wash contaminated clothing before reuse
If swallowed: Immediately call a poison center or doctor
Do NOT induce vomiting
In case of fire: Use water spray, fog or regular foam for extinction

Precautionary Statements - Storage
Store in a well-ventilated place. Keep cool
Store locked up

Precautionary Statements - Disposal
Dispose of contents/container at an approved waste disposal plant

3. COMPOSITION/INFORMATION ON INGREDIENTS

Benzene is a six carbon aromatic petroleum hydrocarbon.

Composition Information

Name	CAS Number	% Concentration
Benzene	71-43-2	99-100

All concentrations are percent by weight unless material is a gas. Gas concentrations are in percent by volume.

4. FIRST AID MEASURES

First aid measures

General advice In case of accident or if you feel unwell, seek medical advice immediately (show directions

for use or safety data sheet if possible).

Inhalation

Remove to fresh air. If not breathing, utilize bag valve mask or other form of barrier device to institute rescue breathing. If breathing is difficult, ensure airway is clear, give oxygen and continue to monitor. If heart has stopped, immediately begin cardiopulmonary resuscitation (CPR). Keep affected person warm and at rest. Get immediate medical attention.

Skin contact

Immediately wash exposed skin with plenty of soap and water while removing contaminated clothing and shoes. May be absorbed through the skin in harmful amounts. Get medical attention if irritation persists.

Place contaminated clothing in closed container until cleaned or discarded. If clothing is to be laundered, inform the person performing the operation of contaminant's hazardous properties. Destroy contaminated, non-chemical resistant footwear.

Eye contact

Flush immediately with large amounts of water for at least 15 minutes. Gently remove contacts while flushing. Eyelids should be held away from the eyeball to ensure thorough rinsing. Gently remove contacts while flushing. Get medical attention if irritation persists.

Ingestion

Do not induce vomiting because of danger of aspirating liquid into lungs, causing serious damage and chemical pneumonitis. If spontaneous vomiting occurs, keep head below hips, or if patient is lying down, turn body and head to side to prevent aspiration and monitor for breathing difficulty. Never give anything by mouth to an unconscious person. Keep affected person warm and at rest. Get immediate medical attention.

Most important signs and symptoms, both short-term and delayed with overexposure

Adverse effects

Overexposure to vapors may cause eye, skin and respiratory irritation. Headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue. Prolonged and repeated contact may cause defatting and drying of the skin and may lead to irritation and/or dermatitis. Prolonged or repeated exposure may cause adverse effects on blood, blood-forming organs, and immune system.

Indication of any immediate medical attention and special treatment needed

Notes to physician

INHALATION: This material (or a component) sensitizes the myocardium to the effects of sympathomimetic amines. Epinephrine and other sympathomimetic drugs may initiate cardiac arrhythmias in individuals exposed to this material. Administration of sympathomimetic drugs should be avoided.

INGESTION: This material represents a significant aspiration and chemical pneumonitis hazard. Induction of emesis is not recommended.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media

For small fires, Class B fire extinguishing media such as CO2, dry chemical, foam or water spray can be used. For large fires, water spray, fog or foam can be used. Firefighting should be attempted only by those who are adequately trained and equipped with proper protective equipment.

Unsuitable extinguishing media

Do not use straight water streams to avoid spreading fire.

Specific hazards arising from the chemical

This product has been determined to be a highly flammable liquid per the OSHA Hazard Communication Standard and should be handled accordingly. Vapors may travel along the ground or be moved by ventilation and ignited by many sources such as pilot lights, sparks, electric motors, static discharge, or other ignition sources at locations distant from material handling. Flashback can occur along vapor trail. For additional fire related information, see NFPA 30 or the Emergency Response Guidebook 130.

Hazardous combustion products

Smoke, carbon monoxide, and other products of incomplete combustion.

Explosion data

Sensitivity to mechanical impact:	No.
Sensitivity to static discharge:	Yes.

Special protective equipment and precautions for firefighters

Firefighters should wear full protective clothing and positive-pressure self-contained breathing apparatus (SCBA) with a full face-piece, as appropriate. Avoid using straight water streams. Water may be ineffective in extinguishing low flash point fires, but can be used to cool exposed surfaces. Avoid excessive water spray application. Water spray and foam must be applied carefully to avoid frothing and from as far a distance as possible. Keep run-off water out of sewers and water sources.

Additional firefighting tactics

FIRES INVOLVING TANKS OR CAR/TRAILER LOADS: Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Cool containers with flooding quantities of water until well after the fire is out. Do not direct water at source of leak or safety devices; icing may occur. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles: if this is impossible, withdraw from area and let fire burn.

EVACUATION: Consider initial downwind evacuation for at least 1000 feet. If tank, rail car or tank truck is involved in a fire, ISOLATE for 5280 feet (1 mile) in all directions; also, consider initial evacuation of 5280 feet (1 mile) in all directions.

NFPA	Health 2	Flammability 3	Instability 0	Special Hazard -

6. ACCIDENTAL RELEASE MEASURES

Personal precautions

Keep public away. Isolate and evacuate area. Shut off source if safe to do so. Eliminate all ignition sources.

Protective equipment

Use personal protection measures as recommended in Section 8.

Emergency procedures

Advise authorities and National Response Center (800-424-8802) if the product has entered a water course or sewer. Notify local health and pollution control agencies, if appropriate.

Environmental precautions

Avoid release to the environment. Avoid subsoil penetration.

Methods and materials for containment

Contain liquid with sand or soil.

Methods and materials for cleaning up

Use suitable absorbent materials such as vermiculite, sand, or clay to clean up residual liquids. Recover and return free product to proper containers. When recovering free liquids ensure all equipment is grounded and bonded. Use only non-sparking tools.

7. HANDLING AND STORAGE

Safe handling precautions

NEVER SIPHON THIS PRODUCT BY MOUTH. Static accumulating flammable liquid. Use appropriate grounding and bonding practices. Bonding and grounding may be insufficient to eliminate the hazard from static electricity. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. Use only non-sparking tools. Do not cut, drill, grind or weld on empty containers since explosive residues may remain. Avoid contact with skin, eyes and clothing. Avoid breathing vapors or mists. Use only with adequate ventilation. Use personal protection measures as recommended in Section 8. Exercise good personal hygiene including removal of soiled clothing and prompt washing with soap and water. Comply with all applicable EPA, OSHA, NFPA and consistent state and local requirements.

Hydrocarbons are basically non-conductors of electricity and can become electrostatically charged during mixing, filtering, pumping at high flow rates or loading and transfer operations. If this charge reaches a sufficiently high level, sparks can form that may ignite

the vapors of flammable liquids. Sudden release of hot organic chemical vapors or mists from process equipment operating under elevated temperature and pressure, or sudden ingress of air into vacuum equipment may result in ignition of vapors or mists without the presence of obvious ignition sources. Nozzle spouts must be kept in contact with the containers or tank during the entire filling operation.

Storage conditions Store in properly closed containers that are appropriately labeled and in a cool, well-ventilated area.

Incompatible materials Strong oxidizing agents.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Name	ACGIH TLV	OSHA PELS	NIOSH IDLH
Benzene 71-43-2	0.5 ppm TWA 2.5 ppm STEL Skin - potential significant contribution to overall exposure by the cutaneous route	TWA: 1 ppm STEL: 5 ppm TWA: 10 ppm (applies to industry segments exempt from the benzene standard) (see 29 CFR 1910.1028)	500 ppm

Notes: No further information available.

Engineering measures Local or general exhaust required in an enclosed area or when there is inadequate ventilation. Use mechanical ventilation equipment that is explosion-proof.

Personal protective equipment

Eye protection Use goggles or face-shield if the potential for splashing exists.

Skin and body protection For non-exposure jobs or where exposure is expected to be less than 15 minutes, neoprene gloves can be used to prevent skin contact. For all exposure jobs expected to be greater than 15 minutes, Viton® gloves should be used to prevent skin contact. Glove suitability is based on workplace conditions and usage. Contact the glove manufacturer for specific advice on glove selection and breakthrough times. Depending upon the conditions of use and specific work situations, additional protective equipment and/or clothing may be required to control exposures.

Respiratory protection Approved organic vapor chemical cartridge or supplied air respirators should be worn for exposures to any components exceeding the established exposure limits. Observe respirator assigned protection factors (APFs) criteria cited in federal OSHA 29 CFR 1910.134. Self-contained breathing apparatus should be used for fire fighting.

Hygiene measures Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes and clothing.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Appearance	Clear Liquid
Physical State	Liquid
Color	Colorless
Odor	Sweet , Distinct
Odor Threshold	12 ppmv

Property	Values (method)
pH	Not applicable
Melting Point / Freezing Point	5.5 °C / 42 °F
Initial Boiling Point / Boiling Range	80 °C / 176 °F
Flash Point	-11 °C / 12 °F

Evaporation Rate	5.1 (Butyl acetate = 1)
Flammability (solid, gas)	Not applicable.
Flammability Limit in Air (%):	
Upper Flammability Limit:	7.1
Lower Flammability Limit:	1.2
Explosion Limits	No data available.
Vapor Pressure	3.21 psia @ 100°F
Vapor Density	2.8 (Air = 1)
Specific Gravity / Relative Density	0.884
Water Solubility	No data available.
Partition Coefficient	No data available.
Autoignition Temperature	497 °C / 928 °F
Decomposition Temperature	No data available.
Kinematic Viscosity	0.593 cSt @ 100°F
VOC Content (%)	No data available.

10. STABILITY AND REACTIVITY

Reactivity The product is non-reactive under normal conditions.

Chemical stability The material is stable at 70°F (21°C), 760 mmHg pressure.

Possibility of hazardous reactions None under normal processing.

Hazardous polymerization Will not occur.

Conditions to avoid Sources of heat or ignition.

Incompatible materials Strong oxidizing agents.

Hazardous decomposition products None known under normal conditions of use.

11. TOXICOLOGICAL INFORMATION

Potential short-term adverse effects from overexposures

Inhalation Overexposure may cause respiratory tract irritation and central nervous system depression. Breathing high concentrations of this material, for example, in a confined space or by intentional abuse, can cause irregular heartbeats which can cause death.

Eye contact Irritating to eyes.

Skin contact Irritating to skin. May be absorbed through the skin in harmful amounts. Effects may become more serious with repeated or prolonged contact.

Ingestion May be fatal if swallowed or vomited and enters airways. May cause irritation of the mouth, throat and gastrointestinal tract. May cause central nervous system depression or effects.

Acute toxicological data

Name	Oral LD50	Dermal LD50	Inhalation LC50
Benzene 71-43-2	> 2000 mg/kg (Rat)	> 5000 mg/kg (Rabbit)	> 20 mg/l (Rat) 4 h

Immediate and delayed effects as well as chronic effects from short and long-term exposure

BENZENE: Benzene exposure may cause skin, eye and respiratory irritation. Excessive exposures may cause central nervous system effects. Numerous studies of workers exposed to airborne benzene for prolonged or repeated periods show strong evidence that overexposure can cause cancer of the blood, AML (acute myeloid leukemia), along with other disorders indicating damage to the blood forming organs including aplastic anemia, leukopenia, thrombocytopenia, and the development of myelodysplastic syndrome. Some studies of pregnant women occupationally exposed to benzene suggest associations with an

increased risk of miscarriage, stillbirth, reduced birth weight, and gestational age. Prolonged and repeated exposure to benzene has induced chromosomal aberrations in circulating human lymphocytes, in bone marrow cells of laboratory animals, and in sperm cells of both humans and laboratory animals.

Adverse effects related to the physical, chemical and toxicological characteristics

Signs and symptoms Overexposure to vapors may cause eye, skin and respiratory irritation. Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting Repeated or prolonged skin contact may cause drying, reddening, itching and cracking.

Acute toxicity None known.

Skin corrosion/irritation Irritating to skin.

Serious eye damage/eye irritation Causes serious eye irritation.

Sensitization None known.

Mutagenic effects May cause genetic defects.

Carcinogenicity May cause cancer.
Cancer designations are listed in the table below

Name	ACGIH (Class)	IARC (Class)	NTP	OSHA
Benzene 71-43-2	Confirmed human carcinogen (A1)	Carcinogenic to humans (1)	Known to be human carcinogen	Known carcinogen

Reproductive toxicity None known.

Specific Target Organ Toxicity (STOT) - single exposure Not classified.

Specific Target Organ Toxicity (STOT) - repeated exposure Causes damage to organs (blood, blood-forming organs, immune system) through prolonged or repeated exposure.

Aspiration hazard May be fatal if swallowed or vomited and enters airways.

12. ECOLOGICAL INFORMATION

Ecotoxicity This product should be considered toxic to aquatic organisms.

Name	Fish	Crustacea	Algae/aquatic plants
Benzene 71-43-2	96-hr LC50 = 5.3 mg/l Rainbow trout (flow-through)	48-hr EC50 = 8.76-15.6 mg/l Daphnia magna (Static)	72-hr EC50 = 29 mg/l Algae

Persistence and degradability Readily biodegradable in the environment.

Bioaccumulation Not expected to bioaccumulate in aquatic organisms.

Mobility in soil May partition into air, soil and water.

Other adverse effects No information available.

13. DISPOSAL CONSIDERATIONS

Description of waste residues This material may be a flammable liquid waste.

Safe handling of wastes Handle in accordance with applicable local, state, and federal regulations. Use personal

protection measures as required. Use appropriate grounding and bonding practices. Use only non-sparking tools. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. No smoking.

Disposal of wastes / methods of disposal The user is responsible for determining if any discarded material is a hazardous waste (40 CFR 262.11). Dispose of in accordance with federal, state and local regulations.

Contaminated packaging disposal Empty containers should be completely drained and then discarded or recycled, if possible. Do not cut, drill, grind or weld on empty containers since explosive residues may be present. Dispose of in accordance with federal, state and local regulations.

14. TRANSPORT INFORMATION

DOT

UN/Identification No:	UN 1114
UN Proper Shipping Name:	Benzene
Transport Hazard Class(es):	3
Packing Group:	II

IATA

UN/Identification No:	UN 1114
UN Proper Shipping Name:	Benzene
Transport Hazard Class(es):	3
Packing Group:	II
ERG code:	3L

IMDG

UN/Identification No:	UN 1114
UN Proper Shipping Name:	Benzene
Transport Hazard Class(es):	3
Packing Group:	II
EmS No:	F-E, S-D
Marine Pollutant:	No

15. REGULATORY INFORMATION

Regulatory Information

US TSCA Chemical Inventory This product and/or its components are listed on the TSCA Chemical Inventory or are exempt.

Canada DSL/NDSL Inventory This product and/or its components are listed either on the Domestic Substances List (DSL) or are exempt.

EPA Superfund Amendment & Reauthorization Act (SARA)

SARA Section 302 This product does not contain any component(s) included on EPA's Extremely Hazardous Substance (EHS) List above the de minimis threshold.

SARA Section 304 This product may contain component(s) identified either as an EHS or a CERCLA Hazardous substance which in case of a spill or release may be subject to SARA reporting requirements:

Name	Hazardous Substances RQs
Benzene 71-43-2	10 lb 4.54 kg

SARA Section 311/312 The following EPA hazard categories apply to this product:

Flammable
Hazard Not Otherwise Classified (HNOC)-Physical
Skin corrosion or irritation
Serious eye damage or eye irritation
Germ cell mutagenicity
Carcinogenicity
Specific target organ toxicity
Aspiration hazard

SARA Section 313 This product may contain component(s), which if in exceedance of the de minimus threshold, may be subject to the reporting requirements of SARA Title III Section 313 Toxic Release Reporting (Form R).

Name	CERCLA/SARA 313 Emission reporting
Benzene 71-43-2	0.1 % de minimis concentration

U.S. State Regulations

California Proposition 65 This product can expose you to chemicals which are known to the State of California to cause cancer, birth defects or other reproductive harm.

Name	California Proposition 65
Benzene 71-43-2	Carcinogen, initial date 02/27/87 Male developmental toxicity, initial date 12/26/97

For more information, go to www.P65Warnings.ca.gov.

State Right-To-Know Regulations The following component(s) of this material are identified on the regulatory lists below:

Name	New Jersey Right-To-Know	Pennsylvania Right-To-Know	Massachusetts Right-To Know
Benzene 71-43-2	Listed	Listed	Listed

16. OTHER INFORMATION

Prepared by Toxicology & Product Safety

NFPA



Revision Notes

Revision date 12/28/2021

Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information is intended as guidance for safe handling, use, processing, storage, transportation, accidental release, clean-up and disposal and is not considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

SAFETY DATA SHEET

SDS ID NO.: 0127MAR019 **Revision date** 07/07/2020

1. IDENTIFICATION

Product Name Marathon Petroleum Gasoline - All Grades

Synonym Gasoline; Conventional Gasoline; Regular Unleaded Gasoline; Midgrade Unleaded Gasoline; Premium Unleaded Gasoline; Blendgrade Gasoline; Sub-octane Gasoline; Reformulated Blend Stock for Oxygenated Blending; RBOB; Premium RBOB; PBOB; Recreational Gasoline

Product code 0127MAR019
Chemical family Complex Hydrocarbon Substance

Recommended use Fuel.
Restrictions on use All others.

Manufacturer, Importer, or Responsible Party Name and Address

MARATHON PETROLEUM COMPANY LP
539 South Main Street
Findlay, OH 45840

SDS Information 1-419-421-3070 (M-F; 8-5 EST)

24 Hour Emergency Telephone CHEMTREC: 1-800-424-9300 (CCN# 13740)

2. HAZARD IDENTIFICATION

OSHA Regulatory Status
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Classification

Flammable liquids	Category 1
Skin corrosion/irritation	Category 2
Germ cell mutagenicity	Category 1B
Carcinogenicity	Category 1A
Reproductive toxicity	Category 2
Specific target organ toxicity (single exposure)	Category 3
Specific target organ toxicity (repeated exposure)	Category 1
Aspiration toxicity	Category 1
Chronic aquatic toxicity	Category 2

Hazards Not Otherwise Classified (HNOC)
Static accumulating flammable liquid

Label Elements

Danger

EXTREMELY FLAMMABLE LIQUID AND VAPOR
May accumulate electrostatic charge and ignite or explode
May be fatal if swallowed and enters airways
Causes skin irritation

May cause respiratory irritation
May cause drowsiness or dizziness
May cause genetic defects
May cause cancer
Suspected of damaging fertility or the unborn child
Causes damage to organs (blood, blood-forming organs, immune system) through prolonged or repeated exposure
Toxic to aquatic life with long lasting effects



Appearance Clear yellow liquid **Physical State** Liquid **Odor** Hydrocarbon

Precautionary Statements - Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools.
Take action to prevent static discharges
Do not eat, drink or smoke when using this product
Do not breathe mist/vapors/spray
Use only outdoors or in a well-ventilated area
Wear protective gloves/protective clothing/eye protection/face protection
Wash hands and any possibly exposed skin thoroughly after handling
Avoid release to the environment

Precautionary Statements - Response
If exposed, concerned or you feel unwell: Get medical attention
If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
If skin irritation occurs: Get medical attention
Wash contaminated clothing before reuse
If inhaled: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Call a poison center or doctor if you feel unwell
If swallowed: Immediately call a poison center or doctor
Do NOT induce vomiting
In case of fire: Use water spray, fog or regular foam for extinction
Collect spillage

Precautionary Statements - Storage
Store in a well-ventilated place. Keep container tightly closed
Keep cool
Store locked up

Precautionary Statements - Disposal
Dispose of contents/container at an approved waste disposal plant

3. COMPOSITION/INFORMATION ON INGREDIENTS

Composition Information

Name	CAS Number	% Concentration
Gasoline	86290-81-5	100
Heptane (mixed isomers)	142-82-5	2.5-26
Toluene	108-88-3	1-20
Pentane (mixed isomers)	109-66-0	6-19
Butane (mixed isomers)	106-97-8	0.5-14
Hexane Isomers (other than n-Hexane)	107-83-5	2-12
Xylene (mixed isomers)	1330-20-7	2-10
Benzene	71-43-2	0.1-4.9
n-Hexane	110-54-3	0.1-4.5
Cumene	98-82-8	0-4
1,2,4 Trimethylbenzene	95-63-6	0.5-4
Ethylbenzene	100-41-4	0-2.5
Cyclohexane	110-82-7	0-1.5
Octane	111-65-9	0-1.5
1,2,3-Trimethylbenzene	526-73-8	0-1
Naphthalene	91-20-3	0.1-0.5

Benzene concentration is percent by volume. All other concentrations are percent by weight unless material is a gas. Gas concentrations are in percent by volume.

4. FIRST AID MEASURES

First aid measures

General advice In case of accident or if you feel unwell, seek medical advice immediately (show directions for use or safety data sheet if possible).

Inhalation Remove to fresh air. If not breathing, utilize bag valve mask or other form of barrier device to institute rescue breathing. If breathing is difficult, ensure airway is clear, give oxygen and continue to monitor. If heart has stopped, immediately begin cardiopulmonary resuscitation (CPR). Keep affected person warm and at rest. If symptoms occur get medical attention.

Skin contact Immediately wash exposed skin with plenty of soap and water while removing contaminated clothing and shoes. Place contaminated clothing in closed container until cleaned or discarded. If clothing is to be laundered, inform the person performing the operation of contaminant's hazardous properties. Get medical attention if irritation persists. Any injection injury from high pressure equipment should be evaluated immediately by a physician as potentially serious (See NOTES TO PHYSICIAN).

Eye contact Flush immediately with large amounts of water for at least 15 minutes. Gently remove contacts while flushing. Eyelids should be held away from the eyeball to ensure thorough rinsing. Gently remove contacts while flushing. Get medical attention if irritation persists.

Ingestion Do not induce vomiting because of danger of aspirating liquid into lungs, causing serious damage and chemical pneumonitis. If spontaneous vomiting occurs, keep head below hips, or if patient is lying down, turn body and head to side to prevent aspiration and monitor for breathing difficulty. Never give anything by mouth to an unconscious person. Keep affected person warm and at rest. Get immediate medical attention.

Most important signs and symptoms, both short-term and delayed with overexposure

Adverse effects Irritating to the skin and mucous membranes. Symptoms may include redness, itching, and inflammation. May cause nausea, vomiting, diarrhea, and signs of nervous system depression: headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue. Aspiration hazard. May cause coughing, chest pains, shortness of breath, pulmonary edema and/or chemical pneumonitis. Prolonged or repeated exposure may cause adverse effects on blood, blood-forming organs, and immune system. Repeated or prolonged skin contact may cause drying, reddening, itching and cracking.

Indication of any immediate medical attention and special treatment needed

Notes to physician

INHALATION: This material (or a component) sensitizes the myocardium to the effects of sympathomimetic amines. Epinephrine and other sympathomimetic drugs may initiate cardiac arrhythmias in individuals exposed to this material. Administration of sympathomimetic drugs should be avoided.

SKIN: Leaks or accidents involving high-pressure equipment may inject a stream of material through the skin and initially produce an injury that may not appear serious. Only a small puncture wound may appear on the skin surface but, without proper treatment and depending on the nature, original pressure, volume, and location of the injected material, can compromise blood supply to an affected body part. Prompt surgical debridement of the wound may be necessary to prevent irreversible loss of function and/or the affected body part. High pressure injection injuries may be SERIOUS SURGICAL EMERGENCIES.

INGESTION: This material represents a significant aspiration and chemical pneumonitis hazard. Induction of emesis is not recommended.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media

For small fires, Class B fire extinguishing media such as CO2, dry chemical, foam (AFFF/ATC) or water spray can be used. For large fires, water spray, fog or foam (AFFF/ATC) can be used. Firefighting should be attempted only by those who are adequately trained and equipped with proper protective equipment.

Unsuitable extinguishing media

Do not use straight water streams to avoid spreading fire.

Specific hazards arising from the chemical

This product has been determined to be an extremely flammable liquid per the OSHA Hazard Communication Standard and should be handled accordingly. May accumulate electrostatic charge and ignite or explode. Vapors may travel along the ground or be moved by ventilation and ignited by many sources such as pilot lights, sparks, electric motors, static discharge, or other ignition sources at locations distant from material handling. Flashback can occur along vapor trail. For additional fire related information, see NFPA 30 or the Emergency Response Guidebook 128.

Hazardous combustion products

Smoke, carbon monoxide, and other products of incomplete combustion.

Explosion data

Sensitivity to mechanical impact: No.

Sensitivity to static discharge: Yes.

Special protective equipment and precautions for firefighters

Firefighters should wear full protective clothing and positive-pressure self-contained breathing apparatus (SCBA) with a full face-piece, as appropriate. Avoid using straight water streams. Water may be ineffective in extinguishing low flash point fires, but can be used to cool exposed surfaces. Avoid excessive water spray application. Water spray and foam (AFFF/ATC) must be applied carefully to avoid frothing and from as far a distance as possible. Keep run-off water out of sewers and water sources.

Additional firefighting tactics

FIRES INVOLVING TANKS OR CAR/TRAILER LOADS: Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Cool containers with flooding quantities of water until well after the fire is out. Do not direct water at source of leak or safety devices; icing may occur. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles: if this is impossible, withdraw from area and let fire burn.

EVACUATION: Consider initial downwind evacuation for at least 1000 feet. If tank, rail car or tank truck is involved in a fire, ISOLATE for 2640 feet (1/2 mile) in all directions; also, consider initial evacuation of 2640 feet (1/2 mile) in all directions.

NFPA	Health 1	Flammability 3	Instability 0	Special Hazard -

6. ACCIDENTAL RELEASE MEASURES

Personal precautions

Keep public away. Isolate and evacuate area. Shut off source if safe to do so. Eliminate all ignition sources.

Protective equipment

Use personal protection measures as recommended in Section 8.

Emergency procedures

Advise authorities and National Response Center (800-424-8802) if the product has entered a water course or sewer. Notify local health and pollution control agencies, if appropriate.

Environmental precautions

Avoid release to the environment. Avoid subsoil penetration.

Methods and materials for containment

Contain liquid with sand or soil. Prevent spilled material from entering storm drains, sewers, and open waterways.

Methods and materials for cleaning up

Use suitable absorbent materials such as vermiculite, sand, or clay to clean up residual liquids. Recover and return free product to proper containers. When recovering free liquids ensure all equipment is grounded and bonded. Use only non-sparking tools.

7. HANDLING AND STORAGE

Safe handling precautions

NEVER SIPHON THIS PRODUCT BY MOUTH. Use appropriate grounding and bonding practices. Static accumulating flammable liquid. Bonding and grounding may be insufficient to eliminate the hazard from static electricity. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. Vapors may travel along the ground or be moved by ventilation. Flashback may occur along vapor trails. No smoking. Use only non-sparking tools. Avoid contact with skin, eyes and clothing. Avoid breathing fumes, gas, or vapors. Use only with adequate ventilation. Avoid repeated and prolonged skin contact. Use personal protection measures as recommended in Section 8. Exercise good personal hygiene including removal of soiled clothing and prompt washing with soap and water. Do not cut, drill, grind or weld on empty containers since explosive residues may remain. Refer to applicable EPA, OSHA, NFPA and consistent state and local requirements.

Hydrocarbons are basically non-conductors of electricity and can become electrostatically charged during mixing, filtering, pumping at high flow rates or loading and transfer operations. If this charge reaches a sufficiently high level, sparks can form that may ignite the vapors of flammable liquids. Sudden release of hot organic chemical vapors or mists from process equipment operating under elevated temperature and pressure, or sudden ingress of air into vacuum equipment may result in ignition of vapors or mists without the presence of obvious ignition sources. Nozzle spouts must be kept in contact with the containers or tank during the entire filling operation.

Portable containers should never be filled while in or on a motor vehicle or marine craft. Containers should be placed on the ground. Static electric discharge can ignite fuel vapors when filling non-grounded containers or vehicles on trailers. The nozzle spout must be kept in contact with the container before and during the entire filling operation. Use only approved containers.

A buildup of static electricity can occur upon re-entry into a vehicle during fueling especially in cold or dry climate conditions. The charge is generated by the action of dissimilar fabrics (i.e., clothing and upholstery) rubbing across each other as a person enters/exits the vehicle. A flash fire can result from this discharge if sufficient flammable vapors are present. Therefore, do not get back in your vehicle while refueling.

Cellular phones and other electronic devices may have the potential to emit electrical charges (sparks). Sparks in potentially explosive atmospheres (including fueling areas

such as gas stations) could cause an explosion if sufficient flammable vapors are present. Therefore, turn off cellular phones and other electronic devices when working in potentially explosive atmospheres or keep devices inside your vehicle during refueling.

High-pressure injection of any material through the skin is a serious medical emergency even though the small entrance wound at the injection site may not initially appear serious. These injection injuries can occur from high-pressure equipment such as paint spray or grease or guns, fuel injectors, or pinhole leaks in hoses or hydraulic lines and should all be considered serious. High pressure injection injuries may be SERIOUS SURGICAL EMERGENCIES (See First Aid Section 4).

Storage conditions Store in properly closed containers that are appropriately labeled and in a cool, well-ventilated area. Do not store near an open flame, heat or other sources of ignition.

Incompatible materials Strong oxidizing agents.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Name	ACGIH TLV	OSHA PELS	NIOSH IDLH
Gasoline 86290-81-5	300 ppm TWA 500 ppm STEL	-	-
Heptane (mixed isomers) 142-82-5	400 ppm TWA 500 ppm STEL	TWA: 500 ppm TWA: 2000 mg/m³	750 ppm
Toluene 108-88-3	20 ppm TWA	TWA: 200 ppm Ceiling: 300 ppm	500 ppm
Pentane (mixed isomers) 109-66-0	1000 ppm TWA	TWA: 1000 ppm TWA: 2950 mg/m³	1500 ppm
Butane (mixed isomers) 106-97-8	1000 ppm STEL	-	1600 ppm
Hexane Isomers (other than n-Hexane) 107-83-5	500 ppm TWA 1000 ppm STEL	-	-
Xylene (mixed isomers) 1330-20-7	100 ppm TWA 150 ppm STEL	TWA: 100 ppm TWA: 435 mg/m³	900 ppm
Benzene 71-43-2	0.5 ppm TWA 2.5 ppm STEL Skin - potential significant contribution to overall exposure by the cutaneous route	TWA: 10 ppm (applies to industry segments exempt from the benzene standard) TWA: 1 ppm STEL: 5 ppm (see 29 CFR 1910.1028)	500 ppm
n-Hexane 110-54-3	50 ppm TWA Skin - potential significant contribution to overall exposure by the cutaneous route	TWA: 500 ppm TWA: 1800 mg/m³	1100 ppm
Cumene 98-82-8	50 ppm TWA	TWA: 50 ppm TWA: 245 mg/m³ Skin	900 ppm
1,2,4 Trimethylbenzene 95-63-6	25 ppm TWA	-	-
Ethylbenzene 100-41-4	20 ppm TWA	TWA: 100 ppm TWA: 435 mg/m³	800 ppm
Cyclohexane 110-82-7	100 ppm TWA	TWA: 300 ppm TWA: 1050 mg/m³	1300 ppm
Octane 111-65-9	300 ppm TWA	TWA: 500 ppm TWA: 2350 mg/m³	1000 ppm
1,2,3-Trimethylbenzene 526-73-8	25 ppm TWA	-	-
Naphthalene 91-20-3	10 ppm TWA Skin - potential significant	TWA: 10 ppm TWA: 50 mg/m³	250 ppm

	contribution to overall exposure by the cutaneous route		

Notes: No further information available.

Engineering measures Local or general exhaust required in an enclosed area or when there is inadequate ventilation. Use mechanical ventilation equipment that is explosion-proof.

Personal protective equipment

Eye protection Use goggles or face-shield if the potential for splashing exists.

Skin and body protection Use nitrile rubber, Viton® or PVA gloves for repeated or prolonged skin exposure. Glove suitability is based on workplace conditions and usage. Contact the glove manufacturer for specific advice on glove selection and breakthrough times.

Respiratory protection Use a NIOSH approved organic vapor chemical cartridge or supplied air respirators when there is the potential for airborne exposures to exceed permissible exposure limits or if excessive vapors are generated. Observe respirator assigned protection factors (APFs) criteria cited in federal OSHA 29 CFR 1910.134. Self-contained breathing apparatus should be used for fire fighting.

Hygiene measures Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes and clothing.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Appearance	Clear yellow liquid
Physical State	Liquid
Color	Yellow
Odor	Hydrocarbon
Odor Threshold	No data available.

Property	**Values (method)**
pH	Not applicable
Melting Point / Freezing Point	No data available.
Initial Boiling Point / Boiling Range	21-222 °C / 70-432 °F (ASTM D86)
Flash Point	-43 °C / -45 °F
Evaporation Rate	No data available.
Flammability (solid, gas)	Not applicable.
Flammability Limit in Air (%):	
Upper Flammability Limit:	7.6
Lower Flammability Limit:	1.4
Explosion Limits	No data available.
Vapor Pressure	5.5-15 psi (ASTM D4814)
Vapor Density	3-4
Specific Gravity / Relative Density	0.76 (0.69-0.76)
Water Solubility	Negligible
Partition Coefficient	2.13-4.5
Autoignition Temperature	280 °C / 536 °F
Decomposition Temperature	No data available.
Kinematic Viscosity	No data available.
VOC Content (%)	100%

10. STABILITY AND REACTIVITY

Reactivity The product is non-reactive under normal conditions.

Chemical stability The material is stable at 70°F (21°C), 760 mmHg pressure.

Possibility of hazardous reactions None under normal processing.

Hazardous polymerization Will not occur.

Conditions to avoid Excessive heat, sources of ignition, open flame.

Incompatible materials Strong oxidizing agents.

Hazardous decomposition products None known under normal conditions of use. However, use in an area without adequate ventilation may result in hazardous levels of carbon monoxide and carbon dioxide.

11. TOXICOLOGICAL INFORMATION

Potential short-term adverse effects from overexposures

Inhalation May cause irritation of respiratory tract. May cause drowsiness or dizziness. Breathing high concentrations of this material in a confined space or by intentional abuse can cause irregular heartbeats which can cause death.

Eye contact Exposure to vapor or contact with liquid may cause mild eye irritation, including tearing, stinging, and redness.

Skin contact Irritating to skin. Effects may become more serious with repeated or prolonged contact. May be absorbed through the skin in harmful amounts.

Ingestion May be fatal if swallowed or vomited and enters airways. May cause irritation of the mouth, throat and gastrointestinal tract.

Acute toxicological data

Name	Oral LD50	Dermal LD50	Inhalation LC50
Gasoline 86290-81-5	14000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 5.2 mg/L (Rat) 4 h
Heptane (mixed isomers) 142-82-5	-	3000 mg/kg (Rabbit)	103 g/m³ (Rat) 4 h
Toluene 108-88-3	> 2000 mg/kg (Rat)	8390 mg/kg (Rabbit)	12.5 mg/L (Rat) 4 h
Pentane (mixed isomers) 109-66-0	-	-	364 mg/L (Rat) 4 h
Butane (mixed isomers) 106-97-8	-	-	658 mg/L (Rat) 4 h
Hexane Isomers (other than n-Hexane) 107-83-5	> 5000 mg/kg (Rat)	-	-
Xylene (mixed isomers) 1330-20-7	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 5.04 mg/L (Rat) 4 h
Benzene 71-43-2	> 2000 mg/kg (Rat)	> 5000 mg/kg (Rabbit)	> 20 mg/l (Rat) 4 h
n-Hexane 110-54-3	15000 mg/kg (Rat)	3000 mg/kg (Rabbit)	48000 ppm (Rat) 4 h
Cumene 98-82-8	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 20 mg/L (Rat) 6 h
1,2,4 Trimethylbenzene 95-63-6	3280 mg/kg (Rat)	> 3160 mg/kg (Rabbit)	18,000 mg/m³ (Rat) 4 h
Ethylbenzene 100-41-4	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	17.2 mg/L (Rat) 4 h
Cyclohexane 110-82-7	> 5000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	13.9 mg/L (Rat) 4 h
Octane 111-65-9	-	-	118 g/m³ (Rat) 4 h
Naphthalene 91-20-3	533 mg/kg (Mouse)	> 2000 mg/kg (Rabbit)	> 340 mg/m³ (Rat) 1 h

Immediate and delayed effects as well as chronic effects from short and long-term exposure

GASOLINE: Gasoline blending streams, or naphthas, may be fatal if swallowed and enter the airway. Vapors may be irritating if inhaled. Altered mental state, drowsiness, dizziness, peripheral motor neuropathy, irreversible brain damage (gasoline sniffer's neuropathy), delirium, seizures, and sudden death have been reported from repeated exposure or overexposure. Lifetime exposure of laboratory mice and rats to wholly-vaporized unleaded gasoline produced an increased incidence of liver tumors in female mice at the highest exposure concentration and α-2 urinary globulin-mediated kidney tumors in male rats. Lifetime repeated application of various gasoline blending streams or naphthas to the skin of mice caused an irritation-dependent increased incidence of skin tumors. These tumors occur through a mechanism of questionable human relevance.

TOLUENE: Inhalation abuse of toluene at high concentrations has been associated with adverse effects on the liver, kidney and nervous system, and can cause nervous system depression, cardiac arrhythmias, and death. Studies of workers indicate long-term exposure may be related to impaired color vision and hearing. Some studies of workers suggest long-term exposure may be associated with neurobehavioral and mental functional changes. Laboratory animal studies indicate some changes in reproductive organs after exposure to high airborne concentrations, but no significant effects on mating performance or reproduction were observed. Positive findings include small increases in minor skeletal and visceral malformations and developmental delays following maternal exposure to high concentrations. Adverse effects on the liver, kidney, thymus and nervous system of laboratory animal were observed after very high levels of prolonged and repeated exposure.

BUTANE and PENTANE: Laboratory animal studies indicate exposure to extremely high levels (1-10 vol.% in air) may cause cardiac arrhythmias (irregular heartbeats) which may be serious or fatal.

XYLENE: Overexposure to airborne xylene may cause upper respiratory tract irritation, headache, cyanosis, blood serum changes, nervous system damage and narcosis. Impaired neurological function has been reported in workers exposed to solvents including xylene. Laboratory animal studies have shown evidence of impaired hearing after prolonged exposure high airborne concentrations. Laboratory animal studies suggest some changes in reproductive organs after exposure to high airborne concentrations of xylene without an effect on reproduction. Skeletal and visceral malformations, developmental delays, and increased fetal resorptions were observed in laboratory animals after extremely high airborne concentrations with evidence of maternal toxicity. Adverse effects on the liver, kidney, and bone marrow were observed in laboratory animals after prolonged and repeated exposure to high airborne concentrations of xylene.

BENZENE: Benzene exposure may cause skin, eye and respiratory irritation. Excessive exposures may cause central nervous system effects. Numerous studies of workers exposed to airborne benzene for prolonged or repeated periods show strong evidence that overexposure can cause cancer of the blood, AML (acute myeloid leukemia), along with other disorders indicating damage to the blood forming organs including aplastic anemia, leukopenia, thrombocytopenia, and the development of myelodysplastic syndrome. Some studies of pregnant women occupationally exposed to benzene suggest associations with an increased risk of miscarriage, stillbirth, reduced birth weight, and gestational age. Prolonged and repeated exposure to benzene has induced chromosomal aberrations in circulating human lymphocytes, in bone marrow cells of laboratory animals, and in sperm cells of both humans and laboratory animals.

N-HEXANE: Short-term overexposure to n-hexane vapor may cause headache, nausea, vomiting, dizziness, lightheadedness, loss of consciousness, coma, and even death in humans. Respiratory effects of overexposure may include nose, throat, and lung irritation, coughing, wheezing, and shortness of breath. Direct and prolonged contact with liquid may cause dryness and redness of the skin. Long-term or repeated overexposure to n-hexane can cause peripheral nerve damage. Initial signs are numbness of the fingers and toes. Motor/muscle weakness can occur in the digits, but may also involve muscles of the arms, forearms, and thighs. Onset of these signs may be delayed for several months to a year after initial exposure. Repeated and sustained inhalation exposure to high vapor concentrations of n-hexane resulted in degenerative changes in the testes and reduced sperm count in male laboratory rats.

CUMENE: High airborne concentrations of cumene may cause irritation of the eyes, skin, and respiratory tract. Excessive exposures may cause central nervous system effects. Lifetime inhalation exposure of mice to cumene resulted in lung tumors in both males and females and liver tumors in females. Rats similarly exposed to cumene exhibited male-specific kidney tumors.

1,2,4-TRIMETHYLBENZENE: Contact with eyes can cause serious eye irritation, redness, and pain. Brief inhalation exposure to high vapor concentrations may cause respiratory irritation. Overexposure by inhalation and ingestion can cause confusion, dizziness, drowsiness, headache, vomiting, cough, and sore throat. Long-term overexposure has been associated with asthmatic bronchitis. Direct prolonged skin contact can cause irritation, redness and dry skin.

ETHYLBENZENE: Lifetime exposure studies of rodents to ethylbenzene reported elevated kidney tumors in male and female rats exposed to the highest concentration tested. Tumors of the lungs were elevated in male mice and in the livers of females exposed at the highest concentration tested. Effects on the liver, kidney, lung, thyroid, and pituitary of these animals as well. Laboratory

animal studies (rats) demonstrated hearing loss in combination with exposure to noise.

NAPHTHALENE: Excessive exposure to naphthalene may cause nausea, vomiting, diarrhea, blood in the urine, and a yellow color to the skin. Lifetime inhalation exposure of laboratory rodents to naphthalene resulted in cancers of the respiratory tract in male and female rats. A small increase in cancer of the lung was observed in female mice, but no evidence of lung cancer was observed in male mice. Long-term exposure to excessive airborne naphthalene concentrations may result in destruction of red blood cells, a condition referred to as hemolytic anemia.

CARBON MONOXIDE: Chemical asphyxiant with no warning properties (such as odor). At 400-500 ppm for 1 hour headache and dyspnea may occur. If activity is increased, symptoms of overexposure may include nausea, irritability, increased respiration, tinnitus, sweating, chest pain, confusion, impaired judgement, dizziness, weakness, drowsiness, ataxia, irregular heart beat, cyanosis and pallor. Levels in excess of 1000 ppm can result in collapse, loss of conciousness, respiratory failure and death. Extremely high concentrations (12,800 ppm) can cause immediate unconsciousness and death in 1-3 minutes. Repeated anoxia can lead to central nervous system damage and peripheral neuropathy, with loss of sensation in the fingers, amnesia, and mental deterioration and possible congestive heart failure. Damage may also occur to the fetus, lung, liver, kidney, spleen, cardiovascular system and other organs.

COMBUSTION ENGINE EXHAUST: Lifetime inhalation studies with laboratory animals exposed to gasoline engine exhaust did not produce any carcinogenic effects in mice, rats, or hamsters. Laboratory animal skin painting studies of gasoline engine exhaust condensates/extracts produced an increase in tumors.

Adverse effects related to the physical, chemical and toxicological characteristics

Signs and symptoms Irritating to the skin and mucous membranes. Symptoms may include redness, itching, and inflammation. May cause nausea, vomiting, diarrhea, and signs of nervous system depression: headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue. Aspiration hazard. May cause coughing, chest pains, shortness of breath, pulmonary edema and/or chemical pneumonitis. Prolonged or repeated exposure may cause damage to organs. Repeated or prolonged skin contact may cause drying, reddening, itching and cracking.

Acute toxicity None known.

Skin corrosion/irritation Causes skin irritation.

Serious eye damage/eye irritation None known.

Sensitization None known.

Mutagenic effects May cause genetic defects.

Carcinogenicity May cause cancer.

Name	ACGIH (Class)	IARC (Class)	NTP	OSHA
Gasoline 86290-81-5	Confirmed animal carcinogen (A3)	Possible human carcinogen (2B)	Not Listed	Not Listed
Toluene 108-88-3	Not classifiable (A4)	Not classifiable (3)	Not Listed	Not Listed
Xylene (mixed isomers) 1330-20-7	Not classifiable (A4)	Not classifiable (3)	Not Listed	Not Listed
Benzene 71-43-2	Confirmed human carcinogen (A1)	Carcinogenic to humans (1)	Known to be human carcinogen	Known carcinogen
Cumene 98-82-8	Not Listed	Possible human carcinogen (2B)	Reasonably anticipated to be a human carcinogen	Not Listed
Ethylbenzene 100-41-4	Confirmed animal carcinogen (A3)	Possible human carcinogen (2B)	Not Listed	Not Listed
Naphthalene 91-20-3	Confirmed animal carcinogen (A3)	Possible human carcinogen (2B)	Reasonably anticipated to be a human carcinogen	Not Listed

Reproductive toxicity Suspected of damaging fertility or the unborn child.

Specific Target Organ Toxicity (STOT) - single exposure May cause respiratory irritation. May cause drowsiness or dizziness.

Specific Target Organ Toxicity (STOT) - repeated exposure Causes damage to organs (blood, blood-forming organs, immune system) through prolonged or repeated exposure.

Aspiration hazard May be fatal if swallowed or vomited and enters airways.

12. ECOLOGICAL INFORMATION

Ecotoxicity This product should be considered toxic to aquatic organisms, with the potential to cause long lasting adverse effects in the aquatic environment.

Name	Fish	Crustacea	Algae/aquatic plants
Gasoline 86290-81-5	96-hr LC50 = 11 mg/l Rainbow trout (static)	48-hr LC50 = 7.6 mg/l Daphnia magna	72-hr EC50 = 56 mg/l Algae
Heptane (mixed isomers) 142-82-5	96-hr LC50 = 375 mg/L Tilapia	-	-
Toluene 108-88-3	96-hr LC50 <= 10 mg/l Rainbow trout	48-hr EC50 = 5.46-9.83 mg/l Daphnia magna 48-hr EC50 = 11.5 mg/l Daphnia magna (Static)	72-hr EC50 = 12.5 mg/l Algae
Pentane (mixed isomers) 109-66-0	96-hr LC50 >1 - <10 mgL Rainbow trout	48-hr EC50 = 9.7 mg/L Daphnia magna	-
Xylene (mixed isomers) 1330-20-7	96-hr LC50 = 8 mg/l Rainbow trout	48-hr LC50 = 3.82 mg/l Daphnia magna	72-hr EC50 = 11 mg/l Algae
Benzene 71-43-2	96-hr LC50 = 5.3 mg/l Rainbow trout (flow-through)	48-hr EC50 = 8.76-15.6 mg/l Daphnia magna (Static)	72-hr EC50 = 29 mg/l Algae
n-Hexane 110-54-3	96-hr LC50 = 2.5 mg/l Fathead minnow	-	-
Cumene 98-82-8	96-hr LC50 = 6.04-6.61 mg/l Fathead minnow (Flow-through) 96-hr LC50 = 2.7 mg/l Rainbow trout (semi-static)	48-hr EC50 = 7.9-14.1 mg/l Daphnia magna (static)	72-hr EC50 = 2.6 mg/l Algae
1,2,4 Trimethylbenzene 95-63-6	96-hr LC50 = 7.19-8.28 mg/l Fathead minnow (flow-through)	48-hr EC50 = 6.14 mg/L Daphnia magna	-
Ethylbenzene 100-41-4	96-hr LC50 = 4 mg/L Rainbow trout	48-hr EC50 = 1-4 mg/L Daphnia magna	72-hr EC50 = 1.7-7.6 mg/l Algae
Cyclohexane 110-82-7	96-hr LC50 = 3.96-5.18 mg/l Fathead minnow	48-hr EC50 = 1.7-3.5 mg/L Bay shrimp	72-hr EC50 = 500 mg/l Algae
Octane 111-65-9	-	48-hr LC50 = 0.38 mg/l Daphnia magna	-
1,2,3-Trimethylbenzene 526-73-8	96-hr LC50 = 7.72 mg/l Fathead Minnow (flow-through)	-	-
Naphthalene 91-20-3	96-hr LC50 = 0.91-2.82 mg/l Rainbow trout (static) 96-hr LC50 = 1.99 mg/l Fathead minnow (static)	48-hr LC50 = 1.6 mg/l Daphnia magna	-

Persistence and degradability Expected to be inherently biodegradable.

Bioaccumulation Has the potential to bioaccumulate.

Mobility in soil May partition into air, soil and water.

Other adverse effects No information available.

13. DISPOSAL CONSIDERATIONS

Description of waste residues This material may be a flammable liquid waste.

Safe handling of wastes Handle in accordance with applicable local, state, and federal regulations. Use personal protection measures as required. Use appropriate grounding and bonding practices. Use only non-sparking tools. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. No smoking.

Disposal of wastes / methods of disposal The user is responsible for determining if any discarded material is a hazardous waste (40 CFR 262.11). Dispose of in accordance with federal, state and local regulations.

Contaminated packaging disposal Empty containers should be completely drained and then discarded or recycled, if possible. Do not cut, drill, grind or weld on empty containers since explosive residues may be present. Dispose of in accordance with federal, state and local regulations.

14. TRANSPORT INFORMATION

DOT

UN/Identification No:	UN 1203
UN Proper Shipping Name:	Gasoline
Transport Hazard Class(es):	3
Packing Group:	II

IATA

UN/Identification No:	UN 1203
UN Proper Shipping Name:	Gasoline
Transport Hazard Class(es):	3
Packing Group:	II
ERG code:	3H

IMDG

UN/Identification No:	UN 1203
UN Proper Shipping Name:	Gasoline
Transport Hazard Class(es):	3
Packing Group:	II
EmS No:	F-E, S-E
Marine Pollutant:	Yes

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code
Not applicable

15. REGULATORY INFORMATION

Regulatory Information

US TSCA Chemical Inventory This product and/or its components are listed on the TSCA Chemical Inventory or are exempt.

Canada DSL/NDSL Inventory This product and/or its components are listed either on the Domestic Substances List (DSL) or are exempt.

EPA Superfund Amendment & Reauthorization Act (SARA)

SARA Section 302 This product does not contain any component(s) included on EPA's Extremely Hazardous Substance (EHS) List above the de minimis threshold.

SARA Section 304

This product may contain component(s) identified either as an EHS or a CERCLA Hazardous substance which in case of a spill or release may be subject to SARA reporting requirements:

Name	Hazardous Substances RQs
Toluene 108-88-3	1000 lb 454 kg
Xylene (mixed isomers) 1330-20-7	100 lb 45.4 kg
Benzene 71-43-2	10 lb 4.54 kg
n-Hexane 110-54-3	5000 lb 2270 kg
Cumene 98-82-8	5000 lb 2270 kg
Ethylbenzene 100-41-4	1000 lb 454 kg
Cyclohexane 110-82-7	1000 lb 454 kg
Naphthalene 91-20-3	100 lb 45.4 kg

SARA Section 311/312

The following EPA hazard categories apply to this product:

Flammable
Hazard Not Otherwise Classified (HNOC)-Physical
Skin corrosion or irritation
Germ cell mutagenicity
Carcinogenicity
Reproductive toxicity
Specific target organ toxicity
Aspiration hazard

SARA Section 313

This product may contain component(s), which if in exceedance of the de minimus threshold, may be subject to the reporting requirements of SARA Title III Section 313 Toxic Release Reporting (Form R).

Name	CERCLA/SARA 313 Emission reporting
Toluene 108-88-3	1.0 % de minimis concentration
Xylene (mixed isomers) 1330-20-7	1.0 % de minimis concentration
Benzene 71-43-2	0.1 % de minimis concentration
n-Hexane 110-54-3	1.0 % de minimis concentration
Cumene 98-82-8	1.0 % de minimis concentration
1,2,4 Trimethylbenzene 95-63-6	1.0 % de minimis concentration
Ethylbenzene 100-41-4	0.1 % de minimis concentration
Cyclohexane 110-82-7	1.0 % de minimis concentration
Naphthalene 91-20-3	0.1 % de minimis concentration

U.S. State Regulations

California Proposition 65

This product can expose you to chemicals which are known to the State of California to

cause cancer, birth defects or other reproductive harm.

Name	California Proposition 65
Gasoline 86290-81-5	Unleaded (wholly vaporized), Carcinogen, initial date 04/01/88 Engine exhaust, Carcinogen, initial date 10/01/90
Toluene 108-88-3	Developmental toxicity, initial date 01/01/91
Benzene 71-43-2	Carcinogen, initial date 02/27/87 Male developmental toxicity, initial date 12/26/97
n-Hexane 110-54-3	Male reproductive toxicity, initial date 12/15/17
Cumene 98-82-8	Carcinogen, initial date 04/06/10
Ethylbenzene 100-41-4	Carcinogen, initial date 06/11/04
Naphthalene 91-20-3	Carcinogen, initial date 04/19/02

For more information, go to www.P65Warnings.ca.gov.

State Right-To-Know Regulations The following component(s) of this material are identified on the regulatory lists below:

Name	New Jersey Right-To-Know	Pennsylvania Right-To-Know	Massachusetts Right-To Know
Gasoline 86290-81-5	Listed	Listed	Listed
Heptane (mixed isomers) 142-82-5	Listed	Listed	Listed
Toluene 108-88-3	Listed	Listed	Listed
Pentane (mixed isomers) 109-66-0	Listed	Listed	Listed
Butane (mixed isomers) 106-97-8	Listed	Listed	Listed
Hexane Isomers (other than n-Hexane) 107-83-5	Listed	Listed	Listed
Xylene (mixed isomers) 1330-20-7	Listed	Listed	Listed
Benzene 71-43-2	Listed	Listed	Listed
n-Hexane 110-54-3	Listed	Listed	Listed
Cumene 98-82-8	Listed	Listed	Listed
1,2,4 Trimethylbenzene 95-63-6	Listed	Listed	Listed
Ethylbenzene 100-41-4	Listed	Listed	Listed
Cyclohexane 110-82-7	Listed	Listed	Listed
Octane 111-65-9	Listed	Listed	Listed
Naphthalene 91-20-3	Listed	Listed	Listed

16. OTHER INFORMATION

Prepared by Toxicology & Product Safety

NFPA



Revision Notes

Revision date	07/07/2020
Previous publish date	11/06/2017
Revised sections	The following sections (§) have been updated: 3. COMPOSITION/INFORMATION ON INGREDIENTS 11. TOXICOLOGICAL INFORMATION 14. TRANSPORT INFORMATION 15. REGULATORY INFORMATION

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information is intended as guidance for safe handling, use, processing, storage, transportation, accidental release, clean-up and disposal and is not considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

SAFETY DATA SHEET

SDS ID NO.: 0157MAR019 **Revision date** 12/28/2021

1. IDENTIFICATION

Product Name	Marathon Petroleum Toluene
Synonym	Toluene; Toluol; Methyl Benzene; ARU Toluene
Product code	0157MAR019
Chemical family	Aromatic Hydrocarbon
Recommended use	Solvent. Chemical intermediate. Gasoline blending.
Restrictions on use	All others. Prohibited for use in the formulation or manufacture of pesticide products.
Manufacturer, Importer, or Responsible Party Name and Address	**MARATHON PETROLEUM COMPANY LP** **539 South Main Street** **Findlay, OH 45840**
SDS Information	1-419-421-3070 (M-F; 8-5 EST)
24 Hour Emergency Telephone	CHEMTREC: 1-800-424-9300 (CCN# 13740)

2. HAZARD IDENTIFICATION

OSHA Regulatory Status
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Classification

Flammable liquids	Category 2
Skin corrosion/irritation	Category 2
Germ cell mutagenicity	Category 1B
Carcinogenicity	Category 1A
Reproductive toxicity	Category 2
Specific target organ toxicity (single exposure)	Category 3
Specific target organ toxicity (repeated exposure)	Category 2
Aspiration toxicity	Category 1

Hazards Not Otherwise Classified (HNOC)
Static accumulating flammable liquid

Label Elements

Danger

HIGHLY FLAMMABLE LIQUID AND VAPOR
May accumulate electrostatic charge and ignite or explode
May be fatal if swallowed and enters airways
Causes skin irritation
May cause respiratory irritation
May cause drowsiness or dizziness
May cause genetic defects
May cause cancer
Suspected of damaging fertility or the unborn child
May cause damage to organs (auditory system, nervous system) through prolonged or repeated exposure



Appearance Clear Liquid **Physical State** Liquid **Odor** Sweet , benzene

Precautionary Statements - Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools.
Take precautionary measures against static discharge
Do not breathe mist/vapors/spray
Use only outdoors or in a well-ventilated area
Wash hands and any possibly exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection
Avoid release to the environment

Precautionary Statements - Response
If exposed, concerned or you feel unwell: Get medical attention
If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
If skin irritation occurs: Get medical attention
Take off contaminated clothing and wash before reuse
If inhaled: Remove person to fresh air and keep at rest in a position comfortable for breathing
Call a poison center or doctor if you feel unwell
If swallowed: Immediately call a poison center or doctor
Do NOT induce vomiting
In case of fire: Use water spray, fog or regular foam for extinction

Precautionary Statements - Storage
Store in a well-ventilated place. Keep container tightly closed
Keep cool
Store locked up

Precautionary Statements - Disposal
Dispose of contents/container at an approved waste disposal plant

3. COMPOSITION/INFORMATION ON INGREDIENTS

Toluene is a seven carbon aromatic petroleum hydrocarbon.

Composition Information

Name	CAS Number	% Concentration
Toluene	108-88-3	86-100
Xylene (mixed isomers)	1330-20-7	0-7.5
Ethylbenzene	100-41-4	0-5.1
Benzene	71-43-2	0-0.8

All concentrations are percent by weight unless material is a gas. Gas concentrations are in percent by volume.

4. FIRST AID MEASURES

First aid measures

General advice

In case of accident or if you feel unwell, seek medical advice immediately (show directions for use or safety data sheet if possible).

Inhalation

Remove to fresh air. If not breathing, utilize bag valve mask or other form of barrier device to institute rescue breathing. If breathing is difficult, ensure airway is clear, give oxygen and continue to monitor. If heart has stopped, immediately begin cardiopulmonary resuscitation (CPR). Keep affected person warm and at rest. Get immediate medical attention.

Skin contact

Immediately wash exposed skin with plenty of soap and water while removing contaminated clothing and shoes. Get medical attention if irritation persists. Place contaminated clothing in closed container until cleaned or discarded. If clothing is to be laundered, inform the person performing the operation of contaminant's hazardous properties.

Eye contact

Flush immediately with large amounts of water for at least 15 minutes. Gently remove contacts while flushing. Eyelids should be held away from the eyeball to ensure thorough rinsing. Gently remove contacts while flushing. Get immediate medical attention.

Ingestion

Do not induce vomiting because of danger of aspirating liquid into lungs, causing serious damage and chemical pneumonitis. If spontaneous vomiting occurs, keep head below hips, or if patient is lying down, turn body and head to side to prevent aspiration and monitor for breathing difficulty. Never give anything by mouth to an unconscious person. Keep affected person warm and at rest. Get immediate medical attention.

Most important signs and symptoms, both short-term and delayed with overexposure

Adverse effects

Irritating to the skin and mucous membranes. Symptoms may include redness, itching, and inflammation. May cause nausea, vomiting, diarrhea, and signs of nervous system depression: headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue. Aspiration hazard. May cause coughing, chest pains, shortness of breath, pulmonary edema and/or chemical pneumonitis. Prolonged or repeated exposure may cause adverse effects on the nervous system and auditory organs. Repeated or prolonged skin contact may cause drying, reddening, itching and cracking.

Indication of any immediate medical attention and special treatment needed

Notes to physician

INHALATION: This material (or a component) sensitizes the myocardium to the effects of sympathomimetic amines. Epinephrine and other sympathomimetic drugs may initiate cardiac arrhythmias in individuals exposed to this material. Administration of sympathomimetic drugs should be avoided.

INGESTION: This material represents a significant aspiration and chemical pneumonitis hazard. Induction of emesis is not recommended.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media

For small fires, Class B fire extinguishing media such as CO2, dry chemical, foam or water spray can be used. For large fires, water spray, fog or foam can be used. Firefighting should be attempted only by those who are adequately trained and equipped with proper protective equipment.

Unsuitable extinguishing media

Do not use straight water streams to avoid spreading fire.

Specific hazards arising from the chemical

This product has been determined to be a highly flammable liquid per the OSHA Hazard Communication Standard and should be handled accordingly. Vapors may travel along the ground or be moved by ventilation and ignited by many sources such as pilot lights, sparks, electric motors, static discharge, or other ignition sources at locations distant from material handling. Flashback can occur along vapor trail. For additional fire related information, see

NFPA 30 or the Emergency Response Guidebook 130.

Hazardous combustion products Smoke, carbon monoxide, and other products of incomplete combustion.

Explosion data

Sensitivity to mechanical impact: No.

Sensitivity to static discharge: Yes.

Special protective equipment and precautions for firefighters Firefighters should wear full protective clothing and positive-pressure self-contained breathing apparatus (SCBA) with a full face-piece, as appropriate. Avoid using straight water streams. Water may be ineffective in extinguishing low flash point fires, but can be used to cool exposed surfaces. Avoid excessive water spray application. Water spray and foam must be applied carefully to avoid frothing and from as far a distance as possible. Keep run-off water out of sewers and water sources.

Additional firefighting tactics FIRES INVOLVING TANKS OR CAR/TRAILER LOADS: Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Cool containers with flooding quantities of water until well after the fire is out. Do not direct water at source of leak or safety devices; icing may occur. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles: if this is impossible, withdraw from area and let fire burn.

EVACUATION: Consider initial downwind evacuation for at least 1000 feet. If tank, rail car or tank truck is involved in a fire, ISOLATE for 5280 feet (1 mile) in all directions; also, consider initial evacuation of 5280 feet (1 mile) in all directions.

NFPA	Health 2	Flammability 3	Instability 0	Special Hazard -

6. ACCIDENTAL RELEASE MEASURES

Personal precautions Keep public away. Isolate and evacuate area. Shut off source if safe to do so. Eliminate all ignition sources.

Protective equipment Use personal protective equipment (See section 8).

Emergency procedures Advise authorities and National Response Center (800-424-8802) if the product has entered a water course or sewer. Notify local health and pollution control agencies, if appropriate.

Environmental precautions Avoid release to the environment. Avoid subsoil penetration.

Methods and materials for containment Contain liquid with sand or soil.

Methods and materials for cleaning up Use suitable absorbent materials such as vermiculite, sand, or clay to clean up residual liquids. Recover and return free product to proper containers. When recovering free liquids ensure all equipment is grounded and bonded. Use only non-sparking tools.

7. HANDLING AND STORAGE

Safe handling precautions Do not expose to heat, open flames, strong oxidizers or other sources of ignition. No smoking. Use appropriate grounding and bonding practices. Static accumulating flammable liquid. Bonding and grounding may be insufficient to eliminate the hazard from static electricity. Use only non-sparking tools. Avoid contact with eyes, skin and clothing. Avoid breathing vapors or mists. Use only with adequate ventilation. Avoid repeated and prolonged skin contact. Use personal protection measures as recommended in Section 8. Do not cut, drill, grind or weld on empty containers since explosive residues may remain. Refer to applicable EPA, OSHA, NFPA and consistent state and local requirements.

Hydrocarbons are basically non-conductors of electricity and can become electrostatically charged during mixing, filtering, pumping at high flow rates or loading and transfer operations. If this charge reaches a sufficiently high level, sparks can form that may ignite the vapors of flammable liquids. Sudden release of hot organic chemical vapors or mists from process equipment operating under elevated temperature and pressure, or sudden ingress of air into vacuum equipment may result in ignition of vapors or mists without the presence of obvious ignition sources. Nozzle spouts must be kept in contact with the containers or tank during the entire filling operation.

Storage conditions Store in properly closed containers that are appropriately labeled and in a cool, well-ventilated area.

Incompatible materials Strong oxidizing agents.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Name	ACGIH TLV	OSHA PELS	NIOSH IDLH
Toluene 108-88-3	20 ppm TWA OTO - potential to cause hearing impairment alone or in combination with noise	TWA: 200 ppm Ceiling: 300 ppm	500 ppm
Xylene (mixed isomers) 1330-20-7	100 ppm TWA 150 ppm STEL	TWA: 100 ppm TWA: 435 mg/m^3	900 ppm
Ethylbenzene 100-41-4	20 ppm TWA	TWA: 100 ppm TWA: 435 mg/m^3	800 ppm
Benzene 71-43-2	0.5 ppm TWA 2.5 ppm STEL Skin - potential significant contribution to overall exposure by the cutaneous route	TWA: 1 ppm STEL: 5 ppm TWA: 10 ppm (applies to industry segments exempt from the benzene standard) (see 29 CFR 1910.1028)	500 ppm

Notes: No further information available.

Engineering measures Local or general exhaust required in an enclosed area or when there is inadequate ventilation. Use mechanical ventilation equipment that is explosion-proof.

Personal protective equipment

Eye protection Use goggles or face-shield if there is a potential for splashing.

Skin and body protection Viton® gloves should be used to prevent skin contact. Glove suitability is based on workplace conditions and usage. Contact the glove manufacturer for specific advice on glove selection and breakthrough times.

Respiratory protection Approved organic vapor chemical cartridge or supplied air respirators should be worn for exposures to any components exceeding the established exposure limits. Observe respirator assigned protection factors (APFs) criteria cited in federal OSHA 29 CFR 1910.134. Self-contained breathing apparatus should be used for fire fighting.

Hygiene measures Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes and clothing.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Appearance Clear Liquid
Physical State Liquid
Color Colorless
Odor Sweet , benzene

Odor Threshold	2.9 ppmv

Property	**Values (method)**
pH	Not applicable.
Melting Point / Freezing Point	-95 °C / -139 °F
Initial Boiling Point / Boiling Range	110 °C / 231 °F
Flash Point	4.8 °C / 40.7 °F
Evaporation Rate	1.9 (Butyl Acetate = 1)
Flammability (solid, gas)	No available data.
Flammability Limit in Air (%):	
Upper Flammability Limit:	7.1
Lower Flammability Limit:	1.2
Explosion Limits	No data available.
Vapor Pressure	1.03 psi @ 100°F
Vapor Density	3.1 (Air = 1)
Specific Gravity / Relative Density	0.86-0.88
Water Solubility	No data available.
Partition Coefficient	No data available.
Autoignition Temperature	480 °C / 896 °F
Decomposition Temperature	No data available.
Kinematic Viscosity	0.56 cSt @ 100°F
VOC Content (%)	No data available.
Softening Point	Not applicable.
Bulk Density	Not applicable.

10. STABILITY AND REACTIVITY

Reactivity	The product is non-reactive under normal conditions.
Chemical stability	The material is stable at 70°F (21°C), 760 mmHg pressure.
Possibility of hazardous reactions	None under normal processing.
Hazardous polymerization	Will not occur.
Conditions to avoid	Sources of heat or ignition.
Incompatible materials	Strong oxidizing agents.
Hazardous decomposition products	None known under normal conditions of use.

11. TOXICOLOGICAL INFORMATION

Potential short-term adverse effects from overexposures

Inhalation	May cause irritation of respiratory tract. May cause drowsiness or dizziness. Breathing high concentrations of this material, for example, in a confined space or by intentional abuse, can cause irregular heartbeats which can cause death.
Eye contact	Contact with eyes may cause irritation.
Skin contact	Irritating to skin. Repeated exposure may cause skin dryness or cracking.
Ingestion	May be fatal if swallowed or vomited and enters airways. May cause irritation of the mouth, throat and gastrointestinal tract.

Acute toxicological data

Name	Oral LD50	Dermal LD50	Inhalation LC50
Toluene 108-88-3	> 2000 mg/kg (Rat)	8390 mg/kg (Rabbit)	12.5 mg/L (Rat) 4 h

Xylene (mixed isomers) 1330-20-7	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 5.04 mg/L (Rat) 4 h
Ethylbenzene 100-41-4	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	17.2 mg/L (Rat) 4 h
Benzene 71-43-2	> 2000 mg/kg (Rat)	> 5000 mg/kg (Rabbit)	> 20 mg/l (Rat) 4 h

Immediate and delayed effects as well as chronic effects from short and long-term exposure

TOLUENE: Inhalation abuse of toluene at high concentrations has been associated with adverse effects on the liver, kidney and nervous system, and can cause nervous system depression, cardiac arrhythmias, and death. Studies of workers indicate long-term exposure may be related to impaired color vision and hearing. Some studies of workers suggest long-term exposure may be associated with neurobehavioral and mental functional changes. Laboratory animal studies indicate some changes in reproductive organs after exposure to high airborne concentrations, but no significant effects on mating performance or reproduction were observed. Positive findings include small increases in minor skeletal and visceral malformations and developmental delays following maternal exposure to high concentrations. Adverse effects on the liver, kidney, thymus and nervous system of laboratory animal were observed after very high levels of prolonged and repeated exposure.

XYLENE: Overexposure to airborne xylene may cause upper respiratory tract irritation, headache, cyanosis, blood serum changes, nervous system damage and narcosis. Impaired neurological function has been reported in workers exposed to solvents including xylene. Laboratory animal studies have shown evidence of impaired hearing after prolonged exposure high airborne concentrations. Laboratory animal studies suggest some changes in reproductive organs after exposure to high airborne concentrations of xylene without an effect on reproduction. Skeletal and visceral malformations, developmental delays, and increased fetal resorptions were observed in laboratory animals after extremely high airborne concentrations with evidence of maternal toxicity. Adverse effects on the liver, kidney, and bone marrow were observed in laboratory animals after prolonged and repeated exposure to high airborne concentrations of xylene.

ETHYLBENZENE: Lifetime exposure studies of rodents to ethylbenzene reported elevated kidney tumors in male and female rats exposed to the highest concentration tested. Tumors of the lungs were elevated in male mice and in the livers of females exposed at the highest concentration tested. Effects on the liver, kidney, lung, thyroid, and pituitary of these animals as well. Laboratory animal studies (rats) demonstrated hearing loss in combination with exposure to noise.

BENZENE: Benzene exposure may cause skin, eye and respiratory irritation. Excessive exposures may cause central nervous system effects. Numerous studies of workers exposed to airborne benzene for prolonged or repeated periods show strong evidence that overexposure can cause cancer of the blood, AML (acute myeloid leukemia), along with other disorders indicating damage to the blood forming organs including aplastic anemia, leukopenia, thrombocytopenia, and the development of myelodysplastic syndrome. Some studies of pregnant women occupationally exposed to benzene suggest associations with an increased risk of miscarriage, stillbirth, reduced birth weight, and gestational age. Prolonged and repeated exposure to benzene has induced chromosomal aberrations in circulating human lymphocytes, in bone marrow cells of laboratory animals, and in sperm cells of both humans and laboratory animals.

Adverse effects related to the physical, chemical and toxicological characteristics

Signs and symptoms Irritating to the skin and mucous membranes. Symptoms may include redness, itching, and inflammation. May cause nausea, vomiting, diarrhea, and signs of nervous system depression: headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue. Aspiration may cause coughing, chest pains, shortness of breath, pulmonary edema and/or chemical pneumonitis. Prolonged or repeated exposure may cause damage to organs. Repeated exposure may cause skin dryness or cracking.

Acute toxicity None known.

Skin corrosion/irritation Causes skin irritation.

Serious eye damage/eye irritation None known.

Sensitization None known.

Mutagenic effects May cause genetic defects.

Carcinogenicity May cause cancer.

Name	ACGIH	IARC	NTP	OSHA

	(Class)	(Class)		
Toluene 108-88-3	Not classifiable (A4)	Not classifiable (3)	Not Listed	Not Listed
Xylene (mixed isomers) 1330-20-7	Not classifiable (A4)	Not classifiable (3)	Not Listed	Not Listed
Ethylbenzene 100-41-4	Confirmed animal carcinogen (A3)	Possible human carcinogen (2B)	Not Listed	Not Listed
Benzene 71-43-2	Confirmed human carcinogen (A1)	Carcinogenic to humans (1)	Known to be human carcinogen	Known carcinogen

Reproductive toxicity Suspected of damaging fertility or the unborn child.

Specific Target Organ Toxicity (STOT) - single exposure May cause respiratory irritation. May cause drowsiness or dizziness.

Specific Target Organ Toxicity (STOT) - repeated exposure May cause damage to organs (nervous system, auditory system) through prolonged or repeated exposure.

Aspiration hazard May be fatal if swallowed and enters airways.

12. ECOLOGICAL INFORMATION

Ecotoxicity This product should be considered toxic to aquatic organisms. May cause long lasting harmful effects to aquatic life.

Name	Fish	Crustacea	Algae/aquatic plants
Toluene 108-88-3	96-hr LC50 <= 10 mg/l Rainbow trout	48-hr EC50 = 5.46-9.83 mg/l Daphnia magna 48-hr EC50 = 11.5 mg/l Daphnia magna (Static)	72-hr EC50 = 12.5 mg/l Algae
Xylene (mixed isomers) 1330-20-7	96-hr LC50 = 8 mg/l Rainbow trout	48-hr LC50 = 3.82 mg/l Daphnia magna	72-hr EC50 = 11 mg/l Algae
Ethylbenzene 100-41-4	96-hr LC50 = 4 mg/L Rainbow trout	48-hr EC50 = 1-4 mg/L Daphnia magna	72-hr EC50 = 1.7-7.6 mg/l Algae
Benzene 71-43-2	96-hr LC50 = 5.3 mg/l Rainbow trout (flow-through)	48-hr EC50 = 8.76-15.6 mg/l Daphnia magna (Static)	72-hr EC50 = 29 mg/l Algae

Persistence and degradability Readily biodegradable in the environment.

Bioaccumulation Not expected to bioaccumulate in aquatic organisms.

Mobility in soil May partition into air, soil and water.

Other adverse effects No information available.

13. DISPOSAL CONSIDERATIONS

Description of waste residues This material may be a flammable liquid waste.

Safe handling of wastes Handle in accordance with applicable local, state, and federal regulations. Use personal protection measures as required. Use appropriate grounding and bonding practices. Use only non-sparking tools. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. No smoking.

Disposal of wastes / methods of disposal The user is responsible for determining if any discarded material is a hazardous waste (40 CFR 262.11). Dispose of in accordance with federal, state and local regulations.

Contaminated packaging disposal Empty containers should be completely drained and then discarded or recycled, if possible. Do not cut, drill, grind or weld on empty containers since explosive residues may be present. Dispose of in accordance with federal, state and local regulations.

14. TRANSPORT INFORMATION

DOT

UN/Identification No:	UN 1294
UN Proper Shipping Name:	Toluene
Transport Hazard Class(es):	3
Packing Group:	II

IATA

UN/Identification No:	UN 1294
UN Proper Shipping Name:	Toluene
Transport Hazard Class(es):	3
Packing Group:	II
ERG code:	3L

IMDG

UN/Identification No:	UN 1294
UN Proper Shipping Name:	Toluene
Transport Hazard Class(es):	3
Packing Group:	II
EmS No:	F-E, S-D
Marine Pollutant:	No

15. REGULATORY INFORMATION

Regulatory Information

US TSCA Chemical Inventory This product and/or its components are listed on the TSCA Chemical Inventory or are exempt.

Canada DSL/NDSL Inventory This product and/or its components are listed either on the Domestic Substances List (DSL) or are exempt.

EPA Superfund Amendment & Reauthorization Act (SARA)

SARA Section 302 This product does not contain any component(s) included on EPA's Extremely Hazardous Substance (EHS) List above the de minimis threshold.

SARA Section 304 This product may contain component(s) identified either as an EHS or a CERCLA Hazardous substance which in case of a spill or release may be subject to SARA reporting requirements:

Name	Hazardous Substances RQs
Toluene 108-88-3	1000 lb 454 kg
Xylene (mixed isomers) 1330-20-7	100 lb 45.4 kg
Ethylbenzene 100-41-4	1000 lb 454 kg
Benzene 71-43-2	10 lb 4.54 kg

SARA Section 311/312 The following EPA hazard categories apply to this product:

Flammable
Hazard Not Otherwise Classified (HNOC)-Physical
Skin corrosion or irritation
Germ cell mutagenicity

Carcinogenicity
Reproductive toxicity
Specific target organ toxicity
Aspiration hazard

SARA Section 313 This product may contain component(s), which if in exceedance of the de minimus threshold, may be subject to the reporting requirements of SARA Title III Section 313 Toxic Release Reporting (Form R).

Name	CERCLA/SARA 313 Emission reporting
Toluene 108-88-3	1.0 % de minimis concentration
Xylene (mixed isomers) 1330-20-7	1.0 % de minimis concentration
Ethylbenzene 100-41-4	0.1 % de minimis concentration
Benzene 71-43-2	0.1 % de minimis concentration

U.S. State Regulations

California Proposition 65 This product can expose you to chemicals which are known to the State of California to cause cancer, birth defects or other reproductive harm.

Name	California Proposition 65
Toluene 108-88-3	Developmental toxicity, initial date 01/01/91
Ethylbenzene 100-41-4	Carcinogen, initial date 06/11/04
Benzene 71-43-2	Carcinogen, initial date 02/27/87 Male developmental toxicity, initial date 12/26/97

For more information, go to www.P65Warnings.ca.gov.

State Right-To-Know Regulations The following component(s) of this material are identified on the regulatory lists below:

Name	New Jersey Right-To-Know	Pennsylvania Right-To-Know	Massachusetts Right-To Know
Toluene 108-88-3	Listed	Listed	Listed
Xylene (mixed isomers) 1330-20-7	Listed	Listed	Listed
Ethylbenzene 100-41-4	Listed	Listed	Listed
Benzene 71-43-2	Listed	Listed	Listed

16. OTHER INFORMATION

Prepared by Toxicology & Product Safety

NFPA



Revision Notes

Revision date	12/28/2021
Previous publish date	11/06/2017

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information is intended as guidance for safe handling, use, processing, storage, transportation, accidental release, clean-up and disposal and is not considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

SAFETY DATA SHEET

SDS ID NO.: 0158MAR019 **Revision date** 12/28/2021

1. IDENTIFICATION

Product Name Marathon Petroleum Xylene

Synonym Xylene; Mixed Xylenes, Dimethyl Benzene; Methyl Toluene; Para-Rich Xylene; ARU Xylene
Product code 0158MAR019
Chemical family Aromatic Hydrocarbon

Recommended use Solvent. Chemical intermediate. Gasoline blending.
Restrictions on use All others.

Manufacturer, Importer, or Responsible Party Name and Address

MARATHON PETROLEUM COMPANY LP
539 South Main Street
Findlay, OH 45840

SDS Information 1-419-421-3070 (M-F; 8-5 EST)

24 Hour Emergency Telephone 1-877-627-5463

2. HAZARD IDENTIFICATION

OSHA Regulatory Status
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Classification

Flammable liquids	Category 3
Skin corrosion/irritation	Category 2
Serious eye damage/eye irritation	Category 2A
Carcinogenicity	Category 2
Reproductive toxicity	Category 2
Specific target organ toxicity (single exposure)	Category 3
Specific target organ toxicity (repeated exposure)	Category 2
Aspiration toxicity	Category 1

Hazards Not Otherwise Classified (HNOC)
Static accumulating flammable liquid

Label Elements

Danger

FLAMMABLE LIQUID AND VAPOR
May accumulate electrostatic charge and ignite or explode
May be fatal if swallowed and enters airways
Causes skin irritation
Causes serious eye irritation
May cause respiratory irritation
May cause drowsiness or dizziness
Suspected of causing cancer
Suspected of damaging the unborn child
May cause damage to organs (auditory system, nervous system) through prolonged or repeated exposure



Appearance Clear Liquid **Physical State** Liquid **Odor** Sweet Aromatic

Precautionary Statements - Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools.
Take precautionary measures against static discharge
Wear protective gloves/protective clothing/eye protection/face protection
Do not breathe mist/vapors/spray
Use only outdoors or in a well-ventilated area
Wash hands and any possibly exposed skin thoroughly after handling
Avoid release to the environment

Precautionary Statements - Response
IF exposed or concerned: Get medical attention
If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
If eye irritation persists: Get medical attention
If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
If skin irritation occurs: Get medical attention
Take off contaminated clothing and wash before reuse
If inhaled: Remove person to fresh air and keep at rest in a position comfortable for breathing
Call a poison center or doctor if you feel unwell
If swallowed: Immediately call a poison center or doctor
Do NOT induce vomiting
In case of fire: Use water spray, fog or regular foam for extinction

Precautionary Statements - Storage
Store in a well-ventilated place. Keep container tightly closed
Keep cool
Store locked up

Precautionary Statements - Disposal
Dispose of contents/container at an approved waste disposal plant

3. COMPOSITION/INFORMATION ON INGREDIENTS

Xylene is a mixture of eight carbon aromatic petroleum hydrocarbons composed of the three isomers of xylene (ortho, meta & para) and ethylbenzene.

Composition Information

Name	CAS Number	% Concentration
Xylene (mixed isomers)	1330-20-7	78-99
Ethylbenzene	100-41-4	1.5-20
Cumene	98-82-8	0-1.0
Toluene	108-88-3	0-0.7

All concentrations are percent by weight unless material is a gas. Gas concentrations are in percent by volume.

4. FIRST AID MEASURES

First aid measures

General advice

In case of accident or if you feel unwell, seek medical advice immediately (show directions for use or safety data sheet if possible).

Inhalation

Remove to fresh air. If not breathing, utilize bag valve mask or other form of barrier device to institute rescue breathing. If breathing is difficult, ensure airway is clear, give oxygen and continue to monitor. If heart has stopped, immediately begin cardiopulmonary resuscitation (CPR). Keep affected person warm and at rest. Get immediate medical attention.

Skin contact

Immediately wash exposed skin with plenty of soap and water while removing contaminated clothing and shoes. Get medical attention if irritation persists. Place contaminated clothing in closed container until cleaned or discarded. If clothing is to be laundered, inform the person performing the operation of contaminant's hazardous properties.

Eye contact

Flush immediately with large amounts of water for at least 15 minutes. Gently remove contacts while flushing. Eyelids should be held away from the eyeball to ensure thorough rinsing. Gently remove contacts while flushing. Get medical attention if irritation persists.

Ingestion

Do not induce vomiting because of danger of aspirating liquid into lungs, causing serious damage and chemical pneumonitis. If spontaneous vomiting occurs, keep head below hips, or if patient is lying down, turn body and head to side to prevent aspiration and monitor for breathing difficulty. Never give anything by mouth to an unconscious person. Keep affected person warm and at rest. Get immediate medical attention.

Most important signs and symptoms, both short-term and delayed with overexposure

Adverse effects

Acute: Headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue. Delayed: Dry skin and possible irritation with repeated or prolonged exposure.

Indication of any immediate medical attention and special treatment needed

Notes to physician

INHALATION: This material (or a component) sensitizes the myocardium to the effects of sympathomimetic amines. Epinephrine and other sympathomimetic drugs may initiate cardiac arrhythmias in individuals exposed to this material. Administration of sympathomimetic drugs should be avoided.

INGESTION: This material represents a significant aspiration and chemical pneumonitis hazard. Induction of emesis is not recommended.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media

For small fires, Class B fire extinguishing media such as CO2, dry chemical, foam or water spray can be used. For large fires, water spray, fog or foam can be used. Firefighting should be attempted only by those who are adequately trained and equipped with proper protective equipment.

Unsuitable extinguishing media

Do not use straight water streams to avoid spreading fire.

Specific hazards arising from the chemical

This product has been determined to be a flammable liquid per the OSHA Hazard Communication Standard and should be handled accordingly. May accumulate electrostatic charge and ignite or explode. Vapors may travel along the ground or be moved by ventilation and ignited by many sources such as pilot lights, sparks, electric motors, static discharge, or other ignition sources at locations distant from material handling. Flashback can occur along vapor trail. For additional fire related information, see NFPA 30 or the Emergency Response Guidebook 130.

Hazardous combustion products	Smoke, carbon monoxide, and other products of incomplete combustion.
Explosion data	
Sensitivity to mechanical impact:	No.
Sensitivity to static discharge:	No.
Special protective equipment and precautions for firefighters	Firefighters should wear full protective clothing and positive-pressure self-contained breathing apparatus (SCBA) with a full face-piece, as appropriate. Avoid using straight water streams. Water may be ineffective in extinguishing low flash point fires, but can be used to cool exposed surfaces. Avoid excessive water spray application. Water spray and foam must be applied carefully to avoid frothing and from as far a distance as possible. Keep run-off water out of sewers and water sources.
Additional firefighting tactics	FIRES INVOLVING TANKS OR CAR/TRAILER LOADS: Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Cool containers with flooding quantities of water until well after the fire is out. Do not direct water at source of leak or safety devices; icing may occur. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles: if this is impossible, withdraw from area and let fire burn. EVACUATION: Consider initial downwind evacuation for at least 1000 feet. If tank, rail car or tank truck is involved in a fire, ISOLATE for 5280 feet (1 mile) in all directions; also, consider initial evacuation of 5280 feet (1 mile) in all directions.

NFPA	Health 2	Flammability 3	Instability 0	Special Hazard -

6. ACCIDENTAL RELEASE MEASURES

Personal precautions	Keep public away. Isolate and evacuate area. Shut off source if safe to do so. Eliminate all ignition sources.
Protective equipment	Use personal protection measures as recommended in Section 8.
Emergency procedures	Advise authorities and National Response Center (800-424-8802) if the product has entered a water course or sewer. Notify local health and pollution control agencies, if appropriate.
Environmental precautions	Avoid release to the environment. Avoid subsoil penetration.
Methods and materials for containment	Contain liquid with sand or soil.
Methods and materials for cleaning up	Use suitable absorbent materials such as vermiculite, sand, or clay to clean up residual liquids. Recover and return free product to proper containers. When recovering free liquids ensure all equipment is grounded and bonded. Use only non-sparking tools.

7. HANDLING AND STORAGE

Safe handling precautions	NEVER SIPHON THIS PRODUCT BY MOUTH. Use appropriate grounding and bonding practices. Static accumulating flammable liquid. Bonding and grounding may be insufficient to eliminate the hazard from static electricity. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. No smoking. Avoid repeated and prolonged skin contact. Use personal protection measures as recommended in Section 8. Use only non-sparking tools. Do not cut, drill, grind or weld on empty containers since explosive residues may remain. Refer to applicable EPA, OSHA, NFPA and consistent state and local requirements.

Hydrocarbons are basically non-conductors of electricity and can become electrostatically charged during mixing, filtering, pumping at high flow rates or loading and transfer operations. If this charge reaches a sufficiently high level, sparks can form that may ignite the vapors of flammable liquids. Sudden release of hot organic chemical vapors or mists from process equipment operating under elevated temperature and pressure, or sudden ingress of air into vacuum equipment may result in ignition of vapors or mists without the presence of obvious ignition sources. Nozzle spouts must be kept in contact with the containers or tank during the entire filling operation.

Storage conditions Store in properly closed containers that are appropriately labeled and in a cool, well-ventilated area.

Incompatible materials Strong oxidizing agents.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Name	ACGIH TLV	OSHA PELS	NIOSH IDLH
Xylene (mixed isomers) 1330-20-7	100 ppm TWA 150 ppm STEL	TWA: 100 ppm TWA: 435 mg/m³	900 ppm
Ethylbenzene 100-41-4	20 ppm TWA	TWA: 100 ppm TWA: 435 mg/m³	800 ppm
Cumene 98-82-8	5 ppm TWA	TWA: 50 ppm TWA: 245 mg/m³ Skin	900 ppm
Toluene 108-88-3	20 ppm TWA OTO - potential to cause hearing impairment alone or in combination with noise	TWA: 200 ppm Ceiling: 300 ppm	500 ppm

Notes: No further information available.

Engineering measures Local or general exhaust required in an enclosed area or when there is inadequate ventilation. Use mechanical ventilation equipment that is explosion-proof.

Personal protective equipment

Eye protection Use goggles or face-shield if there is a potential for splashing.

Skin and body protection Viton® gloves should be used to prevent skin contact. Glove suitability is based on workplace conditions and usage. Contact the glove manufacturer for specific advice on glove selection and breakthrough times.

Respiratory protection Approved organic vapor chemical cartridge or supplied air respirators should be worn for exposures to any components exceeding the established exposure limits. Observe respirator assigned protection factors (APFs) criteria cited in federal OSHA 29 CFR 1910.134. Self-contained breathing apparatus should be used for fire fighting.

Hygiene measures Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes and clothing.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Appearance Clear Liquid
Physical State Liquid
Color Colorless
Odor Sweet Aromatic
Odor Threshold 0.4 ppmv

Property **Values (method)**

pH	Not Applicable
Melting Point / Freezing Point	-29.4 °C / -20.9 °F
Initial Boiling Point / Boiling Range	136-142 °C / 277-288 °F
Flash Point	27 °C / 81 °F
Evaporation Rate	0.76 (Butyl Acetate = 1)
Flammability (solid, gas)	No available data.
Flammability Limit in Air (%):	
Upper Flammability Limit:	7.0
Lower Flammability Limit:	0.9
Explosion Limits	No data available.
Vapor Pressure	No data available.
Vapor Density	3.66 (Air=1)
Specific Gravity / Relative Density	0.86-0.88
Water Solubility	Insoluble
Partition Coefficient	3.12-3.20 Log Kow
Autoignition Temperature	465 °C / 869 °F
Decomposition Temperature	No data available.
Kinematic Viscosity	No data available.
VOC Content (%)	No data available.
Softening Point	Not Applicable
Density	7.25 lbs/gal

10. STABILITY AND REACTIVITY

Reactivity The product is non-reactive under normal conditions.

Chemical stability The material is stable at 70°F (21°C), 760 mmHg pressure.

Possibility of hazardous reactions None under normal processing.

Hazardous polymerization Will not occur.

Conditions to avoid Sources of heat or ignition.

Incompatible materials Strong oxidizing agents.

Hazardous decomposition products None known under normal conditions of use.

11. TOXICOLOGICAL INFORMATION

Potential short-term adverse effects from overexposures

Inhalation May cause irritation of respiratory tract. May cause drowsiness or dizziness. Breathing high concentrations of this material, for example, in a confined space or by intentional abuse, can cause irregular heartbeats which can cause death.

Eye contact Irritating to eyes.

Skin contact Irritating to skin. Repeated exposure may cause skin dryness or cracking.

Ingestion May be fatal if swallowed or vomited and enters airways. May cause irritation of the mouth, throat and gastrointestinal tract.

Acute toxicological data

Name	Oral LD50	Dermal LD50	Inhalation LC50
Xylene (mixed isomers) 1330-20-7	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 5.04 mg/L (Rat) 4 h
Ethylbenzene 100-41-4	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	17.2 mg/L (Rat) 4 h
Cumene	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 20 mg/L (Rat) 6 h

98-82-8			
Toluene 108-88-3	> 2000 mg/kg (Rat)	8390 mg/kg (Rabbit)	12.5 mg/L (Rat) 4 h

Immediate and delayed effects as well as chronic effects from short and long-term exposure

XYLENE: Overexposure to airborne xylene may cause upper respiratory tract irritation, headache, cyanosis, blood serum changes, nervous system damage and narcosis. Impaired neurological function has been reported in workers exposed to solvents including xylene. Laboratory animal studies have shown evidence of impaired hearing after prolonged exposure high airborne concentrations. Laboratory animal studies suggest some changes in reproductive organs after exposure to high airborne concentrations of xylene without an effect on reproduction. Skeletal and visceral malformations, developmental delays, and increased fetal resorptions were observed in laboratory animals after extremely high airborne concentrations with evidence of maternal toxicity. Adverse effects on the liver, kidney, and bone marrow were observed in laboratory animals after prolonged and repeated exposure to high airborne concentrations of xylene.

ETHYLBENZENE: Lifetime exposure studies of rodents to ethylbenzene reported elevated kidney tumors in male and female rats exposed to the highest concentration tested. Tumors of the lungs were elevated in male mice and in the livers of females exposed at the highest concentration tested. Effects on the liver, kidney, lung, thyroid, and pituitary of these animals as well. Laboratory animal studies (rats) demonstrated hearing loss in combination with exposure to noise.

CUMENE: High airborne concentrations of cumene may cause irritation of the eyes, skin, and respiratory tract. Excessive exposures may cause central nervous system effects. Lifetime inhalation exposure of mice to cumene resulted in lung tumors in both males and females and liver tumors in females. Rats similarly exposed to cumene exhibited male-specific kidney tumors.

TOLUENE: Inhalation abuse of toluene at high concentrations has been associated with adverse effects on the liver, kidney and nervous system, and can cause nervous system depression, cardiac arrhythmias, and death. Studies of workers indicate long-term exposure may be related to impaired color vision and hearing. Some studies of workers suggest long-term exposure may be associated with neurobehavioral and mental functional changes. Laboratory animal studies indicate some changes in reproductive organs after exposure to high airborne concentrations, but no significant effects on mating performance or reproduction were observed. Positive findings include small increases in minor skeletal and visceral malformations and developmental delays following maternal exposure to high concentrations. Adverse effects on the liver, kidney, thymus and nervous system of laboratory animal were observed after very high levels of prolonged and repeated exposure.

Adverse effects related to the physical, chemical and toxicological characteristics

Signs and symptoms Respiratory tract irritation. May cause nausea, vomiting, diarrhea, and signs of nervous system depression: headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue.

Acute toxicity None known.

Skin corrosion/irritation Causes skin irritation.

Serious eye damage/eye irritation Causes serious eye irritation.

Sensitization Not expected to be a skin or respiratory sensitizer.

Mutagenic effects None known.

Carcinogenicity Cancer designations are listed in the table below

Name	ACGIH (Class)	IARC (Class)	NTP	OSHA
Xylene (mixed isomers) 1330-20-7	Not classifiable (A4)	Not classifiable (3)	Not Listed	Not Listed
Ethylbenzene 100-41-4	Confirmed animal carcinogen (A3)	Possible human carcinogen (2B)	Not Listed	Not Listed
Cumene 98-82-8	Not Listed	Possible human carcinogen (2B)	Reasonably anticipated to be a human carcinogen	Not Listed
Toluene 108-88-3	Not classifiable (A4)	Not classifiable (3)	Not Listed	Not Listed

Reproductive toxicity Suspected of damaging the unborn child.

Specific Target Organ Toxicity (STOT) - single exposure May cause drowsiness or dizziness. May cause respiratory irritation.

Specific Target Organ Toxicity (STOT) - repeated exposure May cause damage to organs (auditory system, nervous system) through prolonged or repeated exposure.

Aspiration hazard May be fatal if swallowed or vomited and enters airways.

12. ECOLOGICAL INFORMATION

Ecotoxicity This product should be considered toxic to aquatic organisms, with the potential to cause long lasting adverse effects in the aquatic environment.

Name	Fish	Crustacea	Algae/aquatic plants
Xylene (mixed isomers) 1330-20-7	96-hr LC50 = 8 mg/l Rainbow trout	48-hr LC50 = 3.82 mg/l Daphnia magna	72-hr EC50 = 11 mg/l Algae
Ethylbenzene 100-41-4	96-hr LC50 = 4 mg/L Rainbow trout	48-hr EC50 = 1-4 mg/L Daphnia magna	72-hr EC50 = 1.7-7.6 mg/l Algae
Cumene 98-82-8	96-hr LC50 = 6.04-6.61 mg/l Fathead minnow (Flow-through) 96-hr LC50 = 2.7 mg/l Rainbow trout (semi-static)	48-hr EC50 = 7.9-14.1 mg/l Daphnia magna (static)	72-hr EC50 = 2.6 mg/l Algae
Toluene 108-88-3	96-hr LC50 <= 10 mg/l Rainbow trout	48-hr EC50 = 5.46-9.83 mg/l Daphnia magna 48-hr EC50 = 11.5 mg/l Daphnia magna (Static)	72-hr EC50 = 12.5 mg/l Algae

Persistence and degradability Readily biodegradable in the environment.

Bioaccumulation Not expected to bioaccumulate in aquatic organisms.

Mobility in soil May partition into air, soil and water.

Other adverse effects No information available.

13. DISPOSAL CONSIDERATIONS

Description of waste residues This material may be a flammable liquid waste.

Safe handling of wastes Handle in accordance with applicable local, state, and federal regulations. Use personal protection measures as required. Use appropriate grounding and bonding practices. Use only non-sparking tools. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. No smoking.

Disposal of wastes / methods of disposal The user is responsible for determining if any discarded material is a hazardous waste (40 CFR 262.11). Dispose of in accordance with federal, state and local regulations.

Contaminated packaging disposal Empty containers should be completely drained and then discarded or recycled, if possible. Do not cut, drill, grind or weld on empty containers since explosive residues may be present. Dispose of in accordance with federal, state and local regulations.

14. TRANSPORT INFORMATION

DOT

UN/Identification No: UN 1307
UN Proper Shipping Name: Xylenes
Transport Hazard Class(es): 3
Packing Group: III

IATA

UN/Identification No:	UN 1307
UN Proper Shipping Name:	Xylenes
Transport Hazard Class(es):	3
Packing Group:	III
ERG code:	3L

IMDG

UN/Identification No:	UN 1307
UN Proper Shipping Name:	Xylenes
Transport Hazard Class(es):	3
Packing Group:	III
EmS No:	F-E, S-D
Marine Pollutant:	No

15. REGULATORY INFORMATION

Regulatory Information

US TSCA Chemical Inventory This product and/or its components are listed on the TSCA Chemical Inventory or are exempt.

Canada DSL/NDSL Inventory This product and/or its components are listed either on the Domestic Substances List (DSL) or are exempt.

EPA Superfund Amendment & Reauthorization Act (SARA)

SARA Section 302 This product does not contain any component(s) included on EPA's Extremely Hazardous Substance (EHS) List above the de minimis threshold.

SARA Section 304 This product may contain component(s) identified either as an EHS or a CERCLA Hazardous substance which in case of a spill or release may be subject to SARA reporting requirements:

Name	Hazardous Substances RQs
Xylene (mixed isomers) 1330-20-7	100 lb 45.4 kg
Ethylbenzene 100-41-4	1000 lb 454 kg
Cumene 98-82-8	5000 lb 2270 kg
Toluene 108-88-3	1000 lb 454 kg

SARA Section 311/312 The following EPA hazard categories apply to this product:

Flammable
Hazard Not Otherwise Classified (HNOC)-Physical
Skin corrosion or irritation
Serious eye damage or eye irritation
Carcinogenicity
Reproductive toxicity
Specific target organ toxicity
Aspiration hazard

SARA Section 313 This product may contain component(s), which if in exceedance of the de minimus threshold, may be subject to the reporting requirements of SARA Title III Section 313 Toxic Release Reporting (Form R).

Name	CERCLA/SARA 313 Emission reporting
Xylene (mixed isomers) 1330-20-7	1.0 % de minimis concentration
Ethylbenzene 100-41-4	0.1 % de minimis concentration
Cumene 98-82-8	0.1 % de minimis concentration
Toluene 108-88-3	1.0 % de minimis concentration

U.S. State Regulations

California Proposition 65 This product can expose you to chemicals which are known to the State of California to cause cancer, birth defects or other reproductive harm.

Name	California Proposition 65
Ethylbenzene 100-41-4	Carcinogen, initial date 06/11/04
Cumene 98-82-8	Carcinogen, initial date 04/06/10
Toluene 108-88-3	Developmental toxicity, initial date 01/01/91

For more information, go to www.P65Warnings.ca.gov.

State Right-To-Know Regulations The following component(s) of this material are identified on the regulatory lists below:

Name	New Jersey Right-To-Know	Pennsylvania Right-To-Know	Massachusetts Right-To Know
Xylene (mixed isomers) 1330-20-7	Listed	Listed	Listed
Ethylbenzene 100-41-4	Listed	Listed	Listed
Cumene 98-82-8	Listed	Listed	Listed
Toluene 108-88-3	Listed	Listed	Listed

16. OTHER INFORMATION

Prepared by Toxicology & Product Safety

NFPA



Revision Notes

Revision date 12/28/2021

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information is intended as guidance for safe handling, use, processing, storage, transportation, accidental release, clean-up and disposal and is not considered a warranty or quality specification. The

information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Safety Data Sheet
Diesel Fuel

SECTION 1 IDENTIFICATION

Product Name: Diesel Fuel
Synonyms: No. 2 Diesel Fuel, Ultra Low Sulfur Diesel, Oil Distillate, Cycle Oil, Fuel Oil Diesels Cycle Oil, Furnace Oil, Dyed Fuel

SDS #: F2

Product Use: Diesel Fuel
Restrictions on Use: Use only as directed

Manufacturer:
Sinclair Oil Company
P.O. Box 30825
Salt Lake City, Utah 84130

Telephone: **General Information:** (801) 524-2777 **Fax:** (801) 524-2740
Contact person: Jeremiah Webster

Emergency Telephone: 800-424-9300 (CHEMTREC) or (703) 527-3887

SDS Date of Preparation: January 23, 2015

SECTION 2: HAZARDS IDENTIFICATION

Classification:

Physical	Health
Flammable Liquid Category 3	Acute Toxicity Category 4 (Oral) Aspiration Toxicity Category 1 Skin Irritation Category 2 Specific Target Organ Toxicity Repeat Exposure Category 1 Carcinogen Category 2

Label Elements:
Danger!



Hazard Phrases:
Flammable liquid and vapor.
Harmful if inhaled.
May be fatal if swallowed and enters airways.
Causes skin irritation.
Suspected of causing cancer.
Causes damage to thymus, liver and bone marrow through prolonged or repeated exposure.

Precautionary Phrases:
Prevention
Obtain special instructions before use.
Do not handle until all safety precautions have been read and understood.
Keep away from heat, sparks, open flames, and hot surfaces. No smoking.
Keep container tightly closed.
Ground and bond container and receiving equipment
Use explosion-proof electrical, ventilating and lighting equipment.
Use only non-sparking tools.
Take precautionary measures against static discharge.
Do not breathe mist, vapors or spray.
Wash thoroughly after handling.
Use only outdoors or in a well-ventilated area.
Wear protective gloves, eye protection.

Response
IF SWALLOWED: Immediately call a POISON CENTER or doctor.
Do NOT induce vomiting.
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water.
If skin irritation occurs: Get medical attention.
Take off contaminated clothing and wash it before reuse.
IF INHALED: Remove person to fresh air and keep comfortable for breathing.
Call a POISON CENTER or doctor.
IF exposed or concerned: Get medical attention.
In case of fire: Use water fog, foam, carbon dioxide, or dry chemical to extinguish.

Storage and Disposal
Store in a well-ventilated place. Keep cool. Keep container tightly closed.
Store locked up.
Dispose of contents and container in accordance with local and national regulations.

SECTION 3 COMPOSITION / INFORMATION ON INGREDIENTS

Chemical name	CAS No.	Concentration
Diesel Fuel	68476-34-6	97-100%
Naphthalene	91-20-3	0-3%

SECTION 4 EMERGENCY and FIRST AID PROCEDURES

Eye Contact: Immediately flush eyes with water for several minutes. Get medical attention if irritation persists.

Skin Contact: Remove contaminated clothing and flush skin with water for several minutes. Wash thoroughly with soap and water. Get medical attention if irritation develops or persists. Launder clothing before reuse. Discard contaminated shoes.

Inhalation: Remove to fresh air. If breathing is difficult have qualified personnel administer oxygen. If breathing has stopped, administer artificial respiration. Get medical attention**.**

Ingestion: Do not induce vomiting. Rinse mouth with water. Never give anything by mouth to an unconsciousness person. If vomiting occurs spontaneously, keep head below hips to prevent aspiration into the lungs. Get immediate medical attention.

Most important symptoms/effects, acute and delayed: May cause eye irritation. Causes skin irritation with redness and drying. Inhalation may cause respiratory irritation and central nervous system effects. Harmful or fatal if swallowed. Aspiration during swallowing or vomiting may cause lung damage. May cause cancer based on animal data.

Indication of immediate medical attention and special treatment, if necessary: Immediate medical attention is required for ingestion.

SECTION 5 FIRE and EXPLOSION HAZARD DATA

Suitable extinguishing media: Use water fog, foam, carbon dioxide, or dry chemical. Do not use a steady stream of water. Product may float on the surface of water and create a floating fire hazard.
Specific hazards arising from the chemical: This product is highly flammable and forms explosive mixtures with air. Vapors are heavier than air and will travel along surfaces to remote ignition sources and flash back. Closed containers may explode if exposed to extreme heat. Combustion may produce carbon oxides and other products of incomplete combustion.
Special protective equipment and precautions for fire-fighters: Firefighters should wear full emergency equipment and a NIOSH approved positive pressure self-contained breathing apparatus. Cool fire exposed container with water. Do not allow run-off from firefighting to enter drains or water courses.

SECTION 6 ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment, and emergency procedures: Wear appropriate protective equipment. Eliminate ignitions sources and ventilate the area with explosion proof equipment. Wash thoroughly after handling.
Environmental hazards: Avoid release into the environment. Report spill as required by local and federal regulations.
Methods and materials for containment and cleaning up: Contain with an inert absorbent and place into a closable container for disposal. Use non-sparking tools and equipment. If spill has not ignited, use water spray to disperse the vapors and protect personnel attempting to stop leak. Prevent entry in storm sewers and waterways. Runoff can cause a fire or explosion hazard in sewers.

SECTION 7 HANDLING and STORAGE

Precautions for safe handling: Avoid contact with eyes, skin and clothing. Avoid breathing vapors. Wash thoroughly after handling. Use only with adequate ventilation. Wash thoroughly with soap and water after handling. Keep containers closed when not in use. Keep product away from heat, sparks, flames and all other sources of ignition. Do not permit smoking in use or storage areas. Use with non-sparking tools and explosion proof equipment. Electrically bond and ground containers for transfer

Do not cut, drill, grind or weld on or near containers, even empty containers. Empty containers retain product residues can be hazardous. Follow all SDS precautions when handling empty containers.

Conditions for safe storage, including any incompatibilities: S Store in accordance with regulations for the storage of flammable liquids. Store in a dry, well ventilated area away from heat, direct sunlight and all sources of ignition. Store away from oxidizers and other incompatible materials. Protect containers from physical damage.

SECTION 8 EXPOSURE CONTROLS and PERSONAL PROTECTION

Exposure Guidelines:

INGREDIENTS	EXPOSURE LIMITS
Diesel Fuel	100 mg/m^3 TWA ACGIH TLV (inhalable fraction and vapor)
Naphthalene	10 ppm TWA OSHA PEL
	10 ppm, skin TWA ACGIH TLV

Appropriate engineering controls: Use with local exhaust ventilation to maintain exposures below the occupational exposure limits. Use explosion proof equipment where required

Respiratory protection: If exposures are exceeded, use a NIOSH approved organic vapor respirator appropriate for the form and concentration of the contaminants should be used. Selection of respiratory protection depends on the contaminant type, form and concentration. Select in accordance with OSHA 1910.134 and good Industrial Hygiene practice.
Skin protection: Impervious gloves such as nitrile rubber recommended to prevent skin contact.
Eye protection: Wear chemical safety goggles to avoid eye contact.
Other: Impervious coveralls, apron and boots is required to prevent skin contact and contamination of personal clothing. A safety shower and eye wash should be available in the immediate work area.

SECTION 9 PHYSICAL and CHEMICAL PROPERTIES

Appearance (physical state, color, etc.): Colored or clear liquid
Odor: Aromatic hydrocarbon odor.

Odor threshold: Not available	**pH:** Not applicable
Melting point/Pourpoint: Not available	**Boiling Point:** 320-700° F (160-371-1°C)
Flash point: 126-152°F (51.6-66.6°C)	**Evaporation rate:** Not available
Flammability (solid, gas): Not applicable	
Flammable limits: LEL: 0.6%	**UEL:** 7.5%
Vapor pressure: <1 mmHg @ 60°F	**Vapor density:** ~3
Relative density: 0.82-0.88	**Solubility:** Insoluble in water
Partition coefficient: n-ctanol/water: Not available	**Auto-ignition temperature:** >490-545°F (>254.4-285°C)
Decomposition temperature: Not available	**Viscosity:** Not applicable

SECTION 10 STABILITY and REACTIVITY

Reactivity: This product is not expected to be reactive.
Chemical stability: The product is stable.
Possibility of hazardous reactions: None known.
Conditions to avoid: Keep away from heat and all sources of ignition.
Incompatible materials: Avoid oxidizing agents, acids, alkalies and halogens.
Hazardous decomposition products: Thermal decomposition may yield carbon oxides and other products of incomplete combustion.

SECTION 11 TOXICOLOGICAL INFORMATION

Health Hazards:

Inhalation: Vapors may cause respiratory irritation and central nervous system effect including headache, dizziness, headaches, giddiness, euphoria, vertigo, blurred vision, nausea, numbness, drowsiness, anesthesia, and coma.

Skin Contact: Skin contact may cause irritation, redness and defatting of the skin.

Eye Contact: Eye contact may cause mild irritation with redness, tearing and pain.

Ingestion: Swallowing may cause gastrointestinal irritation, nausea, vomiting, diarrhea, vertigo, drowsiness, mental confusion, staggering gait, slurred speech, convulsions, unconsciousness and death due to circulatory failure. Aspiration during swallowing or vomiting may cause lung damage.

Chronic Effects of Overexposure: Prolonged occupational overexposure may cause dermatitis. Reports have associated repeated and prolonged overexposure to petroleum distillates with adverse liver, kidney and bone marrow effects and with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the product may be harmful or fatal.

Mutagenicity: Diesel fuel was negative in the AMES test and in an in vitro mouse lymphoma assay.

Reproductive Toxicity: In a developmental study with diesel fuel, rats were administered 100 and 400 ppm for 6 hours a day from day 6-15 of gestation. No adverse effects were seen on reproduction or developmental paramental or in soft tissues or skeletons. NOEAL: 400 ppm

Carcinogenicity: Naphthalene is listed by IARC as “Possibly Carcinogenic to Humans”, Group 2B, as “Reasonably Anticipated to be a Human Carcinogen” and as a “Confirmed Animal Carcinogen with Unknown Relevance to Humans”, A3 by ACGIH.

Acute Toxicity Values: Acute Toxicity Estimate: Oral 14492 mg/kg
Diesel Fuel: Oral rat LD50 17900 mg/kg, Inhalation rat LC50 4.1 mg/L/4 hr, Dermal rabbit LD50 >4300 mg/kg
Naphthalene: Oral rat LD50 533 mg/kg, Inhalation rat LC0 0.4 mg/L (highest attainable concentration), Dermal rat LC50 >2500 mg/kg

SECTION 12: ECOLOGICAL INFORMATION

Ecotoxicity:
Diesel Fuel: 96 hr LL50 Oncorhynchus mykiss 65 mg/kg, 48 hr EL50 > 1000, 72 hr EL50 Pseudokirchnerella subcapitata 10 mg/L
Naphthalene: 96 hr LC50 Pimephales promelas 6.08 mg/L, 48 hr EC50 daphnia magna 2.16 mg/L

Persistence and degradability: Diesel fuel is inherently biodegradable.
Bioaccumulative potential: The bioaccumulation potentials of the major components of diesel fuel range from low to high. Some higher molecular weight components may be taken up by fish and domestic animals and bioconcentrated if they persist in environment.
Mobility in soil: No data available.
Other adverse effects: None known.

SECTION 13: DISPOSAL INFORMATION

Waste Disposal Method: Dispose in accordance with all local, state and federal regulations.

SECTION 14: TRANSPORTATION INFORMATION

	UN Number	Proper shipping name	Hazard Class	Packing Group	Environmental Hazard
DOT	NA1993	Diesel Fuel	3	PG III	No
TDG	UN1202	Diesel Fuel	3	PG III	No
IMDG	UN1202	Diesel Fuel	3	PG III	No
IATA	UN1202	Diesel Fuel	3	PG III	No

Transport in bulk (according to Annex II of MARPOL 73/78 and the IBC Code): Not applicable.

Special precautions: None known.

SECTION 15: REGULATORY INFORMATION

Safety, health, and environmental regulations specific for the product in question.

CERCLA Hazardous Substances (Section 103)/RQ: This product has a Reportable Quantity (RQ) of 3,333 lbs. (based on the RQ for Naphthalene of 100 lbs). Releases above the RQ must be reported to the National Response Center. Many states have more stringent release reporting requirements. Report spills required under federal, state and local regulations.

EPA SARA 311 Hazard Classification: Acute Health, Chronic Health, Fire Hazard

SARA 313: This product contains the following chemicals subject to Annual Release Reporting Requirements Under SARA Title III, Section 313 (40 CFR 372):

Naphthalene 91-20-3 0-3%

CALIFORNIA PROPOSITION 65: This product contains the following chemicals known to the State of California to cause cancer or reproductive toxicity.

Naphthalene 91-20-3 0-3% Cancer

WHMIS CLASSIFICATION: Class B, Division 3 (Combustible Liquid), Class D, Division 2A (Very Toxic Material Causing Other Toxic Effects)

This product has been classified in accordance with the hazard criteria in the CPR and the SDS contains all the information required by the CPR.

Australia AICS: All of the components are listed on the Australian Inventory of Chemical Substances.

Canada DSL: All of the components are listed on the Canadian Domestic Substances List.

China: All the components are listed on Inventory of Existing Chemical Substances in China.

European EINECS: All of the ingredients are listed on the EINECS inventory.

Korea: All the components are listed on the Korean Existing Chemical List.

New Zealand: All the components are listed on the New Zealand Inventory of Chemicals.

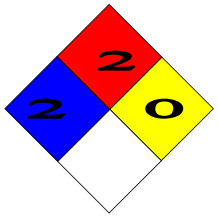
Philippines: All the components are listed on the Philippine Inventory of Chemical and Chemical Substances inventory.

US EPA Toxic Substances Control Act: All of the components of this product are listed on the TSCA inventory.

SECTION 16: OTHER INFORMATION

SDS Revision History: Converted to GHS format – all Sections revised
Date of current revision: January 23, 2015
Date of previous revision: January 2007

National Fire Protection Association (U.S.A)



Health: 2*
Flammability : 2
Instability: 0
Specific Hazard:

Disclaimer: This product material safety data sheet provides health and safety information. The product should be used in applications consistent with this product literature. For any other uses, exposures should be evaluated so that appropriate handling practices and training programs can be established to ensure safe workplace operations.

This material safety data sheet is provided in good faith and meets the requirements of the hazardous communication provisions of SARA TITLE III and 29 CFR 1910.1200(g) of the OSHA regulations. The above information is based on review of available information Sinclair believes is reliable and is supplied for informational purposes only. Sinclair does not guarantee its completeness or accuracy. Since conditions of use are outside the control of Sinclair, Sinclair disclaims all warranties, express or implied, and any liability for damage or injury which results from the use of the above data. Nothing herein is intended to permit infringement of valid patents and licenses.

Safety Data Sheet
Gasoline

SECTION 1 IDENTIFICATION

Product Name: Gasoline
Synonyms: Unleaded Gasoline, Regular Gasoline, Motor Fuel, 85 Octane Gasoline, 87 Octane Gasoline

SDS #: F1

Product Use: Motor Fuel
Restrictions on Use: Use only as directed

Manufacturer:
Sinclair Oil Company
P.O. Box 30825
Salt Lake City, Utah 84130

Telephone: **General Information:** (801) 524-2777 **Fax:** (801) 524-2740
Contact person: Jeremiah Webster

Emergency Telephone: 800-424-9300 (CHEMTREC) or (703) 527-3887

SDS Date of Preparation: January 23, 2015

SECTION 2: HAZARDS IDENTIFICATION

Classification:

Physical	Health
Flammable Liquid Category 2	Aspiration Toxicity Category 1 Skin Irritation Category 2 Specific Target Organ Toxicity Single Exposure Category 3 (Nervous System) Carcinogen Category 1A Germ Cell Mutagenicity Category 1B

Label Elements:
Danger!



Hazard Phrases:
Highly flammable liquid and vapor.
May be fatal if swallowed and enters airways.
Causes skin irritation.
May cause drowsiness or dizziness.
May cause cancer.
May cause genetic defects.

Precautionary Phrases:
Prevention

Obtain special instructions before use.
Do not handle until all safety precautions have been read and understood
Keep away from heat, sparks, open flames, and hot surfaces. No smoking.
Keep container tightly closed.
Ground and bond container and receiving equipment
Use explosion-proof electrical, ventilating and lighting equipment.
Use only non-sparking tools.
Take precautionary measures against static discharge.
Avoid breathing vapors.
Wash thoroughly after handling.
Use only outdoors or in a well-ventilated area.
Wear protective gloves, skin protection and eye protection.

Response
IF SWALLOWED: Immediately call a POISON CENTER or doctor.
Do NOT induce vomiting.
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water.
If skin irritation occurs: Get medical attention.
Take off contaminated clothing and wash it before reuse.
IF INHALED: Remove person to fresh air and keep comfortable for breathing.
Call a POISON CENTER or doctor if you feel unwell.
IF exposed or concerned: Get medical attention.
In case of fire: Use water fog, carbon dioxide, dry chemical and foam to extinguish.

Storage and Disposal
Store in a well-ventilated place. Keep cool. Keep container tightly closed.
Store locked up.
Dispose of contents and container in accordance with local and national regulations.

SECTION 3 COMPOSITION / INFORMATION ON INGREDIENTS

Chemical name	CAS No.	Concentration
Gasoline	8006-61-9	95-100%
Naphthalene	91-20-3	0-3%
Benzene	71-43-2	0-0.5%

SECTION 4 EMERGENCY and FIRST AID PROCEDURES

Eye Contact: Immediately flush eyes with water for several minutes. Get medical attention if irritation persists.

Skin Contact: Remove contaminated clothing and flush skin with water for several minutes. Wash thoroughly with soap and water. Get medical attention if irritation develops or persists. Launder clothing before reuse. Discard contaminated shoes.

Inhalation: Remove to fresh air. If breathing is difficult have qualified personnel administer oxygen. If breathing has stopped, administer artificial respiration. Get medical attention**.**

Ingestion: Do not induce vomiting. Rinse mouth with water. Never give anything by mouth to an unconsciousness person. If vomiting occurs spontaneously, keep head below hips to prevent aspiration into the lungs. Get immediate medical attention.

Most important symptoms/effects, acute and delayed: May cause eye irritation. Causes skin irritation with redness and drying. Inhalation may cause respiratory irritation and central nervous system effects. Harmful or fatal if swallowed. Aspiration during swallowing or vomiting may cause lung damage. May cause cancer. May cause genetic defects.

Indication of immediate medical attention and special treatment, if necessary: Immediate medical attention is required for ingestion.

SECTION 5 FIRE and EXPLOSION HAZARD DATA

Suitable extinguishing media: Use water fog, foam, carbon dioxide, or dry chemical. Do not use a steady stream of water. Product may float on the surface of water and create a floating fire hazard.
Specific hazards arising from the chemical: This product is highly flammable and forms explosive mixtures with air. Vapors are heavier than air and will travel along surfaces to remote ignition sources and flash back. Closed containers may explode if exposed to extreme heat. Combustion may produce carbon oxides and other products of incomplete combustion.
Special protective equipment and precautions for fire-fighters: Firefighters should wear full emergency equipment and a NIOSH approved positive pressure self-contained breathing apparatus. Cool fire exposed container with water. Do not allow run-off from firefighting to enter drains or water courses.

SECTION 6 ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment, and emergency procedures: Wear appropriate protective equipment. Eliminate ignitions sources and ventilate the area with explosion proof equipment. Wash thoroughly after handling.
Environmental hazards: Avoid release into the environment. Report spill as required by local and federal regulations.
Methods and materials for containment and cleaning up: Contain with an inert absorbent and place into a closable container for disposal. Use non-sparking tools and equipment. If spill has not ignited, use water spray to disperse the vapors and protect personnel attempting to stop leak. Prevent entry in storm sewers and waterways. Runoff can cause a fire or explosion hazard in sewers.

SECTION 7 HANDLING and STORAGE

Precautions for safe handling: Avoid contact with eyes, skin and clothing. Avoid breathing vapors. Wash thoroughly after handling. Use only with adequate ventilation. Wash thoroughly with soap and water after handling. Keep containers closed when not in use. Keep product away from heat, sparks, flames and all other sources of ignition. Do not permit smoking in use or storage areas. Use with non-sparking tools and explosion proof equipment. Electrically bond and ground containers for transfer

Do not cut, drill, grind or weld on or near containers, even empty containers. Empty containers retain product residues can be hazardous. Follow all SDS precautions when handling empty containers.

Improper filling of portable gasoline containers creates a fire hazard. Only dispense gasoline into an approved and properly labeled gasoline container. Always place portable containers on the ground while filling. Ensure pump nozzle is in contact with the container while filling. Do not use the nozzle’s lock open device. Do not fill portable containers that are inside a vehicle or trailer/truck bed.

Do not use as a cleaner or solvent. Use only as a motor fuel. Do not siphon by mouth.

Refer to OSHA 1910.1028 for requirements for handling and use of benzene.

Conditions for safe storage, including any incompatibilities: S Store in accordance with regulations for the storage of flammable liquids. Store in a dry, well ventilated area away from heat, direct sunlight and all sources of ignition. Store away from oxidizers and other incompatible materials. Protect containers from physical damage.

SECTION 8 EXPOSURE CONTROLS and PERSONAL PROTECTION

Exposure Guidelines:

INGREDIENTS	EXPOSURE LIMITS
Gasoline	300 ppm TWA , 500 ppm STEL ACGIH TLV
Naphthalene	10 ppm TWA OSHA PEL
	10 ppm, skin TWA ACGIH TLV
Benzene	1 ppm TWA, 5 ppm STEL OSHA PEL
	0.5 ppm TWA, 2.5 ppm STEL ACGIH TLV

29 CFR 1910.1028 is the OSHA regulation on Occupational Exposure to Benzene. Assure compliance with these regulations.

Appropriate engineering controls: Use with local exhaust ventilation to maintain exposures below the occupational exposure limits. Use explosion proof equipment where required

Respiratory protection: If exposures are exceeded, use a NIOSH approved organic vapor respirator appropriate for the form and concentration of the contaminants should be used. Selection of respiratory protection depends on the contaminant type, form and concentration. Select in accordance with OSHA 1910.134 and good Industrial Hygiene practice.
Skin protection: Impervious gloves such as viton recommended to prevent skin contact.
Eye protection: Wear chemical safety goggles to avoid eye contact.
Other: Impervious coveralls, apron and boots is required to prevent skin contact and contamination of personal clothing. A safety shower and eye wash should be available in the immediate work area.

SECTION 9 PHYSICAL and CHEMICAL PROPERTIES

Appearance (physical state, color, etc.): Colored or clear liquid
Odor: Aromatic hydrocarbon odor.

Odor threshold: 0.3 ppm (gasoline)	**pH:** Not applicable
Melting point/Pourpoint: -76°F (-60°C)	**Boiling Point:** 230° F (110°C)
Flash point: -45°F (-42.8°C)	**Evaporation rate:** Not available
Flammability (solid, gas): Not applicable	
Flammable limits: LEL: 1.4%	**UEL:** 7.6%
Vapor pressure: 7-15 psia	**Vapor density:** >1
Relative density: 0.65-0.75	**Solubility:** Insoluble in water
Partition coefficient: n-ctanol/water: Not available	**Auto-ignition temperature:** >530°F (>276.6°C)
Decomposition temperature: Not available	**Viscosity:** Not applicable

SECTION 10 STABILITY and REACTIVITY

Reactivity: This product is not expected to be reactive.
Chemical stability: The product is stable.
Possibility of hazardous reactions: None known.
Conditions to avoid: Keep away from heat and all sources of ignition.
Incompatible materials: Avoid oxidizing agents, acids, alkalies and halogens.

Hazardous decomposition products: Thermal decomposition may yield carbon oxides and other products of incomplete combustion.

SECTION 11 TOXICOLOGICAL INFORMATION

Health Hazards:

Inhalation: Vapors may cause respiratory irritation and central nervous system effect including headache, dizziness, headaches, giddiness, euphoria, vertigo, blurred vision, nausea, numbness, drowsiness, anesthesia, and coma. Gasoline vapors are heavier than air and may cause asphyxiation in enclosed or poorly ventilated area. Overexposure to benzene by inhalation may cause exhilaration, nervous excitation, and/or giddiness, followed by a period of depression, drowsiness, or fatigue, tightness of the chest, unconsciousness, tremors or death.

Skin Contact: Skin contact may cause irritation, redness and defatting of the skin.

Eye Contact: Eye contact may cause mild irritation with redness, tearing and pain.

Ingestion: Swallowing may cause gastrointestinal irritation, nausea, vomiting, diarrhea, vertigo, drowsiness, mental confusion, staggering gait, slurred speech, convulsions, unconsciousness and death due to circulatory failure. Aspiration during swallowing or vomiting may cause lung damage.

Chronic Effects of Overexposure: Prolonged occupational overexposure may cause dermatitis. Reports have associated repeated and prolonged overexposure to petroleum distillates with adverse liver, kidney and bone marrow effects and with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the product may be harmful or fatal. Repetitive direct skin application of kerosene over a two year period resulted in skin cancer in laboratory animals. Petroleum hydrocarbons of similar composition and boiling ranges have been known to product kidney damage and tumors in male rats following prolonged inhalation exposures. Benzene has been shown to cause damage to the blood forming system with anemia, leukopenia and thrombocytopenia by all routes of exposure.

Mutagenicity: Benzene did not induce in vitro mutation in bacteria using standard AMES test conditions. Mammalian cell gene mutation tests carried out in various human, mouse and Chinese hamster cells resulted in mixed results. Benzene is an in vivo mutagen in mammals, especially when chromosomal aberrations and micronuclei are induced. It has been reported that benzene exposure in humans induces genotoxic effects in lymphocytes in vivo.

Reproductive Toxicity: In a reproductive study, rats were administered 250 and 1000 mg/kg of petroleum distillates for at least 70 days prior to mating and during the 14 day mating cycle. The absence of adverse effects on in-life parameters (such as body weight, feed consumption, and clinical observations), a dosage level of 1000 mg/kg/day was considered to be the no-observed-adverse-effect level (NOAEL) for reproductive and systemic toxicity.

Carcinogenicity: Gasoline is listed by IARC as “Possibly Carcinogenic to Humans”, Group 2B and as a “Confirmed Animal Carcinogen with Unknown Relevance to Humans: A3 by ACGIH. Benzene is listed by IARC as “Carcinogenic to Humans” Group 1, by NTP as “Known to Be a Human Carcinogen” and as a “Confirmed Human Carcinogen”, A1 by ACGIH. Naphthalene is listed by IARC as “Possibly Carcinogenic to Humans”, Group 2B, as “Reasonably Anticipated to be a Human Carcinogen” and as a “Confirmed Animal Carcinogen with Unknown Relevance to Humans”, A3 by ACGIH.

Acute Toxicity Values: Acute Toxicity Estimate: Oral 14492 mg/kg
Gasoline: Oral rat LD50 >5000 mg/kg, Inhalation rat LC50 >5.61 mg/L/4 hr, Dermal rabbit LD50 >2000 mg/kg
Naphthalene: Oral rat LD50 533 mg/kg, Inhalation rat LC0 0.4 mg/L (highest attainable concentration), Dermal rat LC50 >2500 mg/kg
Benzene: Oral rat LD50 >2000 mg/kg, Inhalation rat LC50 41.69 mg/L/4 hr, Dermal rabbit LD50 > 8260 mg/kg

SECTION 12: ECOLOGICAL INFORMATION

Ecotoxicity:
Gasoline: 96 hr LL50 Pimephales promelas 8.2 mg/kg, 48 hr EL50 4.5 mg/L, 72 hr EL50 Pseudokirchnerella subcapitata 3.1 mg/L
Naphthalene: 96 hr LC50 Pimephales promelas 6.08 mg/L, 48 hr EC50 daphnia magna 2.16 mg/L
Benzene: 96 hr LC50 Oncorhynchus mykiss 5.3 mg/L, 48 hr EC50 daphnia magna 10 mg/L, 72 hr EC50 Pseudokirchnerella subcapitata 32 mg/L

Persistence and degradability: Gasoline is inherently biodegradable.
Bioaccumulative potential: The bioaccumulation potentials of the major components of gasoline range from low to high. Some higher molecular weight components may be taken up by fish and domestic animals and bioconcentrated if they persist in environment.
Mobility in soil: Gasoline is expected to possess low to moderate mobility in soil.
Other adverse effects: None known.

SECTION 13: DISPOSAL INFORMATION

Waste Disposal Method: Dispose in accordance with all local, state and federal regulations.

SECTION 14: TRANSPORTATION INFORMATION

	UN Number	Proper shipping name	Hazard Class	Packing Group	Environmental Hazard
DOT	UN1203	Gasoline	3	PG II	No
TDG	UN1203	Gasoline	3	PG II	No
IMDG	UN1203	Gasoline	3	PG II	No
IATA	UN1203	Gasoline	3	PG II	No

Transport in bulk (according to Annex II of MARPOL 73/78 and the IBC Code): Not applicable.

Special precautions: None known.

SECTION 15: REGULATORY INFORMATION

Safety, health, and environmental regulations specific for the product in question.

CERCLA Hazardous Substances (Section 103)/RQ: This product has a Reportable Quantity (RQ) of 3,333 lbs. (based on the RQ for Naphthalene of 100 lbs). Releases above the RQ must be reported to the National Response Center. Many states have more stringent release reporting requirements. Report spills required under federal, state and local regulations.

EPA SARA 311 Hazard Classification: Acute Health, Chronic Health, Fire Hazard

SARA 313: This product contains the following chemicals subject to Annual Release Reporting Requirements Under SARA Title III, Section 313 (40 CFR 372):

Benzene	71-43-2	0-0.5%
Naphthalene	91-20-3	0-3%

CALIFORNIA PROPOSITION 65: This product contains chemicals known to the State of California to cause cancer or reproductive toxicity.

WHMIS CLASSIFICATION: Class B, Division 2 (Flammable Liquid), Class D, Division 2A (Very Toxic Material Causing Other Toxic Effects)

This product has been classified in accordance with the hazard criteria in the CPR and the MSDS contains all the information required by the CPR.

Australia AICS: All of the components are listed on the Australian Inventory of Chemical Substances.

Canada DSL: All of the components are listed on the Canadian Domestic Substances List.

China: All the components are listed on Inventory of Existing Chemical Substances in China.

European EINECS: All of the ingredients are listed on the EINECS inventory.

Korea: All the components are listed on the Korean Existing Chemical List.

New Zealand: All the components are listed on the New Zealand Inventory of Chemicals.

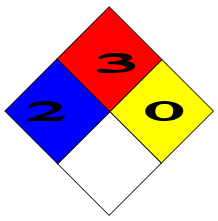
Philippines: All the components are listed on the Philippine Inventory of Chemical and Chemical Substances inventory.

US EPA Toxic Substances Control Act: All of the components of this product are listed on the TSCA inventory.

SECTION 16: OTHER INFORMATION

SDS Revision History: Converted to GHS format – all Sections revised
Date of current revision: January 9, 2015
Date of previous revision: December 2002

National Fire Protection Association (U.S.A)



Health: 2*
Flammability : 3
Instability: 0
Specific Hazard:

Disclaimer: This product material safety data sheet provides health and safety information. The product should be used in applications consistent with this product literature. For any other uses, exposures should be evaluated so that appropriate handling practices and training programs can be established to ensure safe workplace operations.

This material safety data sheet is provided in good faith and meets the requirements of the hazardous communication provisions of SARA TITLE III and 29 CFR 1910.1200(g) of the OSHA regulations. The above information is based on review of available information Sinclair believes is reliable and is supplied for informational purposes only. Sinclair does not guarantee its completeness or accuracy. Since conditions of use are outside the control of Sinclair, Sinclair disclaims all warranties, express or implied, and any liability for damage or injury which results from the use of the above data. Nothing herein is intended to permit infringement of valid patents and licenses.

SAFETY DATA SHEET

Creation Date 12-Mar-2009 **Revision Date** 24-Dec-2021 **Revision Number** 10

1. Identification

Product Name **Nitric acid (65 - 70%)**

Cat No. : **AC124650000; AC124650010; AC124650011; AC124650025; 124650026**

CAS No 7697-37-2
Synonyms Azotic acid; Engraver's acid; Aqua fortis

Recommended Use Laboratory chemicals.
Uses advised against Food, drug, pesticide or biocidal product use.

Details of the supplier of the safety data sheet

Company

Fisher Scientific Company
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number

For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887
CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 001-703-527-3887

2. Hazard(s) identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Oxidizing liquids	Category 3
Corrosive to metals	Category 1
Acute Inhalation Toxicity - Vapors	Category 3
Skin Corrosion/Irritation	Category 1 A
Serious Eye Damage/Eye Irritation	Category 1

Label Elements

Signal Word
Danger

Hazard Statements

May intensify fire; oxidizer
May be corrosive to metals
Causes severe skin burns and eye damage
Toxic if inhaled
Corrosive to the respiratory tract



Precautionary Statements
Prevention
Do not breathe dust/fume/gas/mist/vapors/spray
Wash face, hands and any exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection
Use only outdoors or in a well-ventilated area
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep/Store away from clothing/ other combustible materials
Take any precaution to avoid mixing with combustibles
Keep only in original container
Wear respiratory protection
Response
Immediately call a POISON CENTER or doctor/physician
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Immediately call a POISON CENTER or doctor/physician
Skin
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
Wash contaminated clothing before reuse
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
Ingestion
IF SWALLOWED: Rinse mouth. DO NOT induce vomiting
Fire
In case of fire: Use CO2, dry chemical, or foam for extinction
Spills
Absorb spillage to prevent material damage
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Store in a dry place
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Corrosive to the respiratory tract

3. Composition/Information on Ingredients

Component	CAS No	Weight %
Nitric acid …% [C ≤ 70 %]	7697-37-2	65 - 70
Water	7732-18-5	30 - 35

4. First-aid measures

General Advice Immediate medical attention is required. Show this safety data sheet to the doctor in attendance.

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Immediate medical attention is required.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Remove and wash contaminated clothing and gloves, including the inside, before re-use. Call a physician immediately.

Inhalation If breathing is difficult, give oxygen. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Remove from exposure, lie down. Call a physician immediately.

Ingestion Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Clean mouth with water. Call a physician immediately.

Most important symptoms and effects Causes burns by all exposure routes. Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation: Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated

Notes to Physician Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media CO_2, dry chemical, dry sand, alcohol-resistant foam.

Unsuitable Extinguishing Media No information available

Flash Point Not applicable
Method - No information available

Autoignition Temperature No information available

Explosion Limits
Upper No data available
Lower No data available

Oxidizing Properties Oxidizer

Sensitivity to Mechanical Impact No information available
Sensitivity to Static Discharge No information available

Specific Hazards Arising from the Chemical
Thermal decomposition can lead to release of irritating gases and vapors. The product causes burns of eyes, skin and mucous membranes. Oxidizer: Contact with combustible/organic material may cause fire. May ignite combustibles (wood paper, oil, clothing, etc.).

Hazardous Combustion Products
Nitrogen oxides (NOx). Thermal decomposition can lead to release of irritating gases and vapors.

Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Thermal decomposition can lead to release of irritating gases and vapors.

NFPA

Health	Flammability	Instability	Physical hazards
4	0	0	OX

6. Accidental release measures

Personal Precautions Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak. Ensure adequate ventilation. Use personal protective equipment as required.

Environmental Precautions Should not be released into the environment. Do not flush into surface water or sanitary sewer system. See Section 12 for additional Ecological Information.

Methods for Containment and Clean Up Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Sweep up and shovel into suitable containers for disposal. Wear self-contained breathing apparatus and protective suit.

7. Handling and storage

Handling Use only under a chemical fume hood. Wear personal protective equipment/face protection. Do not get in eyes, on skin, or on clothing. Do not ingest. If swallowed then seek immediate medical assistance. Do not breathe mist/vapors/spray. Keep away from clothing and other combustible materials.

Storage. Keep containers tightly closed in a dry, cool and well-ventilated place. Do not store near combustible materials. Do not store in metal containers. Keep in properly labeled containers. Corrosives area. Incompatible Materials. Combustible material. Strong bases. Reducing Agent. Metals. Finely powdered metals. Organic materials. Aldehydes. Alcohols. Cyanides. Ammonia. Strong reducing agents.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Nitric acid …% [C ≤ 70 %]	TWA: 2 ppm STEL: 4 ppm	(Vacated) TWA: 2 ppm (Vacated) TWA: 5 mg/m³ (Vacated) STEL: 4 ppm (Vacated) STEL: 10 mg/m³ TWA: 2 ppm TWA: 5 mg/m³	IDLH: 25 ppm TWA: 2 ppm TWA: 5 mg/m³ STEL: 4 ppm STEL: 10 mg/m³	TWA: 2 ppm STEL: 4 ppm

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: NIOSH - National Institute for Occupational Safety and Health

Engineering Measures Use only under a chemical fume hood. Ensure that eyewash stations and safety showers are close to the workstation location. Ensure adequate ventilation, especially in confined areas.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166. Tight sealing safety goggles. Face protection shield.

Skin and body protection Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures Keep away from food, drink and animal feeding stuffs. When using do not eat, drink or smoke. Contaminated work clothing should not be allowed out of the workplace. Provide regular cleaning of equipment, work area and clothing. Avoid contact with skin, eyes or

clothing. Remove and wash contaminated clothing and gloves, including the inside, before re-use. Wear suitable gloves and eye/face protection.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Clear Colorless, Light yellow
Odor	Strong Acrid
Odor Threshold	No information available
pH	< 1.0 (0.1M)
Melting Point/Range	-41 °C / -41.8 °F
Boiling Point/Range	Not applicable
Flash Point	Not applicable
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	0.94 kPa (20°C)
Vapor Density	No information available
Specific Gravity	1.40
Solubility	miscible
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	No information available
Molecular Formula	HNO3
Molecular Weight	63.01

10. Stability and reactivity

Reactive Hazard Yes

Stability Oxidizer: Contact with combustible/organic material may cause fire.

Conditions to Avoid Incompatible products. Combustible material. Excess heat. Exposure to air or moisture over prolonged periods.

Incompatible Materials Combustible material, Strong bases, Reducing Agent, Metals, Finely powdered metals, Organic materials, Aldehydes, Alcohols, Cyanides, Ammonia, Strong reducing agents

Hazardous Decomposition Products Nitrogen oxides (NOx), Thermal decomposition can lead to release of irritating gases and vapors

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Oral LD50 Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.

Dermal LD50 Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.

Mist LC50 Category 3. ATE = 1 - 5 mg/l.

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Nitric acid …% [C ≤ 70 %]	Not listed	Not listed	LC50 = 2500 ppm. (Rat) 1h
Water	-	-	-

Toxicologically Synergistic No information available

Products

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation Causes severe burns by all exposure routes

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS No	IARC	NTP	ACGIH	OSHA	Mexico
Nitric acid …% [C ≤ 70 %]	7697-37-2	Not listed	Not listed	Not listed	Not listed	Not listed
Water	7732-18-5	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure None known

STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation: Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Do not empty into drains. Large amounts will affect pH and harm aquatic organisms.

Persistence and Degradability Miscible with water Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its water solubility.

Component	log Pow
Nitric acid …% [C ≤ 70 %]	-2.3

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT

UN-No UN2031
Proper Shipping Name NITRIC ACID
Hazard Class 8
Subsidiary Hazard Class 5.1
Packing Group II

TDG

UN-No	UN2031
Proper Shipping Name	NITRIC ACID
Hazard Class	8
Subsidiary Hazard Class	5.1
Packing Group	II

IATA

UN-No	UN2031
Proper Shipping Name	NITRIC ACID
Hazard Class	8
Subsidiary Hazard Class	5.1
Packing Group	II

IMDG/IMO

UN-No	UN2031
Proper Shipping Name	NITRIC ACID
Hazard Class	8
Subsidiary Hazard Class	5.1
Packing Group	II

15. Regulatory information

United States of America Inventory

Component	CAS No	TSCA	TSCA Inventory notification - Active-Inactive	TSCA - EPA Regulatory Flags
Nitric acid …% [C ≤ 70 %]	7697-37-2	X	ACTIVE	-
Water	7732-18-5	X	ACTIVE	-

Legend:
TSCA US EPA (TSCA) - Toxic Substances Control Act, (40 CFR Part 710)
X - Listed
'-' - Not Listed

TSCA 12(b) - Notices of Export Not applicable

International Inventories
Canada (DSL/NDSL), Europe (EINECS/ELINCS/NLP), Philippines (PICCS), Japan (ENCS), Japan (ISHL), Australia (AICS), China (IECSC), Korea (KECL).

Component	CAS No	DSL	NDSL	EINECS	PICCS	ENCS	ISHL	AICS	IECSC	KECL
Nitric acid …% [C ≤ 70 %]	7697-37-2	X	-	231-714-2	X	X	X	X	X	KE-25911
Water	7732-18-5	X	-	231-791-2	X	X		X	X	KE-35400

KECL - NIER number or KE number (http://ncis.nier.go.kr/en/main.do)

U.S. Federal Regulations

SARA 313

Component	CAS No	Weight %	SARA 313 - Threshold Values %
Nitric acid …% [C ≤ 70 %]	7697-37-2	65 - 70	1.0

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Nitric acid …% [C ≤ 70 %]	X	1000 lb	-	-

Clean Air Act Not applicable

OSHA - Occupational Safety and Health Administration

Component	Specifically Regulated Chemicals	Highly Hazardous Chemicals
Nitric acid …% [C ≤ 70 %]	-	TQ: 500 lb

CERCLA This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Nitric acid …% [C ≤ 70 %]	1000 lb	1000 lb

California Proposition 65 This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Nitric acid …% [C ≤ 70 %]	X	X	X	X	X
Water	-	-	X	-	-

U.S. Department of Transportation

Reportable Quantity (RQ): Y
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security This product contains the following DHS chemicals:
Legend - STQs = Screening Threshold Quantities, APA = A placarded amount

Component	DHS Chemical Facility Anti-Terrorism Standard
Nitric acid …% [C ≤ 70 %]	Release STQs - 15000lb Theft STQs - 400lb

Other International Regulations

Mexico - Grade No information available

Authorisation/Restrictions according to EU REACH

Component	REACH (1907/2006) - Annex XIV - Substances Subject to Authorization	REACH (1907/2006) - Annex XVII - Restrictions on Certain Dangerous Substances	REACH Regulation (EC 1907/2006) article 59 - Candidate List of Substances of Very High Concern (SVHC)
Nitric acid …% [C ≤ 70 %]	-	Use restricted. See item 75. (see link for restriction details)	-

https://echa.europa.eu/substances-restricted-under-reach

Safety, health and environmental regulations/legislation specific for the substance or mixture

Component	CAS No	OECD HPV	Persistent Organic Pollutant	Ozone Depletion Potential	Restriction of Hazardous Substances (RoHS)
Nitric acid …% [C ≤ 70 %]	7697-37-2	Listed	Not applicable	Not applicable	Not applicable
Water	7732-18-5	Listed	Not applicable	Not applicable	Not applicable

Component	CAS No	Seveso III Directive (2012/18/EC) - Qualifying Quantities for Major Accident Notification	Seveso III Directive (2012/18/EC) - Qualifying Quantities for Safety Report Requirements	Rotterdam Convention (PIC)	Basel Convention (Hazardous Waste)

Nitric acid …% [C ≤ 70 %]	7697-37-2	Not applicable	Not applicable	Not applicable	Annex I - Y34
Water	7732-18-5	Not applicable	Not applicable	Not applicable	Not applicable

16. Other information

Prepared By
Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 12-Mar-2009
Revision Date 24-Dec-2021
Print Date 24-Dec-2021
Revision Summary SDS sections updated. 2. 11.

Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

SAFETY DATA SHEET

Creation Date 24-Nov-2010 **Revision Date** 24-Dec-2021 **Revision Number** 5

1. Identification

Product Name **N,N-Diethyl-m-toluamide**

Cat No. : **AC114570000; AC114570025; AC114570050; AC114571000; AC114575000**

CAS No 134-62-3
Synonyms DEET

Recommended Use Laboratory chemicals.
Uses advised against Food, drug, pesticide or biocidal product use.

Details of the supplier of the safety data sheet

Company

Fisher Scientific Company
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Acute oral toxicity	Category 4
Skin Corrosion/Irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2

Label Elements

Signal Word
Warning

Hazard Statements
Harmful if swallowed

Causes skin irritation
Causes serious eye irritation



Precautionary Statements
Prevention
Wash face, hands and any exposed skin thoroughly after handling
Do not eat, drink or smoke when using this product
Wear protective gloves/protective clothing/eye protection/face protection
Skin
IF ON SKIN: Wash with plenty of soap and water
If skin irritation occurs: Get medical advice/attention
Take off contaminated clothing and wash before reuse
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
If eye irritation persists: Get medical advice/attention
Ingestion
IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell
Rinse mouth
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Harmful to aquatic life with long lasting effects

3. Composition/Information on Ingredients

Component	CAS No	Weight %
N,N-Diethyl-m-toluamide	134-62-3	<=100

4. First-aid measures

General Advice If symptoms persist, call a physician.

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. If skin irritation persists, call a physician.

Inhalation Remove to fresh air. If not breathing, give artificial respiration. Get medical attention if symptoms occur.

Ingestion Clean mouth with water and drink afterwards plenty of water.

Most important symptoms and effects No information available.

Notes to Physician Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media Water spray. Carbon dioxide (CO_2). Dry chemical. Chemical foam.

Unsuitable Extinguishing Media No information available

Flash Point 155 °C / 311 °F

Method - No information available

Autoignition Temperature No information available

Explosion Limits

Upper No data available

Lower No data available

Sensitivity to Mechanical Impact No information available

Sensitivity to Static Discharge No information available

Specific Hazards Arising from the Chemical

Keep product and empty container away from heat and sources of ignition.

Hazardous Combustion Products

Nitrogen oxides (NOx). Carbon monoxide (CO). Carbon dioxide (CO_2).

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
2	1	0	N/A

6. Accidental release measures

Personal Precautions Use personal protective equipment as required. Ensure adequate ventilation.

Environmental Precautions Should not be released into the environment. Do not flush into surface water or sanitary sewer system.

Methods for Containment and Clean Up Soak up with inert absorbent material. Keep in suitable, closed containers for disposal.

7. Handling and storage

Handling Wear personal protective equipment/face protection. Ensure adequate ventilation. Do not get in eyes, on skin, or on clothing. Avoid ingestion and inhalation.

Storage. Keep container tightly closed in a dry and well-ventilated place. Incompatible Materials. Strong oxidizing agents. Strong acids. Strong bases. Strong reducing agents.

8. Exposure controls / personal protection

Exposure Guidelines This product does not contain any hazardous materials with occupational exposure limitsestablished by the region specific regulatory bodies.

Engineering Measures Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection No protective equipment is needed under normal use conditions.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	Odorless
Odor Threshold	No information available
pH	No information available
Melting Point/Range	No data available
Boiling Point/Range	111 °C / 231.8 °F @ 1 mmHg
Flash Point	155 °C / 311 °F
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	19 mmHg @ 160 °C
Vapor Density	6.60
Specific Gravity	0.996
Solubility	Insoluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	13.3 cP at 30 °C
Molecular Formula	C12 H17 N O
Molecular Weight	191.27

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability No information available.

Conditions to Avoid Incompatible products. Excess heat.

Incompatible Materials Strong oxidizing agents, Strong acids, Strong bases, Strong reducing agents

Hazardous Decomposition Products Nitrogen oxides (NOx), Carbon monoxide (CO), Carbon dioxide (CO_2)

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
N,N-Diethyl-m-toluamide	LD50 = 1892 mg/kg (Rat)	LD50 = 3180 mg/kg (Rabbit)	LC50 = 5860 mg/m³ (Rat) 4 h LC50 = 6000 mg/m³ (Rat) 4 h

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation Irritating to eyes and skin

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS No	IARC	NTP	ACGIH	OSHA	Mexico
N,N-Diethyl-m-toluamide	134-62-3	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects Mutagenic effects have occurred in experimental animals.

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure None known
STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed No information available

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment. Contains a substance which is:. Harmful to aquatic organisms. The product contains following substances which are hazardous for the environment.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
N,N-Diethyl-m-toluamide	Not listed	LC50: = 71.25 mg/L, 96h static (Oncorhynchus mykiss) LC50: 106 - 114 mg/L, 96h flow-through (Pimephales promelas)	EC50 = 67.9 mg/L 5 min	Not listed

Persistence and Degradability Soluble in water Persistence is unlikely based on information available. Insoluble in water

Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its water solubility. Is not likely mobile in the environment due its low water solubility. Will likely be mobile in the environment due to its volatility.

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT Not regulated
TDG Not regulated

IATA Not regulated
IMDG/IMO Not regulated

15. Regulatory information

United States of America Inventory

Component	CAS No	TSCA	TSCA Inventory notification - Active-Inactive	TSCA - EPA Regulatory Flags
N,N-Diethyl-m-toluamide	134-62-3	X	ACTIVE	-

Legend:
TSCA US EPA (TSCA) - Toxic Substances Control Act, (40 CFR Part 710)
X - Listed
'-' - Not Listed

TSCA 12(b) - Notices of Export Not applicable

International Inventories
Canada (DSL/NDSL), Europe (EINECS/ELINCS/NLP), Philippines (PICCS), Japan (ENCS), Japan (ISHL), Australia (AICS), China (IECSC), Korea (KECL).

Component	CAS No	DSL	NDSL	EINECS	PICCS	ENCS	ISHL	AICS	IECSC	KECL
N,N-Diethyl-m-toluamide	134-62-3	X	-	205-149-7	X	X	X	X	X	KE-10492

KECL - NIER number or KE number (http://ncis.nier.go.kr/en/main.do)

U.S. Federal Regulations

SARA 313 Not applicable

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act) Not applicable

Clean Air Act Not applicable

OSHA - Occupational Safety and Health Administration Not applicable

CERCLA Not applicable

California Proposition 65 This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations Not applicable

U.S. Department of Transportation
Reportable Quantity (RQ): N
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade No information available

Authorisation/Restrictions according to EU REACH

Component	REACH (1907/2006) - Annex XIV - Substances Subject to Authorization	REACH (1907/2006) - Annex XVII - Restrictions on Certain Dangerous Substances	REACH Regulation (EC 1907/2006) article 59 - Candidate List of Substances of Very High Concern (SVHC)
N,N-Diethyl-m-toluamide	-	Use restricted. See item 75. (see link for restriction details)	-

https://echa.europa.eu/substances-restricted-under-reach

Safety, health and environmental regulations/legislation specific for the substance or mixture

Component	CAS No	OECD HPV	Persistent Organic Pollutant	Ozone Depletion Potential	Restriction of Hazardous Substances (RoHS)
N,N-Diethyl-m-toluamide	134-62-3	Not applicable	Not applicable	Not applicable	Not applicable

Component	CAS No	Seveso III Directive (2012/18/EC) - Qualifying Quantities for Major Accident Notification	Seveso III Directive (2012/18/EC) - Qualifying Quantities for Safety Report Requirements	Rotterdam Convention (PIC)	Basel Convention (Hazardous Waste)
N,N-Diethyl-m-toluamide	134-62-3	Not applicable	Not applicable	Not applicable	Not applicable

16. Other information

Prepared By
Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 24-Nov-2010
Revision Date 24-Dec-2021
Print Date 24-Dec-2021
Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

Section 1: IDENTIFICATION

Product Name: Simple Green® All-Purpose Cleaner
Additional Names:

Manufacturer's Part Number: **Please refer to Section 16*

Recommended Use: Cleaner & Degreaser for water tolerant surfaces.
Restrictions on Use: Do not use on non-rinseable surfaces.

Company: Sunshine Makers, Inc.
15922 Pacific Coast Highway
Huntington Beach, CA 92649 USA
Telephone: 800-228-0709 ● 562-795-6000 *Mon – Fri, 8am – 5pm PST*
Fax: 562-592-3830
Email: info@simplegreen.com
Emergency Phone: Chem-Tel 24-Hour Emergency Service: 800-255-3924

Section 2: HAZARDS IDENTIFICATION

This product is not considered hazardous under 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200).

OSHA HCS 2012
Label Elements
Signal Word: None
Hazard Symbol(s)/Pictogram(s): None required
Hazard Statements: None
Precautionary Statements: None
Hazards Not Otherwise Classified (HNOC): None
Other Information: None Known

Section 3: COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient	CAS Number	Percent Range
Water	7732-18-5	> 80.698%*
C9-11 Alcohols Ethoxylated	68439-46-3	< 5.000%*
Surfactant	Proprietary	< 5.000%*
Sodium Citrate	68-04-2	< 5.000%*
Sodium Carbonate	497-19-8	< 1.000%*
Tetrasodium Glutamate Diacetate	51981-21-6	< 1.000%*
Citric Acid	77-92-9	< 1.000%*
Blend of Polyoxyalkylene Substituted Chromophores (Cyan and Yellow)	Proprietary Mixture	< 0.100%*
Fragrances	Proprietary Mixture	< 1.000%*
Anethole	104-46-1	< 0.100%*
Eucalyptol	470-82-6	< 0.100%*
Methylchloroisothiazolinone	26172-55-4	< 0.001%*
Methylisothiazolinone	2682-20-4	< 0.0001%*

**specific percentages of composition are being withheld as a trade secret*

Section 4: FIRST-AID MEASURES

Inhalation: Not expected to cause respiratory irritation. If adverse effect occurs, move to fresh air.
Skin Contact: Not expected to cause skin irritation. If adverse effect occurs, rinse skin with water.
Eye Contact: Not expected to cause eye irritation. If adverse effect occurs, flush eyes with water.
Ingestion: May cause upset stomach. Drink plenty of water to dilute. See section 11.
Most Important Symptoms/Effects, Acute and Delayed: None known.

Section 4: FIRST-AID MEASURES - continued

Indication of Immediate Medical Attention and Special Treatment Needed, if necessary: Treat symptomatically

Section 5: FIRE-FIGHTING MEASURES

Suitable & Unsuitable Extinguishing Media: Use Dry chemical, CO2, water spray or "alcohol" foam. Avoid high volume jet water.
Specific Hazards Arising from Chemical: In event of fire, fire created carbon oxides may be formed.
Special Protective Actions for Fire-Fighters: Wear positive pressure self-contained breathing apparatus; Wear full protective clothing.

This product is non-flammable. See Section 9 for Physical Properties.

Section 6: ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment and Emergency Procedures: *For non-emergency and emergency personnel:* See section 8 – personal protection. Avoid eye contact. Safety goggles suggested.

Environmental Precautions: Do not allow into open waterways and ground water systems.

Methods and Materials for Containment and Clean Up: Dike or soak up with inert absorbent material. See section 13 for disposal considerations.

Section 7: HANDLING AND STORAGE

Precautions for Safe Handling: Ensure adequate ventilation. Keep out of reach of children. Keep away from heat, sparks, open flame and direct sunlight. Do not pierce any part of the container. Do not mix or contaminate with any other chemical. Do not eat, drink or smoke while using this product.

Conditions for Safe Storage including Incompatibilities: Keep container tightly closed. Keep in cool dry area. Avoid prolonged exposure to sunlight. Do not store at temperatures above 109°F (42.7°C). If separation occurs, mix the product for reconstitution.

Section 8: EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure Limit Values: No components listed with TWA or STEL values under OSHA or ACGIH.

Appropriate Engineering Controls: Showers, eyewash stations, ventilation systems

Individual Protection Measures / Personal Protective Equipment (PPE)
Eye Contact: Use protective glasses or safety goggles if splashing or spray-back is likely.
Respiratory: Use in well ventilated areas or local exhaust ventilations when cleaning small spaces.
Skin Contact: Use protective gloves (any material) when used for prolonged periods or dermally sensitive.
General Hygiene Considerations: Wash thoroughly after handling and before eating or drinking.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Green Liquid	**Partition Coefficient: n-octanol/water:**	Not determined
Odor:	Added sassafras odor	**Autoignition Temperature:**	Non-flammable
Odor Threshold:	Not determined	**Decomposition Temperature:**	42.7°C (109°F)
pH:	8.5 – 9.2	**Viscosity:**	Like water
Freezing Point:	0-3.33°C (32-38°F)	**Specific Gravity:**	1.01 – 1.03
Boiling Point & Range:	101°C (213.8°F)	**VOCs:**	***Water & fragrance exemption in calculation*

Section 9: PHYSICAL AND CHEMICAL PROPERTIES - continued

Flash Point:	> 212°F	SCAQMD 304-91 / EPA 24:	0 g/L	0 lb/gal	0%
Evaporation Rate:	Not determined	CARB Method 310**:	< 5 g/L	<0.0417lb/gal	<0.5%
Flammability (solid, gas):	Not applicable	SCAQMD Method 313:	Not tested		
Upper/Lower Flammability or Explosive Limits:	Not applicable	**VOC Composite Partial Pressure:**	Not determined		
Vapor Pressure:	0.60 PSI @77°F, 2.05 PSI @100°F	**Relative Density:**	8.42 – 8.59 lb/gal		
Vapor Density:	Not determined	**Solubility:**	100% in water		

Section 10: STABILITY AND REACTIVITY

Reactivity: Non-reactive.
Chemical Stability: Stable under normal conditions 70°F (21°C) and 14.7 psig (760 mmHg).
Possibility of Hazardous Reactions: None known.
Conditions to Avoid: Excessive heat or cold.
Incompatible Materials: Do not mix with oxidizers, acids, bathroom cleaners, or disinfecting agents.
Hazardous Decomposition Products: Normal products of combustion - CO, CO2.

Section 11: TOXICOLOGICAL INFORMATION

Likely Routes of Exposure:
Inhalation - Overexposure may cause headache.
Skin Contact - Not expected to cause irritation, repeated contact may cause dry skin.
Eye Contact - Not expected to cause irritation.
Ingestion - May cause upset stomach.

Symptoms related to the physical, chemical and toxicological characteristics: no symptoms expected under typical use conditions.
Delayed and immediate effects and or chronic effects from short term exposure: no symptoms expected under typical use conditions.
Delayed and immediate effects and or chronic effects from long term exposure: headache, dry skin, or skin irritation may occur.
Interactive effects: Not known.

Numerical Measures of Toxicity
Acute Toxicity: Oral LD_{50} (rat) > 5 g/kg body weight
Dermal LD_{50} (rabbit) > 5 g/kg body weight
Calculated via OSHA HCS 2012 / Globally Harmonized System of Classification and Labelling of Chemicals

Skin Corrosion/Irritation: Non-irritant per Dermal Irritection® assay modeling. No animal testing performed.
Eye Damage/Irritation: Non-irritant per Ocular Irritection® assay modeling. No animal testing performed.
Germ Cell Mutagenicity: Mixture does not classify under this category.
Carcinogenicity: Mixture does not classify under this category.
Reproductive Toxicity: Mixture does not classify under this category.
STOT-Single Exposure: Mixture does not classify under this category.
STOT-Repeated Exposure: Mixture does not classify under this category.
Aspiration Hazard: Mixture does not classify under this category.

Section 12: ECOLOGICAL INFORMATION

Ecotoxicity: Volume of ingredients used does not trigger toxicity classifications under the Globally Harmonized System of Classification and Labelling of Chemicals.
Aquatic: Aquatic Toxicity - Low, based on OECD 201, 202, 203 + Microtox: EC_{50} & IC_{50} ≥100 mg/L. Volume of ingredients used does not trigger toxicity classifications under the Globally Harmonized System of Classification and Labelling of Chemicals.
Terrestrial: Not tested on finished formulation.

Section 12: ECOLOGICAL INFORMATION - continued

Persistence and Degradability: Readily Biodegradable per OCED 301D, Closed Bottle Test. Reaches 100% biodegradation within 60 days.
Bioaccumulative Potential: No data available.
Mobility in Soil: No data available.
Other Adverse Effects: No data available.

Section 13: DISPOSAL CONSIDERATIONS

Unused or Used Liquid: May be considered hazardous in your area depending on usage and tonnage of disposal – check with local, regional, and or national regulations for appropriate methods of disposal.

Empty Containers: May be offered for recycling.

Never dispose of used degreasing rinsates into lakes, streams, and open bodies of water or storm drains.

Section 14: TRANSPORT INFORMATION

U.N. Number: Not applicable
U.N. Proper Shipping Name: Cleaning Compound, Liquid NOI
Transport Hazard Class(es): Not applicable
Packing Group: Not applicable
Environmental Hazards: Marine Pollutant - NO
Transport in Bulk (according to Annex II of MARPOL 73/78 and IBC Code): Unknown.
Special precautions which user needs to be aware of/comply with, in connection with transport or conveyance either within or outside their premises: None known.

U.S. (DOT) / Canadian TDG: Not Regulated for shipping.
IMO / IDMG: Not classified as Hazardous
ICAO/ IATA: Not classified as Hazardous
ADR/RID: Not classified as Hazardous

Section 15: REGULATORY INFORMATION

All components are listed on: TSCA and DSL Inventory.

SARA Title III: Sections 311/312 Hazard Categories – Not applicable.
Sections 313 Superfunds Amendments and Reauthorizations Act of 1986 – Not applicable.
Sections 302 – Not applicable.

Clean Air Act (CAA): Not applicable
Clean Water Act (CWA): Not applicable

State Right To Know Lists: No ingredients listed
California Proposition 65: No ingredients listed

This product has been classified as “not classifiable as hazardous” in accordance with Consumer Product Safety Commission (16 CFR Chapter 2) and labelled and packaged accordingly.

US Consumer Product Safety Commission Regulations
This product is labeled in accordance with regulations administered by the Consumer Product Safety Commission (CPSC). However, the use pattern and exposure in the workplace are generally not consistent with those experienced by consumers. Therefore, the requirements of the Occupational Safety and Health Administration applicable to this SDS differ from the labeling requirements of the CPSC, and this SDS may contain additional health hazard information not pertinent to consumer use and not found on the product label.

Section 16: OTHER INFORMATION

Size	UPC	Size	UPC
2 fl. oz.	043318131035	67.6 fl. oz.	043318000393
4 fl. oz.	043318130014	67.6 fl. oz.w/ dilution bottle	043318005442
16 fl. oz.	043318130021	140 fl. oz.	043318001390
22 fl. oz.	043318130229	140 fl. oz. w/ dilution bottle	043318001468
24 fl. oz.	043318006241	1 gallon	043318000799
24 fl. oz.	043318130137	1 gallon	043318004957
32 fl. oz.	043318000652	1 gallon	043318130052
32 fl. oz.	043318002557	1 gallon w/ dilution bottle	043318480416
32 fl. oz.	043318130335	1 gallon w/ dilution bottle	043318480492
67.6 fl. oz.	043318130144	2.5 gallon	043318004889

USA items listed only. Not all items listed. USA items may not be valid for international sale.

NFPA:
Health – None
Flammability – Non-flammable
Stability – Stable
Special - None



Acronyms

NTP	National Toxicology Program	IARC	International Agency for Research on Cancer
OSHA	Occupational Safety and Health Administration	CPSC	Consumer Product Safety Commission
TSCA	Toxic Substances Control Act	DSL	Domestic Substances List

Prepared / Revised By: Sunshine Makers, Inc., Regulatory Department.
This SDS has been revised in the following sections: Aligned Section 3 with California Ingredient Disclosure and minor fixes.

DISCLAIMER: The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

SAFETY DATA SHEET

Version 6.5
Revision Date 05/07/2021
Print Date 06/11/2022

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name : Naphthalene

Product Number : 147141
Brand : Aldrich
Index-No. : 601-052-00-2
CAS-No. : 91-20-3

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich Inc.
3050 SPRUCE ST
ST. LOUIS MO 63103
UNITED STATES

Telephone : +1 314 771-5765
Fax : +1 800 325-5052

1.4 Emergency telephone

Emergency Phone # : 800-424-9300 CHEMTREC (USA) +1-703-527-3887 CHEMTREC (International) 24 Hours/day; 7 Days/week

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

Flammable solids (Category 2), H228
Acute toxicity, Oral (Category 4), H302
Carcinogenicity (Category 2), H351
Short-term (acute) aquatic hazard (Category 1), H400
Long-term (chronic) aquatic hazard (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word Warning

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operates as MilliporeSigma in the US and Canada

Hazard statement(s)

H228	Flammable solid.
H302	Harmful if swallowed.
H351	Suspected of causing cancer.
H410	Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P210	Keep away from heat/ sparks/ open flames/ hot surfaces. No smoking.
P240	Ground/bond container and receiving equipment.
P241	Use explosion-proof electrical/ ventilating/ lighting/ equipment.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P312 + P330	IF SWALLOWED: Call a POISON CENTER/ doctor if you feel unwell. Rinse mouth.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
P391	Collect spillage.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

SECTION 3: Composition/information on ingredients

3.1 Substances

Formula	:	C10H8
Molecular weight	:	128.17 g/mol
CAS-No.	:	91-20-3
EC-No.	:	202-049-5
Index-No.	:	601-052-00-2

Component	Classification	Concentration
Naphthalene		
	Flam. Sol. 2; Acute Tox. 4; Carc. 2; Aquatic Acute 1; Aquatic Chronic 1; H228, H302, H351, H400, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

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SECTION 4: First aid measures

4.1 Description of first-aid measures

General advice
Show this material safety data sheet to the doctor in attendance.

If inhaled
After inhalation: fresh air. Call in physician.

In case of skin contact
In case of skin contact: Take off immediately all contaminated clothing. Rinse skin with water/ shower. Consult a physician.

In case of eye contact
After eye contact: rinse out with plenty of water. Call in ophthalmologist. Remove contact lenses.

If swallowed
After swallowing: immediately make victim drink water (two glasses at most). Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
Carbon oxides
Combustible.
Vapors are heavier than air and may spread along floors.
Forms explosive mixtures with air on intense heating.
Development of hazardous combustion gases or vapours possible in the event of fire.

5.3 Advice for firefighters
Stay in danger area only with self-contained breathing apparatus. Prevent skin contact by keeping a safe distance or by wearing suitable protective clothing.

5.4 Further information
Remove container from danger zone and cool with water. Prevent fire extinguishing water from contaminating surface water or the ground water system.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures
Advice for non-emergency personnel: Avoid inhalation of dusts. Avoid substance contact. Ensure adequate ventilation. Keep away from heat and sources of ignition. Evacuate the danger area, observe emergency procedures, consult an expert.

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For personal protection see section 8.

6.2 Environmental precautions
Do not let product enter drains. Risk of explosion.

6.3 Methods and materials for containment and cleaning up
Cover drains. Collect, bind, and pump off spills. Observe possible material restrictions (see sections 7 and 10). Take up dry. Dispose of properly. Clean up affected area. Avoid generation of dusts.

6.4 Reference to other sections
For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on safe handling
Work under hood. Do not inhale substance/mixture.

Advice on protection against fire and explosion
Keep away from open flames, hot surfaces and sources of ignition.Take precautionary measures against static discharge.

Hygiene measures
Immediately change contaminated clothing. Apply preventive skin protection. Wash hands and face after working with substance.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Storage conditions
Tightly closed. Keep away from heat and sources of ignition.
Storage class (TRGS 510): 4.1B: Flammable solid hazardous materials

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Ingredients with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Naphthalene	91-20-3	TWA	10 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Confirmed animal carcinogen with unknown relevance to humans Danger of cutaneous absorption		

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		TWA	10 ppm 50 mg/m3	USA. NIOSH Recommended Exposure Limits
		ST	15 ppm 75 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	10 ppm 50 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		PEL	0.1 ppm 0.5 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		Skin		

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Naphthalene	91-20-3	1-Naphthol + 2-Naphthol			ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift (As soon as possible after exposure ceases)			

8.2 Exposure controls

Appropriate engineering controls
Immediately change contaminated clothing. Apply preventive skin protection. Wash hands and face after working with substance.

Personal protective equipment

Eye/face protection
Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU). Safety glasses

Skin protection
This recommendation applies only to the product stated in the safety data sheet, supplied by us and for the designated use. When dissolving in or mixing with other substances and under conditions deviating from those stated in EN374 please contact the supplier of CE-approved gloves (e.g. KCL GmbH, D-36124 Eichenzell, Internet: www.kcl.de).
Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:KCL 741 Dermatril® L

This recommendation applies only to the product stated in the safety data sheet, supplied by us and for the designated use. When dissolving in or mixing with other substances and under conditions deviating from those stated in EN374 please contact the supplier of CE-approved gloves (e.g. KCL GmbH, D-36124 Eichenzell, Internet: www.kcl.de).
Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:KCL 741 Dermatril® L

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Body Protection
Flame retardant antistatic protective clothing.

Respiratory protection
required when dusts are generated. Our recommendations on filtering respiratory protection are based on the following standards: DIN EN 143, DIN 14387 and other accompanying standards relating to the used respiratory protection system.

Control of environmental exposure
Do not let product enter drains. Risk of explosion.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: flakes, granules Color: white
b)	Odor	aromatic
c)	Odor Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	Melting point/range: 80 - 82 °C (176 - 180 °F) - lit.
f)	Initial boiling point and boiling range	218 °C 424 °F - lit.
g)	Flash point	78.5 °C (173.3 °F) - closed cup - ISO 2719
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	The substance or mixture is a flammable solid with the category 2. - Flammability (solids)
j)	Upper/lower flammability or explosive limits	Upper explosion limit: 5.9 %(V) Lower explosion limit: 0.9 %(V)
k)	Vapor pressure	0.072 hPa at 20 °C (68 °F) - OECD Test Guideline 104
l)	Vapor density	No data available
m)	Relative density	No data available
n)	Water solubility	0.0308 g/l at 25 °C (77 °F) - OECD Test Guideline 105 - slightly soluble
o)	Partition coefficient: n-octanol/water	log Pow: 3.4 at 25 °C (77 °F) - OECD Test Guideline 107 - Bioaccumulation is not expected.
p)	Autoignition temperature	526 - 587 °C (979 - 1089 °F) at 1,013 hPa - DIN 51794
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety information

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Surface tension	31.8 mN/m at 100.0 °C (212.0 °F)

SECTION 10: Stability and reactivity

10.1 Reactivity

Forms explosive mixtures with air on intense heating.
A range from approx. 15 Kelvin below the flash point is to be rated as critical.
The following applies in general to flammable organic substances and mixtures: in correspondingly fine distribution, when whirled up a dust explosion potential may generally be assumed.

10.2 Chemical stability

The product is chemically stable under standard ambient conditions (room temperature) .

10.3 Possibility of hazardous reactions

Violent reactions possible with:
Oxidizing agents
chromium(VI) oxide
benzoyl chloride
aluminium chloride
Risk of explosion with:
nitrogen oxides

10.4 Conditions to avoid

Heat, flames and sparks.
Strong heating.

10.5 Incompatible materials

No data available

10.6 Hazardous decomposition products

In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - Mouse - female - 710 mg/kg
(OECD Test Guideline 401)
LC50 Inhalation - Rat - male and female - 4 h - > 0.4 mg/l
(OECD Test Guideline 403)
LD50 Dermal - Rabbit - 20,000 mg/kg
Remarks: (RTECS)
No data available

Skin corrosion/irritation
Skin - Rabbit
Result: No skin irritation - 24 h
Remarks: (ECHA)

Serious eye damage/eye irritation
Eyes - Rabbit
Result: No eye irritation - 24 h

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Remarks: (ECHA)

Respiratory or skin sensitization
Maximization Test - Guinea pig
Result: negative
(OECD Test Guideline 406)

Germ cell mutagenicity
Test Type: Mutagenicity (mammal cell test): chromosome aberration.
Test system: Chinese hamster ovary cells
Metabolic activation: Metabolic activation
Method: OECD Test Guideline 473
Result: positive
Test Type: Ames test
Test system: Salmonella typhimurium
Metabolic activation: with and without metabolic activation
Method: OECD Test Guideline 471
Result: negative
Test Type: unscheduled DNA synthesis assay
Species: Rat
Cell type: Liver cells
Application Route: Oral
Method: OECD Test Guideline 486
Result: negative
Test Type: Micronucleus test
Species: Mouse
Cell type: Bone marrow
Application Route: Intraperitoneal
Method: US-EPA
Result: negative
Remarks: (ECHA)

Carcinogenicity
Suspected of causing cancer.

IARC:	2B - Group 2B: Possibly carcinogenic to humans (Naphthalene)
	No ingredient of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC. (Naphthalene)
NTP:	No ingredient of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.
OSHA:	No component of this product present at levels greater than or equal to 0.1% is on OSHA's list of regulated carcinogens.

Reproductive toxicity
No data available

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

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11.2 Additional Information

Repeated dose toxicity - Rat - male and female - Oral - 91 Days - NOAEL (No observed adverse effect level) - 200 mg/kg - LOAEL (Lowest observed adverse effect level) - 400 mg/kg

Repeated dose toxicity - Mouse - male and female - Oral - 90 Days - NOAEL (No observed adverse effect level) - 100 mg/kg

Repeated dose toxicity - Rat - male and female - Dermal - 90 Days - NOAEL (No observed adverse effect level) - 1,000 mg/kg

Repeated dose toxicity - Rat - male and female - inhalation (vapor) - 90 Days - NOAEL (No observed adverse effect level) - 300 mg/kg

RTECS: QJ0525000
Absorption into the body leads to the formation of methemoglobin which in sufficient concentration causes cyanosis. Onset may be delayed 2 to 4 hours or longer., Naphthalene is retinotoxic and systemic absorption of its vapors above 15ppm, may result in:, cataracts, optic neuritis, corneal injury, Eye irritation, Ingestion may provoke the following symptoms:, hemolytic anemia, hemoglobinuria, Nausea, Headache, Vomiting, Gastrointestinal disturbance, Convulsions, anemia, Kidney injury may occur., Seizures., Coma.
To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Heart -

SECTION 12: Ecological information

12.1 Toxicity

Toxicity to fish	flow-through test LC50 - Oncorhynchus mykiss (rainbow trout) - 1.6 mg/l - 96 h (OECD Test Guideline 203)
	flow-through test LC50 - Pimephales promelas (fathead minnow) - 7.9 mg/l - 96 h (OECD Test Guideline 203)
Toxicity to daphnia and other aquatic invertebrates	static test EC50 - Daphnia magna (Water flea) - 2.16 mg/l - 48 h (OECD Test Guideline 202)
Toxicity to algae	static test EC50 - Pseudokirchneriella subcapitata (green algae) - 2.96 mg/l - 4 h Remarks: (ECHA)

12.2 Persistence and degradability

Biodegradability	aerobic - Exposure time 28 d Result: 2 % - Not readily biodegradable. (OECD Test Guideline 302C)

12.3 Bioaccumulative potential

Bioaccumulation	Cyprinus carpio (Carp) - 56 d

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at 25 °C(Naphthalene)

Bioconcentration factor (BCF): 36.5 - 168
(OECD Test Guideline 305)

Remarks: Bioaccumulation is unlikely.

12.4 Mobility in soil
No data available

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects
An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product
Waste material must be disposed of in accordance with the national and local regulations. Leave chemicals in original containers. No mixing with other waste. Handle uncleaned containers like the product itself. See www.retrologistik.com for processes regarding the return of chemicals and containers, or contact us there if you have further questions.

SECTION 14: Transport information

DOT (US)
UN number: 1334 Class: 4.1 Packing group: III
Proper shipping name: Naphthalene, refined
Reportable Quantity (RQ): 100 lbs
1) Marine pollutant: yesPoison Inhalation Hazard: No

IMDG
UN number: 1334 Class: 4.1 Packing group: III EMS-No: F-A, S-G
Proper shipping name: NAPHTHALENE, REFINED
Marine pollutant : yes

IATA
UN number: 1334 Class: 4.1 Packing group: III
Proper shipping name: Naphthalene, refined

SECTION 15: Regulatory information

SARA 302 Components
This material does not contain any components with a section 302 EHS TPQ.

SARA 313 Components

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This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards
Fire Hazard, Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components
No components are subject to the Massachusetts Right to Know Act.

SECTION 16: Other information

Further information
The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

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Version: 6.5 Revision Date: 05/07/2021 Print Date: 06/11/2022

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SAFETY DATA SHEET

Creation Date 23-Jun-2009 **Revision Date** 26-Dec-2021 **Revision Number** 9

1. Identification

Product Name **Sulfuric acid**

Cat No. : **AC424520000; AC424520025; AC424520026; AC424520100; AC424525000; AC424525001, AC424528000**

CAS No 7664-93-9
Synonyms No information available

Recommended Use Laboratory chemicals.
Uses advised against Food, drug, pesticide or biocidal product use.

Details of the supplier of the safety data sheet

Company

Fisher Scientific Company
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Skin Corrosion/Irritation	Category 1
Serious Eye Damage/Eye Irritation	Category 1
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Respiratory system.	

Label Elements

Signal Word
Danger

Hazard Statements

Causes severe skin burns and eye damage
May cause respiratory irritation



Precautionary Statements
Prevention
Do not breathe dust/fume/gas/mist/vapors/spray
Wash face, hands and any exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection
Use only outdoors or in a well-ventilated area
Response
Immediately call a POISON CENTER or doctor/physician
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Skin
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
Wash contaminated clothing before reuse
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
Ingestion
IF SWALLOWED: Rinse mouth. DO NOT induce vomiting
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)

WARNING. Cancer - https://www.p65warnings.ca.gov/.

3. Composition/Information on Ingredients

Component	CAS No	Weight %
Sulfuric acid	7664-93-9	>95

4. First-aid measures

General Advice
Immediate medical attention is required. Remove and isolate contaminated clothing and shoes.

Eye Contact
Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Immediate medical attention is required.

Skin Contact
Wash off immediately with plenty of water for at least 15 minutes. Immediate medical attention is required.

Inhalation
Remove to fresh air. If breathing is difficult, give oxygen. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Immediate medical attention is required.

Ingestion	Rinse mouth. Drink 1 or 2 glasses of water. Never give anything by mouth to an unconscious person. Do NOT induce vomiting. Call a physician or poison control center immediately.
Most important symptoms and effects	Causes burns by all exposure routes. . Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated: Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Substance is nonflammable; use agent most appropriate to extinguish surrounding fire.
Unsuitable Extinguishing Media	DO NOT USE WATER
Flash Point	No information available
Method -	No information available
Autoignition Temperature	No information available
Explosion Limits	
Upper	No data available
Lower	No data available
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Corrosive material. Reacts violently with water. Reaction with water may generate much heat which will increase the concentration of fumes in the air. Contact with metals may evolve flammable hydrogen gas. Non-combustible, substance itself does not burn but may decompose upon heating to produce corrosive and/or toxic fumes.

Hazardous Combustion Products
Hydrogen. Sulfur oxides.
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
3	0	2	W

6. Accidental release measures

Personal Precautions	Use personal protective equipment as required. Wear self-contained breathing apparatus and protective suit. Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak. Ensure adequate ventilation. Avoid contact with skin, eyes or clothing.
Environmental Precautions	Avoid release to the environment. See Section 12 for additional Ecological Information.
Methods for Containment and Clean Up	Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. After cleaning, flush away traces with water.

7. Handling and storage

Handling	Handle product only in closed system or provide appropriate exhaust ventilation. Wear personal protective equipment/face protection. Do not get in eyes, on skin, or on clothing. Do not breathe (dust, vapor, mist, gas). Do not ingest. If swallowed then seek immediate medical assistance.
Storage.	Keep containers tightly closed in a dry, cool and well-ventilated place. Corrosives area.

Incompatible Materials. Strong oxidizing agents. Combustible material. Bases. Organic materials. Reducing Agent. Finely powdered metals. Peroxides.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Sulfuric acid	TWA: 0.2 mg/m³	(Vacated) TWA: 1 mg/m³ TWA: 1 mg/m³	IDLH: 15 mg/m³ TWA: 1 mg/m³	TWA: 0.2 mg/m³

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: NIOSH - National Institute for Occupational Safety and Health

Engineering Measures Handle in a place equipped with local exhaust ventilation. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	Odorless
Odor Threshold	No information available
pH	1 1N aq.sol
Melting Point/Range	10 °C / 50 °F
Boiling Point/Range	290 °C / 554 °F
Flash Point	No information available
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	1 mmHg @ 146 °C
Vapor Density	No information available
Specific Gravity	1.840
Solubility	No information available
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	340 °C
Viscosity	21mPa.s @ 25 °C
Molecular Formula	H2 O4 S
Molecular Weight	98.07

10. Stability and reactivity

Reactive Hazard Yes

Stability Water reactive. Hygroscopic.

Conditions to Avoid Incompatible products. Excess heat. Exposure to moist air or water.

Incompatible Materials Strong oxidizing agents, Combustible material, Bases, Organic materials, Reducing Agent, Finely powdered metals, Peroxides

Hazardous Decomposition Products Hydrogen, Sulfur oxides

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions Contact with metals may evolve flammable hydrogen gas. Reacts violently with water.

11. Toxicological information

Acute Toxicity

Product Information

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Sulfuric acid	2140 mg/kg (Rat)	Not listed	LC50 = 0.375 mg/L (Rat) 4 h

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation Causes severe burns by all exposure routes

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS No	IARC	NTP	ACGIH	OSHA	Mexico
Sulfuric acid	7664-93-9	Group 1	Known	A2	X	A2

IARC (International Agency for Research on Cancer)

ACGIH: (American Conference of Governmental Industrial Hygienists)

IARC (International Agency for Research on Cancer)
Group 1 - Carcinogenic to Humans
Group 2A - Probably Carcinogenic to Humans
Group 2B - Possibly Carcinogenic to Humans
A1 - Known Human Carcinogen
A2 - Suspected Human Carcinogen
A3 - Animal Carcinogen
ACGIH: (American Conference of Governmental Industrial Hygienists)

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure Respiratory system

STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated: Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Do not empty into drains. Large amounts will affect pH and harm aquatic organisms.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Sulfuric acid	-	LC50: > 500 mg/L, 96h static (Brachydanio rerio)	-	EC50: 29 mg/L/24h

Persistence and Degradability Miscible with water Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its water solubility.

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT

UN-No UN1830
Proper Shipping Name SULFURIC ACID
Hazard Class 8
Packing Group II

TDG

UN-No UN1830
Proper Shipping Name SULFURIC ACID
Hazard Class 8
Packing Group II

IATA

UN-No UN1830
Proper Shipping Name SULFURIC ACID
Hazard Class 8
Packing Group II

IMDG/IMO

UN-No UN1830
Proper Shipping Name SULFURIC ACID
Hazard Class 8
Packing Group II

15. Regulatory information

United States of America Inventory

Component	CAS No	TSCA	TSCA Inventory notification - Active-Inactive	TSCA - EPA Regulatory Flags
Sulfuric acid	7664-93-9	X	ACTIVE	-

Legend:
TSCA US EPA (TSCA) - Toxic Substances Control Act, (40 CFR Part 710)
X - Listed
'-' - Not Listed

TSCA 12(b) - Notices of Export Not applicable

International Inventories

Canada (DSL/NDSL), Europe (EINECS/ELINCS/NLP), Philippines (PICCS), Japan (ENCS), Japan (ISHL), Australia (AICS), China (IECSC), Korea (KECL).

Component	CAS No	DSL	NDSL	EINECS	PICCS	ENCS	ISHL	AICS	IECSC	KECL
Sulfuric acid	7664-93-9	X	-	231-639-5	X	X	X	X	X	KE-32570

KECL - NIER number or KE number (http://ncis.nier.go.kr/en/main.do)

U.S. Federal Regulations

SARA 313

Component	CAS No	Weight %	SARA 313 - Threshold Values %
Sulfuric acid	7664-93-9	>95	1.0

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Sulfuric acid	X	1000 lb	-	-

Clean Air Act Not applicable

OSHA - Occupational Safety and Health Administration Not applicable

CERCLA This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Sulfuric acid	1000 lb	1000 lb

California Proposition 65 This product contains the following Proposition 65 chemicals.

Component	CAS No	California Prop. 65	Prop 65 NSRL	Category
Sulfuric acid	7664-93-9	Carcinogen	-	Carcinogen

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Sulfuric acid	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ): Y
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade No information available

Authorisation/Restrictions according to EU REACH

Component	REACH (1907/2006) - Annex XIV - Substances Subject to Authorization	REACH (1907/2006) - Annex XVII - Restrictions on Certain Dangerous Substances	REACH Regulation (EC 1907/2006) article 59 - Candidate List of Substances of Very High Concern (SVHC)
Sulfuric acid	-	Use restricted. See item 75. (see link for restriction details)	-

https://echa.europa.eu/substances-restricted-under-reach

Safety, health and environmental regulations/legislation specific for the substance or mixture

Component	CAS No	OECD HPV	Persistent Organic Pollutant	Ozone Depletion Potential	Restriction of Hazardous Substances (RoHS)
Sulfuric acid	7664-93-9	Listed	Not applicable	Not applicable	Not applicable

Component	CAS No	Seveso III Directive (2012/18/EC) - Qualifying Quantities for Major Accident Notification	Seveso III Directive (2012/18/EC) - Qualifying Quantities for Safety Report Requirements	Rotterdam Convention (PIC)	Basel Convention (Hazardous Waste)
Sulfuric acid	7664-93-9	Not applicable	Not applicable	Not applicable	Annex I - Y34

16. Other information

Prepared By
Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 23-Jun-2009
Revision Date 26-Dec-2021
Print Date 26-Dec-2021
Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

SAFETY DATA SHEET

SDS ID NO.: 0130MAR019 **Revision date** 07/07/2020

1. IDENTIFICATION

Product Name Marathon Petroleum Gasoline with Ethanol - All Grades

Synonym Gasoline with Ethanol; Gasohol; Regular Unleaded Gasoline with Ethanol; Midgrade Unleaded Gasoline with Ethanol; Premium Unleaded Gasoline with Ethanol; Top Tier Gasoline; 0128MAR019; 0129MAR019

Product code 0130MAR019

Chemical family Complex Hydrocarbon Substance

Recommended use Fuel.

Restrictions on use All others.

Manufacturer, Importer, or Responsible Party Name and Address

MARATHON PETROLEUM COMPANY LP
539 South Main Street
Findlay, OH 45840

SDS Information 1-419-421-3070 (M-F; 8-5 EST)

24 Hour Emergency Telephone CHEMTREC: 1-800-424-9300 (CCN# 13740)

2. HAZARD IDENTIFICATION

OSHA Regulatory Status
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Classification

Flammable liquids	Category 1
Skin corrosion/irritation	Category 2
Germ cell mutagenicity	Category 1B
Carcinogenicity	Category 1A
Reproductive toxicity	Category 2
Specific target organ toxicity (single exposure)	Category 3
Specific target organ toxicity (repeated exposure)	Category 1
Aspiration toxicity	Category 1
Chronic aquatic toxicity	Category 2

Hazards Not Otherwise Classified (HNOC)
Static accumulating flammable liquid

Label Elements

Danger

EXTREMELY FLAMMABLE LIQUID AND VAPOR
May accumulate electrostatic charge and ignite or explode
May be fatal if swallowed and enters airways
Causes skin irritation
May cause respiratory irritation
May cause drowsiness or dizziness

May cause genetic defects
May cause cancer
Suspected of damaging fertility or the unborn child
Causes damage to organs (blood, blood-forming organs, immune system) through prolonged or repeated exposure
Toxic to aquatic life with long lasting effects



Appearance Clear yellow liquid **Physical State** Liquid **Odor** Hydrocarbon

Precautionary Statements - Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools.
Take precautionary measures against static discharge
Do not eat, drink or smoke when using this product
Do not breathe mist/vapors/spray
Use only outdoors or in a well-ventilated area
Wear protective gloves/protective clothing/eye protection/face protection
Wash hands and any possibly exposed skin thoroughly after handling
Avoid release to the environment

Precautionary Statements - Response
If exposed, concerned or you feel unwell: Get medical attention
If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
If skin irritation occurs: Get medical attention
Wash contaminated clothing before reuse
If inhaled: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Call a poison center or doctor if you feel unwell
If swallowed: Immediately call a poison center or doctor
Do NOT induce vomiting
In case of fire: Use water spray, fog or regular foam for extinction
Collect spillage

Precautionary Statements - Storage
Store in a well-ventilated place. Keep container tightly closed
Keep cool
Store locked up

Precautionary Statements - Disposal
Dispose of contents/container at an approved waste disposal plant

3. COMPOSITION/INFORMATION ON INGREDIENTS

Composition Information

Name	CAS Number	% Concentration
Gasoline	86290-81-5	90-100

Heptane (mixed isomers)	142-82-5	2.5-26
Toluene	108-88-3	1-20
Pentane (mixed isomers)	109-66-0	6-19
Butane (mixed isomers)	106-97-8	0.5-14
Hexane Isomers (other than n-Hexane)	107-83-5	2-12
Ethyl Alcohol	64-17-5	0-10
Xylene (mixed isomers)	1330-20-7	2-10
Benzene	71-43-2	0.1-4.9
n-Hexane	110-54-3	0.2-4.5
Cumene	98-82-8	0-4
1,2,4 Trimethylbenzene	95-63-6	0.5-4
Ethylbenzene	100-41-4	0-2.5
Cyclohexane	110-82-7	0-1.5
Octane	111-65-9	0-1.5
1,2,3-Trimethylbenzene	526-73-8	0-1
Naphthalene	91-20-3	0-0.5

Benzene concentration is percent by volume. All other concentrations are percent by weight unless material is a gas. Gas concentrations are in percent by volume.

4. FIRST AID MEASURES

First aid measures

General advice In case of accident or if you feel unwell, seek medical advice immediately (show directions for use or safety data sheet if possible).

Inhalation Remove to fresh air. If not breathing, utilize bag valve mask or other form of barrier device to institute rescue breathing. If breathing is difficult, ensure airway is clear, give oxygen and continue to monitor. If heart has stopped, immediately begin cardiopulmonary resuscitation (CPR). Keep affected person warm and at rest. If symptoms occur get medical attention.

Skin contact Immediately wash exposed skin with plenty of soap and water while removing contaminated clothing and shoes. Place contaminated clothing in closed container until cleaned or discarded. If clothing is to be laundered, inform the person performing the operation of contaminant's hazardous properties. Get medical attention if irritation persists. Any injection injury from high pressure equipment should be evaluated immediately by a physician as potentially serious (See NOTES TO PHYSICIAN).

Eye contact Flush immediately with large amounts of water for at least 15 minutes. Gently remove contacts while flushing. Eyelids should be held away from the eyeball to ensure thorough rinsing. Gently remove contacts while flushing. Get medical attention if irritation persists.

Ingestion Do not induce vomiting because of danger of aspirating liquid into lungs, causing serious damage and chemical pneumonitis. If spontaneous vomiting occurs, keep head below hips, or if patient is lying down, turn body and head to side to prevent aspiration and monitor for breathing difficulty. Never give anything by mouth to an unconscious person. Keep affected person warm and at rest. Get immediate medical attention.

Most important signs and symptoms, both short-term and delayed with overexposure

Adverse effects Irritating to the skin and mucous membranes. Symptoms may include redness, itching, and inflammation. May cause nausea, vomiting, diarrhea, and signs of nervous system depression: headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue. Aspiration hazard. May cause coughing, chest pains, shortness of breath, pulmonary edema and/or chemical pneumonitis. Prolonged or repeated exposure may cause adverse effects on blood, blood-forming organs, and immune system. Repeated or prolonged skin contact may cause drying, reddening, itching and cracking.

Indication of any immediate medical attention and special treatment needed

Notes to physician

INHALATION: This material (or a component) sensitizes the myocardium to the effects of sympathomimetic amines. Epinephrine and other sympathomimetic drugs may initiate cardiac arrhythmias in individuals exposed to this material. Administration of sympathomimetic drugs should be avoided.

SKIN: Leaks or accidents involving high-pressure equipment may inject a stream of material through the skin and initially produce an injury that may not appear serious. Only a small puncture wound may appear on the skin surface but, without proper treatment and depending on the nature, original pressure, volume, and location of the injected material, can compromise blood supply to an affected body part. Prompt surgical debridement of the wound may be necessary to prevent irreversible loss of function and/or the affected body part. High pressure injection injuries may be SERIOUS SURGICAL EMERGENCIES.

INGESTION: This material represents a significant aspiration and chemical pneumonitis hazard. Induction of emesis is not recommended.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media

For small fires, Class B fire extinguishing media such as CO2, dry chemical, foam (AFFF/ATC) or water spray can be used. For large fires, water spray, fog or foam (AFFF/ATC) can be used. Firefighting should be attempted only by those who are adequately trained and equipped with proper protective equipment.

Unsuitable extinguishing media

Do not use straight water streams to avoid spreading fire.

Specific hazards arising from the chemical

This product has been determined to be an extremely flammable liquid per the OSHA Hazard Communication Standard and should be handled accordingly. May accumulate electrostatic charge and ignite or explode. Vapors may travel along the ground or be moved by ventilation and ignited by many sources such as pilot lights, sparks, electric motors, static discharge, or other ignition sources at locations distant from material handling. Flashback can occur along vapor trail. For additional fire related information, see NFPA 30 or the Emergency Response Guidebook 128.

Hazardous combustion products

Smoke, carbon monoxide, and other products of incomplete combustion.

Explosion data

Sensitivity to mechanical impact: No.

Sensitivity to static discharge: Yes.

Special protective equipment and precautions for firefighters

Firefighters should wear full protective clothing and positive-pressure self-contained breathing apparatus (SCBA) with a full face-piece, as appropriate. Avoid using straight water streams. Water may be ineffective in extinguishing low flash point fires, but can be used to cool exposed surfaces. Avoid excessive water spray application. Water spray and foam (AFFF/ATC) must be applied carefully to avoid frothing and from as far a distance as possible. Keep run-off water out of sewers and water sources.

Additional firefighting tactics

FIRES INVOLVING TANKS OR CAR/TRAILER LOADS: Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Cool containers with flooding quantities of water until well after the fire is out. Do not direct water at source of leak or safety devices; icing may occur. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles: if this is impossible, withdraw from area and let fire burn.

EVACUATION: Consider initial downwind evacuation for at least 1000 feet. If tank, rail car or tank truck is involved in a fire, ISOLATE for 2640 feet (1/2 mile) in all directions; also, consider initial evacuation of 2640 feet (1/2 mile) in all directions.

NFPA	Health 1	Flammability 3	Instability 0	Special Hazard -

6. ACCIDENTAL RELEASE MEASURES

Personal precautions

Keep public away. Isolate and evacuate area. Shut off source if safe to do so. Eliminate all ignition sources.

Protective equipment

Use personal protection measures as recommended in Section 8.

Emergency procedures

Advise authorities and National Response Center (800-424-8802) if the product has entered a water course or sewer. Notify local health and pollution control agencies, if appropriate.

Environmental precautions

Avoid release to the environment. Avoid subsoil penetration. Ethanol in gasoline phase seperates in contact with water. Monitor downstream for dissolved ethanol or other appropriate indicators.

Methods and materials for containment

Contain liquid with sand or soil. Prevent spilled material from entering storm drains, sewers, and open waterways.

Methods and materials for cleaning up

Use suitable absorbent materials such as vermiculite, sand, or clay to clean up residual liquids. Recover and return free product to proper containers. When recovering free liquids ensure all equipment is grounded and bonded. Use only non-sparking tools.

7. HANDLING AND STORAGE

Safe handling precautions

NEVER SIPHON THIS PRODUCT BY MOUTH. Use appropriate grounding and bonding practices. Static accumulating flammable liquid. Bonding and grounding may be insufficient to eliminate the hazard from static electricity. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. Vapors may travel along the ground or be moved by ventilation. Flashback may occur along vapor trails. No smoking. Use only non-sparking tools. Avoid contact with skin, eyes and clothing. Avoid breathing fumes, gas, or vapors. Use only with adequate ventilation. Avoid repeated and prolonged skin contact. Use personal protection measures as recommended in Section 8. Exercise good personal hygiene including removal of soiled clothing and prompt washing with soap and water. Do not cut, drill, grind or weld on empty containers since explosive residues may remain. Refer to applicable EPA, OSHA, NFPA and consistent state and local requirements.

Hydrocarbons are basically non-conductors of electricity and can become electrostatically charged during mixing, filtering, pumping at high flow rates or loading and transfer operations. If this charge reaches a sufficiently high level, sparks can form that may ignite the vapors of flammable liquids. Sudden release of hot organic chemical vapors or mists from process equipment operating under elevated temperature and pressure, or sudden ingress of air into vacuum equipment may result in ignition of vapors or mists without the presence of obvious ignition sources. Nozzle spouts must be kept in contact with the containers or tank during the entire filling operation.

Portable containers should never be filled while in or on a motor vehicle or marine craft. Containers should be placed on the ground. Static electric discharge can ignite fuel vapors when filling non-grounded containers or vehicles on trailers. The nozzle spout must be kept in contact with the container before and during the entire filling operation. Use only approved containers.

A buildup of static electricity can occur upon re-entry into a vehicle during fueling especially in cold or dry climate conditions. The charge is generated by the action of dissimilar fabrics (i.e., clothing and upholstery) rubbing across each other as a person enters/exits the vehicle. A flash fire can result from this discharge if sufficient flammable vapors are present. Therefore, do not get back in your vehicle while refueling.

Cellular phones and other electronic devices may have the potential to emit electrical charges (sparks). Sparks in potentially explosive atmospheres (including fueling areas such as gas stations) could cause an explosion if sufficient flammable vapors are present. Therefore, turn off cellular phones and other electronic devices when working in potentially explosive atmospheres or keep devices inside your vehicle during refueling.

High-pressure injection of any material through the skin is a serious medical emergency even though the small entrance wound at the injection site may not initially appear serious. These injection injuries can occur from high-pressure equipment such as paint spray or grease or guns, fuel injectors, or pinhole leaks in hoses or hydraulic lines and should all be considered serious. High pressure injection injuries may be SERIOUS SURGICAL EMERGENCIES (See First Aid Section 4).

Storage conditions Store in properly closed containers that are appropriately labeled and in a cool, well-ventilated area. Do not store near an open flame, heat or other sources of ignition.

Incompatible materials Strong oxidizing agents.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Name	ACGIH TLV	OSHA PELS	NIOSH IDLH
Gasoline 86290-81-5	300 ppm TWA 500 ppm STEL	-	-
Heptane (mixed isomers) 142-82-5	400 ppm TWA 500 ppm STEL	TWA: 500 ppm TWA: 2000 mg/m^3	750 ppm
Toluene 108-88-3	20 ppm TWA	TWA: 200 ppm Ceiling: 300 ppm	500 ppm
Pentane (mixed isomers) 109-66-0	1000 ppm TWA	TWA: 1000 ppm TWA: 2950 mg/m^3	1500 ppm
Butane (mixed isomers) 106-97-8	1000 ppm STEL	-	1600 ppm
Hexane Isomers (other than n-Hexane) 107-83-5	500 ppm TWA 1000 ppm STEL	-	-
Ethyl Alcohol 64-17-5	1000 ppm STEL	TWA: 1000 ppm TWA: 1900 mg/m^3	3300 ppm
Xylene (mixed isomers) 1330-20-7	100 ppm TWA 150 ppm STEL	TWA: 100 ppm TWA: 435 mg/m^3	900 ppm
Benzene 71-43-2	0.5 ppm TWA 2.5 ppm STEL Skin - potential significant contribution to overall exposure by the cutaneous route	TWA: 10 ppm (applies to industry segments exempt from the benzene standard) TWA: 1 ppm STEL: 5 ppm (see 29 CFR 1910.1028)	500 ppm
n-Hexane 110-54-3	50 ppm TWA Skin - potential significant contribution to overall exposure by the cutaneous route	TWA: 500 ppm TWA: 1800 mg/m^3	1100 ppm
Cumene 98-82-8	50 ppm TWA	TWA: 50 ppm TWA: 245 mg/m^3 Skin	900 ppm
1,2,4 Trimethylbenzene 95-63-6	25 ppm TWA	-	-
Ethylbenzene 100-41-4	20 ppm TWA	TWA: 100 ppm TWA: 435 mg/m^3	800 ppm
Cyclohexane 110-82-7	100 ppm TWA	TWA: 300 ppm TWA: 1050 mg/m^3	1300 ppm
Octane 111-65-9	300 ppm TWA	TWA: 500 ppm TWA: 2350 mg/m^3	1000 ppm

1,2,3-Trimethylbenzene 526-73-8	25 ppm TWA	-	-
Naphthalene 91-20-3	10 ppm TWA Skin - potential significant contribution to overall exposure by the cutaneous route	TWA: 10 ppm TWA: 50 mg/m³	250 ppm

Notes: No further information available.

Engineering measures Local or general exhaust required in an enclosed area or when there is inadequate ventilation. Use mechanical ventilation equipment that is explosion-proof.

Personal protective equipment

Eye protection Use goggles or face-shield if the potential for splashing exists.

Skin and body protection Use nitrile rubber, Viton® or PVA gloves for repeated or prolonged skin exposure. Glove suitability is based on workplace conditions and usage. Contact the glove manufacturer for specific advice on glove selection and breakthrough times.

Respiratory protection Use a NIOSH approved organic vapor chemical cartridge or supplied air respirators when there is the potential for airborne exposures to exceed permissible exposure limits or if excessive vapors are generated. Observe respirator assigned protection factors (APFs) criteria cited in federal OSHA 29 CFR 1910.134. Self-contained breathing apparatus should be used for fire fighting.

Hygiene measures Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes and clothing.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Appearance	Clear yellow liquid
Physical State	Liquid
Color	Yellow
Odor	Hydrocarbon
Odor Threshold	No data available.

Property	**Values (method)**
pH	Not applicable
Melting Point / Freezing Point	No data available.
Initial Boiling Point / Boiling Range	21-222 °C / 70-432 °F (ASTM D86)
Flash Point	-43 °C / -45 °F
Evaporation Rate	No data available.
Flammability (solid, gas)	Not applicable.
Flammability Limit in Air (%):	
Upper Flammability Limit:	7.6
Lower Flammability Limit:	1.4
Explosion Limits	No data available.
Vapor Pressure	5.5-15 psi (ASTM D4814)
Vapor Density	3-4
Specific Gravity / Relative Density	0.76 (0.69-0.76)
Water Solubility	Negligible
Partition Coefficient	2.13-4.5
Autoignition Temperature	280 °C / 536 °F
Decomposition Temperature	No data available.
Kinematic Viscosity	No data available.
VOC Content (%)	100%

10. STABILITY AND REACTIVITY

Reactivity The product is non-reactive under normal conditions.

Chemical stability The material is stable at 70°F (21°C), 760 mmHg pressure.

Possibility of hazardous reactions None under normal processing.

Hazardous polymerization Will not occur.

Conditions to avoid Excessive heat, sources of ignition, open flame.

Incompatible materials Strong oxidizing agents.

Hazardous decomposition products None known under normal conditions of use. However, use in an area without adequate ventilation may result in hazardous levels of carbon monoxide and carbon dioxide.

11. TOXICOLOGICAL INFORMATION

Potential short-term adverse effects from overexposures

Inhalation May cause irritation of respiratory tract. May cause drowsiness or dizziness. Breathing high concentrations of this material in a confined space or by intentional abuse can cause irregular heartbeats which can cause death.

Eye contact Exposure to vapor or contact with liquid may cause mild eye irritation, including tearing, stinging, and redness.

Skin contact Causes skin irritation. Effects may become more serious with repeated or prolonged contact. May be absorbed through the skin in harmful amounts.

Ingestion May be fatal if swallowed or vomited and enters airways. May cause irritation of the mouth, throat and gastrointestinal tract.

Acute toxicological data

Name	Oral LD50	Dermal LD50	Inhalation LC50
Gasoline 86290-81-5	14000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 5.2 mg/L (Rat) 4 h
Heptane (mixed isomers) 142-82-5	-	3000 mg/kg (Rabbit)	103 g/m³ (Rat) 4 h
Toluene 108-88-3	> 2000 mg/kg (Rat)	8390 mg/kg (Rabbit)	12.5 mg/L (Rat) 4 h
Pentane (mixed isomers) 109-66-0	-	-	364 mg/L (Rat) 4 h
Butane (mixed isomers) 106-97-8	-	-	658 mg/L (Rat) 4 h
Hexane Isomers (other than n-Hexane) 107-83-5	> 5000 mg/kg (Rat)	-	-
Ethyl Alcohol 64-17-5	> 5000 mg/kg (Rat)	-	124.7 mg/L (Rat) 4 h
Xylene (mixed isomers) 1330-20-7	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 5.04 mg/L (Rat) 4 h
Benzene 71-43-2	> 2000 mg/kg (Rat)	> 5000 mg/kg (Rabbit)	> 20 mg/l (Rat) 4 h
n-Hexane 110-54-3	15000 mg/kg (Rat)	3000 mg/kg (Rabbit)	48000 ppm (Rat) 4 h
Cumene 98-82-8	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 20 mg/L (Rat) 6 h
1,2,4 Trimethylbenzene 95-63-6	3280 mg/kg (Rat)	> 3160 mg/kg (Rabbit)	18,000 mg/m³ (Rat) 4 h
Ethylbenzene 100-41-4	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	17.2 mg/L (Rat) 4 h
Cyclohexane	> 5000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	13.9 mg/L (Rat) 4 h

110-82-7			
Octane 111-65-9	-	-	118 g/m³ (Rat) 4 h
Naphthalene 91-20-3	533 mg/kg (Mouse)	> 2000 mg/kg (Rabbit)	> 340 mg/m³ (Rat) 1 h

Immediate and delayed effects as well as chronic effects from short and long-term exposure

GASOLINE: Gasoline blending streams, or naphthas, may be fatal if swallowed and enter the airway. Vapors may be irritating if inhaled. Altered mental state, drowsiness, dizziness, peripheral motor neuropathy, irreversible brain damage (gasoline sniffer's neuropathy), delirium, seizures, and sudden death have been reported from repeated exposure or overexposure. Lifetime exposure of laboratory mice and rats to wholly-vaporized unleaded gasoline produced an increased incidence of liver tumors in female mice at the highest exposure concentration and α-2 urinary globulin-mediated kidney tumors in male rats. Lifetime repeated application of various gasoline blending streams or naphthas to the skin of mice caused an irritation-dependent increased incidence of skin tumors. These tumors occur through a mechanism of questionable human relevance.

TOLUENE: Inhalation abuse of toluene at high concentrations has been associated with adverse effects on the liver, kidney and nervous system, and can cause nervous system depression, cardiac arrhythmias, and death. Studies of workers indicate long-term exposure may be related to impaired color vision and hearing. Some studies of workers suggest long-term exposure may be associated with neurobehavioral and mental functional changes. Laboratory animal studies indicate some changes in reproductive organs after exposure to high airborne concentrations, but no significant effects on mating performance or reproduction were observed. Positive findings include small increases in minor skeletal and visceral malformations and developmental delays following maternal exposure to high concentrations. Adverse effects on the liver, kidney, thymus and nervous system of laboratory animal were observed after very high levels of prolonged and repeated exposure.

BUTANE and PENTANE: Laboratory animal studies indicate exposure to extremely high levels (1-10 vol.% in air) may cause cardiac arrhythmias (irregular heartbeats) which may be serious or fatal.

ETHANOL: Repeated ingestion of ethanol can result in alcohol abuse, causing behavioral changes, memory loss, impaired judgement, decreased appetite, irregular heartbeats, and decreased fertility. Prolonged and repeated ingestion of ethanol has also been associated with cancers of the mouth, pharynx, esophagus and liver. Ethanol ingestion by pregnant women can cause miscarriage, low birth weight, premature birth and fetal alcohol syndrome. In males, acute and chronic alcohol ingestion may affect gonadal hormone levels. It may also affect the liver, kidney, brain, blood and cardiovascular system.

XYLENE: Overexposure to airborne xylene may cause upper respiratory tract irritation, headache, cyanosis, blood serum changes, nervous system damage and narcosis. Impaired neurological function has been reported in workers exposed to solvents including xylene. Laboratory animal studies have shown evidence of impaired hearing after prolonged exposure high airborne concentrations. Laboratory animal studies suggest some changes in reproductive organs after exposure to high airborne concentrations of xylene without an effect on reproduction. Skeletal and visceral malformations, developmental delays, and increased fetal resorptions were observed in laboratory animals after extremely high airborne concentrations with evidence of maternal toxicity. Adverse effects on the liver, kidney, and bone marrow were observed in laboratory animals after prolonged and repeated exposure to high airborne concentrations of xylene.

BENZENE: Benzene exposure may cause skin, eye and respiratory irritation. Excessive exposures may cause central nervous system effects. Numerous studies of workers exposed to airborne benzene for prolonged or repeated periods show strong evidence that overexposure can cause cancer of the blood, AML (acute myeloid leukemia), along with other disorders indicating damage to the blood forming organs including aplastic anemia, leukopenia, thrombocytopenia, and the development of myelodysplastic syndrome. Some studies of pregnant women occupationally exposed to benzene suggest associations with an increased risk of miscarriage, stillbirth, reduced birth weight, and gestational age. Prolonged and repeated exposure to benzene has induced chromosomal aberrations in circulating human lymphocytes, in bone marrow cells of laboratory animals, and in sperm cells of both humans and laboratory animals.

N-HEXANE: Short-term overexposure to n-hexane vapor may cause headache, nausea, vomiting, dizziness, lightheadedness, loss of consciousness, coma, and even death in humans. Respiratory effects of overexposure may include nose, throat, and lung irritation, coughing, wheezing, and shortness of breath. Direct and prolonged contact with liquid may cause dryness and redness of the skin. Long-term or repeated overexposure to n-hexane can cause peripheral nerve damage. Initial signs are numbness of the fingers and toes. Motor/muscle weakness can occur in the digits, but may also involve muscles of the arms, forearms, and thighs. Onset of these signs may be delayed for several months to a year after initial exposure. Repeated and sustained inhalation exposure to high vapor concentrations of n-hexane resulted in degenerative changes in the testes and reduced sperm count in male laboratory rats.

CUMENE: High airborne concentrations of cumene may cause irritation of the eyes, skin, and respiratory tract. Excessive exposures may cause central nervous system effects. Lifetime inhalation exposure of mice to cumene resulted in lung tumors in both males and females and liver tumors in females. Rats similarly exposed to cumene exhibited male-specific kidney tumors.

1,2,4-TRIMETHYLBENZENE: Contact with eyes can cause serious eye irritation, redness, and pain. Brief inhalation exposure to high vapor concentrations may cause respiratory irritation. Overexposure by inhalation and ingestion can cause confusion, dizziness, drowsiness, headache, vomiting, cough, and sore throat. Long-term overexposure has been associated with asthmatic bronchitis. Direct prolonged skin contact can cause irritation, redness and dry skin.

ETHYLBENZENE: Lifetime exposure studies of rodents to ethylbenzene reported elevated kidney tumors in male and female rats exposed to the highest concentration tested. Tumors of the lungs were elevated in male mice and in the livers of females exposed at the highest concentration tested. Effects on the liver, kidney, lung, thyroid, and pituitary of these animals as well. Laboratory animal studies (rats) demonstrated hearing loss in combination with exposure to noise.

NAPHTHALENE: Excessive exposure to naphthalene may cause nausea, vomiting, diarrhea, blood in the urine, and a yellow color to the skin. Lifetime inhalation exposure of laboratory rodents to naphthalene resulted in cancers of the respiratory tract in male and female rats. A small increase in cancer of the lung was observed in female mice, but no evidence of lung cancer was observed in male mice. Long-term exposure to excessive airborne naphthalene concentrations may result in destruction of red blood cells, a condition referred to as hemolytic anemia.

CARBON MONOXIDE: Chemical asphyxiant with no warning properties (such as odor). At 400-500 ppm for 1 hour headache and dyspnea may occur. If activity is increased, symptoms of overexposure may include nausea, irritability, increased respiration, tinnitus, sweating, chest pain, confusion, impaired judgement, dizziness, weakness, drowsiness, ataxia, irregular heart beat, cyanosis and pallor. Levels in excess of 1000 ppm can result in collapse, loss of conciousness, respiratory failure and death. Extremely high concentrations (12,800 ppm) can cause immediate unconsciousness and death in 1-3 minutes. Repeated anoxia can lead to central nervous system damage and peripheral neuropathy, with loss of sensation in the fingers, amnesia, and mental deterioration and possible congestive heart failure. Damage may also occur to the fetus, lung, liver, kidney, spleen, cardiovascular system and other organs.

COMBUSTION ENGINE EXHAUST: Lifetime inhalation studies with laboratory animals exposed to gasoline engine exhaust did not produce any carcinogenic effects in mice, rats, or hamsters. Laboratory animal skin painting studies of gasoline engine exhaust condensates/extracts produced an increase in tumors.

Adverse effects related to the physical, chemical and toxicological characteristics

Signs and symptoms Irritating to the skin and mucous membranes. Symptoms may include redness, itching, and inflammation. May cause nausea, vomiting, diarrhea, and signs of nervous system depression: headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue. Aspiration hazard. May cause coughing, chest pains, shortness of breath, pulmonary edema and/or chemical pneumonitis. Prolonged or repeated exposure may cause damage to organs. Repeated or prolonged skin contact may cause drying, reddening, itching and cracking.

Acute toxicity None known.

Skin corrosion/irritation Causes skin irritation.

Serious eye damage/eye irritation None known.

Sensitization None known.

Mutagenic effects May cause genetic defects.

Carcinogenicity May cause cancer.

Name	ACGIH (Class)	IARC (Class)	NTP	OSHA
Gasoline 86290-81-5	Confirmed animal carcinogen (A3)	Possible human carcinogen (2B)	Not Listed	Not Listed
Toluene 108-88-3	Not classifiable (A4)	Not classifiable (3)	Not Listed	Not Listed
Ethyl Alcohol	Confirmed animal	Alcoholic Beverages	Alcoholic Beverage	Not Listed

64-17-5	carcinogen (A3)	Carcinogenic to humans (1)	Consumption Known to be human carcinogen	
Xylene (mixed isomers) 1330-20-7	Not classifiable (A4)	Not classifiable (3)	Not Listed	Not Listed
Benzene 71-43-2	Confirmed human carcinogen (A1)	Carcinogenic to humans (1)	Known to be human carcinogen	Known carcinogen
Cumene 98-82-8	Not Listed	Possible human carcinogen (2B)	Reasonably anticipated to be a human carcinogen	Not Listed
Ethylbenzene 100-41-4	Confirmed animal carcinogen (A3)	Possible human carcinogen (2B)	Not Listed	Not Listed
Naphthalene 91-20-3	Confirmed animal carcinogen (A3)	Possible human carcinogen (2B)	Reasonably anticipated to be a human carcinogen	Not Listed

Reproductive toxicity Suspected of damaging fertility or the unborn child.

Specific Target Organ Toxicity (STOT) - single exposure May cause respiratory irritation. May cause drowsiness or dizziness.

Specific Target Organ Toxicity (STOT) - repeated exposure Causes damage to organs (blood, blood-forming organs, immune system) through prolonged or repeated exposure.

Aspiration hazard May be fatal if swallowed or vomited and enters airways.

12. ECOLOGICAL INFORMATION

Ecotoxicity This product should be considered toxic to aquatic organisms, with the potential to cause long lasting adverse effects in the aquatic environment.

Name	Fish	Crustacea	Algae/aquatic plants
Gasoline 86290-81-5	96-hr LC50 = 11 mg/l Rainbow trout (static)	48-hr LC50 = 7.6 mg/l Daphnia magna	72-hr EC50 = 56 mg/l Algae
Heptane (mixed isomers) 142-82-5	96-hr LC50 = 375 mg/L Tilapia	-	-
Toluene 108-88-3	96-hr LC50 <= 10 mg/l Rainbow trout	48-hr EC50 = 5.46-9.83 mg/l Daphnia magna 48-hr EC50 = 11.5 mg/l Daphnia magna (Static)	72-hr EC50 = 12.5 mg/l Algae
Pentane (mixed isomers) 109-66-0	96-hr LC50 >1 - <10 mgL Rainbow trout	48-hr EC50 = 9.7 mg/L Daphnia magna	-
Ethyl Alcohol 64-17-5	96-hr LC50 >1,000 mg/l Rainbow trout (static) 96-hr LC50 >100 mg/l Fathead minnow (static)	48-hr LC50 > 1,000 mg/l Daphnia magna	-
Xylene (mixed isomers) 1330-20-7	96-hr LC50 = 8 mg/l Rainbow trout	48-hr LC50 = 3.82 mg/l Daphnia magna	72-hr EC50 = 11 mg/l Algae
Benzene 71-43-2	96-hr LC50 = 5.3 mg/l Rainbow trout (flow-through)	48-hr EC50 = 8.76-15.6 mg/l Daphnia magna (Static)	72-hr EC50 = 29 mg/l Algae
n-Hexane 110-54-3	96-hr LC50 = 2.5 mg/l Fathead minnow	-	-
Cumene 98-82-8	96-hr LC50 = 6.04-6.61 mg/l Fathead minnow (Flow-through) 96-hr LC50 = 2.7 mg/l Rainbow trout (semi-static)	48-hr EC50 = 7.9-14.1 mg/l Daphnia magna (static)	72-hr EC50 = 2.6 mg/l Algae
1,2,4 Trimethylbenzene 95-63-6	96-hr LC50 = 7.19-8.28 mg/l Fathead minnow (flow-through)	48-hr EC50 = 6.14 mg/L Daphnia magna	-
Ethylbenzene 100-41-4	96-hr LC50 = 4 mg/L Rainbow	48-hr EC50 = 1-4 mg/L Daphnia	72-hr EC50 = 1.7-7.6 mg/l

	trout	magna	Algae
Cyclohexane 110-82-7	96-hr LC50 = 3.96-5.18 mg/l Fathead minnow	48-hr EC50 = 1.7-3.5 mg/L Bay shrimp	72-hr EC50 = 500 mg/l Algae
Octane 111-65-9	-	48-hr LC50 = 0.38 mg/l Daphnia magna	-
1,2,3-Trimethylbenzene 526-73-8	96-hr LC50 = 7.72 mg/l Fathead Minnow (flow-through)	-	-
Naphthalene 91-20-3	96-hr LC50 = 0.91-2.82 mg/l Rainbow trout (static) 96-hr LC50 = 1.99 mg/l Fathead minnow (static)	48-hr LC50 = 1.6 mg/l Daphnia magna	-

Persistence and degradability Expected to be inherently biodegradable. The presence of ethanol in this product may impede the biodegradation of benzene, toluene, ethylbenzene and xylene in groundwater, resulting in elongated plumes of these constituents.

Bioaccumulation Has the potential to bioaccumulate.

Mobility in soil May partition into air, soil and water.

Other adverse effects No information available.

13. DISPOSAL CONSIDERATIONS

Description of waste residues This material may be a flammable liquid waste.

Safe handling of wastes Handle in accordance with applicable local, state, and federal regulations. Use personal protection measures as required. Use appropriate grounding and bonding practices. Use only non-sparking tools. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. No smoking.

Disposal of wastes / methods of disposal The user is responsible for determining if any discarded material is a hazardous waste (40 CFR 262.11). Dispose of in accordance with federal, state and local regulations.

Contaminated packaging disposal Empty containers should be completely drained and then discarded or recycled, if possible. Do not cut, drill, grind or weld on empty containers since explosive residues may be present. Dispose of in accordance with federal, state and local regulations.

14. TRANSPORT INFORMATION

DOT

UN/Identification No: UN 1203
UN Proper Shipping Name: Gasoline
Transport Hazard Class(es): 3
Packing Group: II

IATA

UN/Identification No: UN 1203
UN Proper Shipping Name: Gasoline
Transport Hazard Class(es): 3
Packing Group: II
ERG code: 3H

IMDG

UN/Identification No: UN 1203
UN Proper Shipping Name: Gasoline
Transport Hazard Class(es): 3
Packing Group: II

EmS No: F-E, S-E
Marine Pollutant: Yes

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code
Not applicable

15. REGULATORY INFORMATION

Regulatory Information

US TSCA Chemical Inventory This product and/or its components are listed on the TSCA Chemical Inventory or are exempt.

Canada DSL/NDSL Inventory This product and/or its components are listed either on the Domestic Substances List (DSL) or are exempt.

EPA Superfund Amendment & Reauthorization Act (SARA)

SARA Section 302 This product does not contain any component(s) included on EPA's Extremely Hazardous Substance (EHS) List above the de minimis threshold.

SARA Section 304 This product may contain component(s) identified either as an EHS or a CERCLA Hazardous substance which in case of a spill or release may be subject to SARA reporting requirements:

Name	Hazardous Substances RQs
Toluene 108-88-3	1000 lb 454 kg
Xylene (mixed isomers) 1330-20-7	100 lb 45.4 kg
Benzene 71-43-2	10 lb 4.54 kg
n-Hexane 110-54-3	5000 lb 2270 kg
Cumene 98-82-8	5000 lb 2270 kg
Ethylbenzene 100-41-4	1000 lb 454 kg
Cyclohexane 110-82-7	1000 lb 454 kg
Naphthalene 91-20-3	100 lb 45.4 kg

SARA Section 311/312 The following EPA hazard categories apply to this product:

Flammable
Hazard Not Otherwise Classified (HNOC)-Physical
Skin corrosion or irritation
Germ cell mutagenicity
Carcinogenicity
Reproductive toxicity
Specific target organ toxicity
Aspiration hazard

SARA Section 313 This product may contain component(s), which if in exceedance of the de minimus threshold, may be subject to the reporting requirements of SARA Title III Section 313 Toxic Release Reporting (Form R).

Name	CERCLA/SARA 313 Emission reporting
Toluene	1.0 % de minimis concentration

108-88-3	
Xylene (mixed isomers) 1330-20-7	1.0 % de minimis concentration
Benzene 71-43-2	0.1 % de minimis concentration
n-Hexane 110-54-3	1.0 % de minimis concentration
Cumene 98-82-8	1.0 % de minimis concentration
1,2,4 Trimethylbenzene 95-63-6	1.0 % de minimis concentration
Ethylbenzene 100-41-4	0.1 % de minimis concentration
Cyclohexane 110-82-7	1.0 % de minimis concentration
Naphthalene 91-20-3	0.1 % de minimis concentration

U.S. State Regulations

California Proposition 65 This product can expose you to chemicals which are known to the State of California to cause cancer, birth defects or other reproductive harm.

Name	California Proposition 65
Gasoline 86290-81-5	Unleaded (wholly vaporized), Carcinogen, initial date 04/01/88 Engine exhaust, Carcinogen, initial date 10/01/90
Toluene 108-88-3	Developmental toxicity, initial date 01/01/91
Ethyl Alcohol 64-17-5	Alcoholic beverages, Carcinogen, initial date 4/29/11 Developmental toxicity, initial date 10/1/87 Associated with alcohol abuse, Carcinogen, initial date 7/1/88
Benzene 71-43-2	Carcinogen, initial date 02/27/87 Male developmental toxicity, initial date 12/26/97
n-Hexane 110-54-3	Male reproductive toxicity, initial date 12/15/17
Cumene 98-82-8	Carcinogen, initial date 04/06/10
Ethylbenzene 100-41-4	Carcinogen, initial date 06/11/04
Naphthalene 91-20-3	Carcinogen, initial date 04/19/02

For more information, go to www.P65Warnings.ca.gov.

State Right-To-Know Regulations The following component(s) of this material are identified on the regulatory lists below:

Name	New Jersey Right-To-Know	Pennsylvania Right-To-Know	Massachusetts Right-To Know
Gasoline 86290-81-5	Listed	Listed	Listed
Heptane (mixed isomers) 142-82-5	Listed	Listed	Listed
Toluene 108-88-3	Listed	Listed	Listed
Pentane (mixed isomers) 109-66-0	Listed	Listed	Listed
Butane (mixed isomers) 106-97-8	Listed	Listed	Listed
Hexane Isomers (other than n-Hexane)	Listed	Listed	Listed

107-83-5			
Ethyl Alcohol 64-17-5	Listed	Listed	Listed
Xylene (mixed isomers) 1330-20-7	Listed	Listed	Listed
Benzene 71-43-2	Listed	Listed	Listed
n-Hexane 110-54-3	Listed	Listed	Listed
Cumene 98-82-8	Listed	Listed	Listed
1,2,4 Trimethylbenzene 95-63-6	Listed	Listed	Listed
Ethylbenzene 100-41-4	Listed	Listed	Listed
Cyclohexane 110-82-7	Listed	Listed	Listed
Octane 111-65-9	Listed	Listed	Listed
Naphthalene 91-20-3	Listed	Listed	Listed

16. OTHER INFORMATION

Prepared by Toxicology & Product Safety

NFPA



Revision Notes

Revision date 07/07/2020
Previous publish date 11/06/2017
Revised sections The following sections (§) have been updated:
2. HAZARD IDENTIFICATION
3. COMPOSITION/INFORMATION ON INGREDIENTS
4. FIRST AID MEASURES
11. TOXICOLOGICAL INFORMATION
14. TRANSPORT INFORMATION
15. REGULATORY INFORMATION

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information is intended as guidance for safe handling, use, processing, storage, transportation, accidental release, clean-up and disposal and is not considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

AECOM

Attachment H

Work Plan/Client SH&E Requirements

Attachment H: Work Plan/Client SH&E Requirements

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NAPL MONITORING AND RECOVERY PLAN

50 Kent Avenue Property Holder Area, Brooklyn, Kings County, New York

October 2 , 2020

Quality information

Prepared by	Checked by	Verified by	Approved by
Melissa Saunders Project Manager/Environmental Scientist	Shail Pandya Associate Vice President		

Revision History

Revision	Revision date	Details	Authorized	Name	Position
DRAFT	October 2, 2020	Draft for Review		Melissa Saunders	Project Manager

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Appendix E – Standard Operating Procedures for NAPL Recovery

Acronym List

bgs	below ground surface
CCR	Construction Completion Report
CFR	Code of Federal Regulations
DSNY	New York City Department of Sanitation
EPA	Environmental Protection Agency
ft	feet
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
IRM	Interim Remedial Measure
MGP	Manufactured Gas Plant
NAPL	Non-Aqueous Phase Liquid
OSHA	Occupational Safety and Health Administration
NYC Parks	New York City Department of Parks & Recreation
NYSDEC	New York State Department of Environmental Conservation
PCB	Polychlorinated Biphenyl
PID	Photoionization Detector
PPE	Personal Protection Equipment
PVC	Polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
VOC	Volatile Organic Compound

1. Introduction

On behalf of National Grid, AECOM USA, Inc. (AECOM) has prepared this Non-Aqueous Phase Liquid (NAPL) Monitoring and Recovery Plan to describe NAPL monitoring and recovery activities implemented as part of the NAPL Recovery Well Interim Remedial Measure (IRM) for the 50 Kent Avenue Property Holder Area located in Brooklyn, New York as shown in **Figure 1-1**.

Routine NAPL monitoring and recovery is completed at the Site to assess NAPL levels and to ensure those levels are maintained below the top of sump of recovery wells. This NAPL Monitoring and Recovery Plan presents the following information:

- Overview of the NAPL recovery well network
- Field activities associated with monitoring of NAPL and the collection and disposal of recovered NAPL
- Data review and reporting requirements
- Periodic well maintenance considerations.

This plan shall be updated annually to address changes associated with the NAPL monitoring and recovery program (i.e. project contacts, recovery frequency, monitoring requirements).

1.1 Background

As per the approved IRM Design and Implementation Plan, 13 NAPL recovery wells were installed for the NAPL Recovery IRM in 2014 and an IRM NAPL Recovery Wells Construction Completion Report (CCR) was submitted to New York State Department of Environmental Conservation (NYSDEC) in 2015. NAPL collection began at these wells in September 2014. A soil excavation/solidification IRM was conducted from November 2015 through June 2017 and a CCR for that work was prepared and submitted to NYSDEC in 2018.

1.2 Well Maintenance, Monitoring, and Collection Completed to Date

In 2016, with NYSDEC's permission, three recovery wells (NRW-01, NRW-02, and NRW-03) located within the Site boundary along with two recovery wells (NRW-09 and NRW-11) damaged during the soil excavation/solidification IRM implementation were abandoned. The latter two wells were replaced with recovery wells NRW-09R and NRW-11R at locations selected in consultation with the NYSDEC in 2017.

Throughout and upon completion of the soil excavation/solidification IRM, NAPL collection continued from existing recovery wells at the Site. NAPL was removed by pump from the recovery wells two to three times a week to maintain the level of cumulated NAPL below the top of the well sumps. During the soil excavation/solidification IRM, sump depths were reduced at some of the recovery wells due to sedimentation and gravel falling into the well or due to damage to well casings. Based on the depth to bottom measurements collected prior to and after completion

of the soil excavation/solidification IRM, it was clear that sump capacities in recovery wells NRW-01, NRW-02, NRW-07, NRW-08, NRW-09R, NRW-11R and NRW-13 were compromised.

In 2019, sump capacities of five of the seven compromised wells were successfully restored using air lift and surge and purge methods. Attempts of obstruction removal was not successful at two NAPL recovery wells (NRW-01 and NRW-08), which resulted in decommissioning of these wells and replacing them with NRW-01R and NRW-08R, as approved by NYSDEC. For further detail regarding the 2019 recovery well rehabilitation and reinstallation effort, refer to the AECOM document titled *2019 NAPL Recovery Well Rehabilitation and Reinstallation Report,* dated September 2019 (AECOM, 2019).

1.3 Recovery Well Network and Recovery Program

Currently, a total of 10 NAPL recovery wells comprise the Site well network, namely: NRW-01R, NRW-02, NRW-06, NRW-07, NRW-08R, NRW-09R, NRW-10, NRW-11R, NRW-12 and NRW-13. Eight NAPL recovery wells are located along North 12th Street, and two NAPL recovery wells are located along North 11th St (North 11th Street and North 12th Street are hereinafter referred to as “the Site”) as shown in **Figure 1-2** attached. NAPL monitoring and recovery events are currently undertaken once a week at the Site and include the following activities:

- Measurement of depth of recovery wells
- Measurement of NAPL thickness in each recovery well
- Recovery of NAPL from wells as required
- Evaluation of NAPL collected in each well sump
- Containerization and off-Site disposal of recovered NAPL.

Whilst it is noted that NAPL recovery events are currently undertaken once a week, NAPL recovery data may indicate that the frequency of NAPL recovery events may be reduced. This will be assessed through ongoing data review as discussed in **Section 3.1**.

Further detail regarding field activities associated with NAPL recovery is provided in the following sections.

1.4 Recovery Well Construction

Each well is six inches in diameter and screen intervals were generally determined based on depths where NAPL contamination was observed during the well drilling process. The bottom of the screen was located at the top of a clay layer at approximately 50 to 60 feet below grade surface (ft bgs). A five-foot long sump was installed into the clay layer, beneath the lowest screened zone, for collection of NAPL. The well construction logs are included in **Appendix A**.

Table 1-1 presents a summary of the depths of each well and the screen intervals.

Table 1-1

NAPL Recovery Well Summary

Recovery Well	Well Depth (ft)	Stainless Steel Screen Intervals bgs (ft)	PVC Screen Intervals bgs (ft)	Stainless Steel Sump Depth bgs (ft)
NRW-01R	58.5	8.5-28.5, 38.5-53.5	---	53.5-58.5
NRW-02	65	20-30, 35-60	---	60-65
NRW-06	67	12-27, 52-62	---	62-67
NRW-07	63	13-18, 38-58	---	58-63
NRW-08R	60.5	10.5-25.5, 35.5-55.5	---	55.5-60.5
NRW-09R	58	10-20, 30-55	---	55-60
NRW-10	55	15-50	---	50-55
NRW-11R	57	---	28-58	58-63
NRW-12	60	20-55	---	55-60
NRW-13	60	---	20-55	55-60

Each well is constructed with a 6-inch diameter by 5-foot long stainless-steel sump; 6-inch diameter, schedule 40 PVC, 0.020-slot continuous wire-wrap screen and/or a 6-inch diameter, stainless-steel, 0.020-slot continuous wire-wrap screen or combination thereof; and a 6-inch diameter, schedule 40 PVC solid riser to grade. Well sumps and screens have been constructed using stainless steel to improve durability and mitigate well degradation caused by NAPL.

2. Field Activities

This section describes the activities that shall be performed during each NAPL monitoring and recovery event. To assist in compliance with health and safety requirements as well as the performance of the tasks below, a checklist is provided in **Appendix B**. The Recovery Well Field Form provided in **Appendix C** is to be completed for each event.

2.1 Health and Safety

The work to be performed under this plan will occur in an area of soil and groundwater contamination as well as the area impacted with NAPL. All work shall be performed in accordance with the latest revision of the Health and Safety Plan (HASP). The current HASP is provided in **Appendix D**.

2.2 Site Access

North 12th Street is secured by locking entrance gate with chains and padlocks. If the gate is not secured with an AECOM- or National Grid-supplied lock, field personnel will coordinate with the New York City Department of Parks and Recreations (NYC Parks) to obtain the keys necessary to gain access to North 12th Street. Keys shall be returned to the person and place where the keys were obtained. Copies of the keys will be requested and made by the field personnel.

NYC Parks contact for the Site and keys:

Mary Salig
North Brooklyn Park Director NYC Parks
Bushwick Inlet Park
86 Kent Avenue
Brooklyn, NY 11211
Office (718) 218-6130
Cell (646) 739-3181

2.3 Site Mobilization

Currently, there is no storage allowed at the Site after field work. Therefore, an off-Site storage facility has been rented for storage of equipment. Prior to work, drums shall be purchased from a local dealer and the equipment shall be retrieved from the storage unit and transported to the Site. Gasoline may not be stored in the storage space, so gasoline for the generator, if the Waterra Hydrolift collection technique is used, must be purchased locally prior to commencement of field work. Purchase only enough gasoline to perform one day's worth of work (approximately 0.5 gallons).

2.4 Well Gauging

The recovery wells are currently gauged for NAPL during scheduled recovery events once a week. For each well, the presence of NAPL is measured using NAPL detection equipment or weighted string. Depth to bottom measurements are also collected for all recovery wells to assess well depth and sump capacity.

The frequency of gauging will be determined based on the accumulation rate of NAPL. **Section 3.1** describes the ongoing data review process that is implemented to inform decision making regarding the frequency of NAPL gauging.

2.5 NAPL Recovery

NAPL recovery events are currently undertaken once a week in conjunction with well gauging. This frequency is designed to prevent overflow of sumps, using accumulation rates based on data collected during recent gauging events.

NAPL collection is performed immediately following gauging activities, unless 1) no NAPL is observed during gauging or 2) the measured NAPL level in the well plus the anticipated accumulation, based on recently collected data, will be less than the height of the sump by the next recovery event.

Approximate volume of NAPL expected is calculated based on the gauging data prior to NAPL removal. NAPL is recovered via pumping using a peristaltic pump or an inertial hydrolift pump (i.e., a Waterra Pump), with the extracted NAPL directed into a drum. Extraction continues until relatively NAPL-free liquid is recovered.

2.6 Storage and Disposal

NAPL shall be collected directly into drums or consolidated into drums that shall be disposed of off-Site daily, unless permission is obtained for on-Site storage. National Grid's current contractor for disposal arrangements is as follows:

George Paolillo
Veolia North America
3001 Burns Avenue, Wantagh NY 11793
1 Eden Lane, Flanders NJ 07836
Office 516-221-8300
Cell 201-874-5390

Schedule for daily pick-up must be made four (4) days or more in advance. Pick-up shall also be confirmed by field personnel the day before the NAPL collection event. Drums with NAPL are not be left unattended at the Site prior to pick-up unless the field personnel have to use the restrooms located in the Parks Building, two blocks south of the Site. The drums shall be properly labeled and secured and the Site gates locked prior to taking the restroom break.

2.7 Standard Operating Procedures for NAPL Recovery

Standard Operating Procedures for NAPL recovery are provided in **Appendix E**.

2.8 Waste Characterization

An initial gauging event took place prior to NAPL recovery activities as well as the collection of an initial sample for disposal characterization on September 12, 2014.

AECOM gauged the amount of NAPL present in each well, and collected a composite sample from two wells that had the greatest amounts of NAPL present, and submitted this for analysis for the following parameters:

- Flash Point
- pH
- Resource Conservation and Recovery act (RCRA) (8 metals)
- Volatiles and semi-volatiles
- Polychlorinated biphenyls (PCBs)

The results of this analysis determined that the NAPL is characterized as hazardous waste based on its ignitability (Flash Point) and toxicity. Unless future analyses change this designation, the NAPL drums shall be labeled as hazardous. PPE and other plastic waste derived from the gauging and recovery activities are not hazardous and shall be clearly labeled as non-hazardous waste.

3. Data Review and Reporting

3.1 Data Review

NAPL monitoring and recovery data is uploaded weekly and maintained in a dedicated project file. Once a month, a data review will be undertaken to assess:

- NAPL thickness in each recovery well and trends (i.e. stable, increasing or decreasing thickness)
- Sump capacity (i.e. stable or decreasing length)
- Well depth (i.e. stable or decreasing depth)
- Well condition (i.e. potential casing damage or blockage)

In addition to the above, NAPL collection rates are to be reviewed to determine if the well screen is damaged or clogged which may prevent the inflow of NAPL.

The outcomes of the monthly data review will be used to inform decision making regarding:

- The frequency of gauging and recovery events (based on the accumulation rate of NAPL)
- The requirements for well maintenance (if any).

A reduction in recovery frequency may be recommended for select recovery wells on a case by case basis should it be demonstrated that NAPL levels:

- Are stable or decreasing; and
- Can be maintained below the top of sump for the designated timeframe.

Section 4.0 provides detail with regard to actions to be taken should the data review identify the need for well maintenance.

3.2 Quarterly NAPL Monitoring and Recovery Report

AECOM will prepare quarterly NAPL Monitoring and Recovery reports that will include the following:

- Presented in cumulative table format:
  - NAPL gauging data
  - Recovered volumes
  - Total well depths.
- Graphs showing:
  - NAPL thickness in each well from commencement of monitoring through to the end of the subject monitoring quarter.
  - Volume of liquid recovered during each event from commencement of monitoring through to the end of the subject monitoring quarter
  - Cumulative volume of liquid recovered since commencement of monitoring.

NAPL Monitoring and Recovery reports will be delivered to NYSDEC in January (for the quarter ending December), April (for the quarter ending March), July (for the quarter ending June) and October (for the quarter ending September).

It is noted that the activities and outcomes of periodic well maintenance (refer **Section 4.0**) will be reported in a comprehensive standalone report which will be submitted to NYSDEC for review.

4. Periodic Recovery Well Maintenance

Periodic recovery well maintenance is required to maintain sufficient well yield to promote NAPL recovery and mitigate NAPL migration. Of note is that well screens can become clogged by NAPL over time which may prevent the inflow of NAPL.

Based on the outcomes of the data review described in **Section 3.1**, it may be considered necessary to undertake well rehabilitation to restore screen functionality and sump capacity. In addition, should it be determined or suspected that recovery wells are compromised and no longer functioning as intended, it may be necessary to undertake well decommissioning and reinstallation activities in order to maintain an adequate well network for NAPL recovery.

Prior to the commencement of well maintenance activities, a Work Plan will be submitted to NYSDEC for review and approval. An overview of well maintenance activities that may be required is provided in the following sections.

4.1 Recovery Well Rehabilitation

Based on well rehabilitation works completed at the Site in 2019 (AECOM, 2019), it is likely that rehabilitation will be accomplished by re-development to remove sediment from the well sumps. However, well rehabilitation may also be required to remove NAPL blockages and restore screen functionality.

Recovery well rehabilitation methods will be assessed on a case by case basis. As discussed in AECOM, 2019, well redevelopment has previously been achieved using a combination of two methods, namely; surge and pump and/or air lifting.

Following well development, wells are to be gauged to provide confirmation that the well has been successfully rehabilitated. It is noted that should redevelopment using surge and pump and/or air lifting not be successful, consideration should be given to the implementation of additional rehabilitation measures or well decommissioning (refer **Section 4.2**).

4.2 Recovery Well Decommissioning

In the event that wells are damaged and need to be decommissioned, wells will be decommissioned in accordance with NYSDEC's CP-43, Groundwater Monitoring Well Decommissioning Policy.

4.3 Recovery Well Installation

In summary, the sequence of work for installation of the NAPL recovery wells will be as follows:

- Removal of hardstand surface at the designated location
- Hand-clearing of well locations to 5ft bgs
- Advancement of soil borings and well installation
- Installation of flush-mount well boxes at each well location
- Development of wells
- Surface restoration.

Recovery wells are to be constructed with:

- 6-inch diameter by 5-foot long stainless-steel sumps;
- 6-inch diameter, 0.020 slot continuous wire-wrap screen (62 square inches open area per foot of screen); and
- 6-inch diameter Schedule 40 PVC solid riser to grade.

After a minimum period of 24-hours post-installation, each well will be developed using a combination of surge and pump and air lift procedures to remove drilling fluids and fine-grained material from the sump, well screen, and filter pack to enhance connectivity with the surrounding aquifer.

5. References

AECOM.2019. NAPL Recovery Well Rehabilitation and Reinstallation Report, dated September 2019.

NYSDEC.2009.CP-43: Groundwater Monitoring Well Decommissioning Policy, dated November 3, 2009.

Figures



Source: Google Earth Pro - © 2012 Google

APPROXIMATE SCALE IN FEET

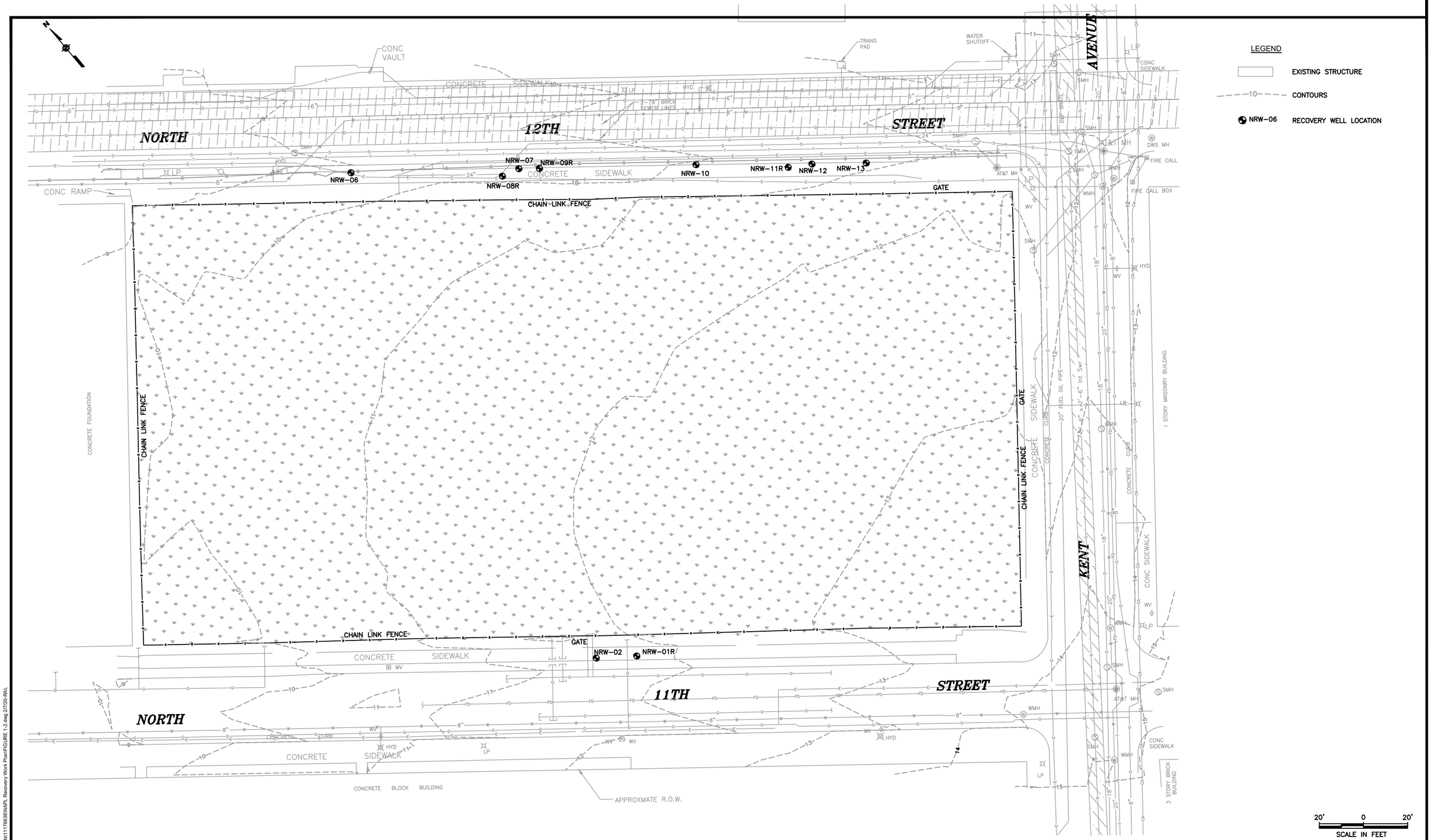
2000 0 2000

AG20745-111176638-071812-GCM

AECOM

50 KENT AVENUE PARCEL OF THE
WILLIAMSBURG WORKS FORMER MGP SITE
BOROUGH OF BROOKLYN, NEW YORK
SITE LOCATION MAP

FIGURE 1-1



LEGEND

- EXISTING STRUCTURE
- 10 CONTOURS
- NRW-06 RECOVERY WELL LOCATION

20' 0 20'
SCALE IN FEET

AECOM

NATIONAL GRID
FORMER WILLIAMSBURG MGP SITE
BROOKLYN, KINGS COUNTY, NEW YORK

NAPL MONITORING AND
RECOVERY PLAN

NAPL RECOVERY WELL LOCATIONS

DATE: FEBRUARY 2020

FIGURE 1-2

\\URSBuffalo.us.ie.urs\Buffalo\Projects\41177683\NAPL Recovery Work Plan\FIGURE 1-2.dwg 2/7/20-RAL

Appendices

Appendix A – Well Construction Logs

AECOM

Boring Log

BORING NO. : NRW-01R

PROJECT:	National Grid Williamsburg	**SHEET:** 1 OF 3	
PROJECT LOCATION:	Midpoint of N 11th St, w of Kent Ave/~20' from NRW-02	**JOB NO. :**	
CLIENT:	National Grid	**TOTAL DEPTH OF BOREHOLE:**	60 ft. bgs
DRILLING CONTRACTOR:	ADT	**GROUND ELEVATION:**	
DRILLING METHOD:	Sonic	**DATE STARTED:**	5/14/2019
DRILL RIG TYPE:	Fraste XL Max	**DATE FINISHED:**	5/21/2019
DRILL BIT SIZE/TYPE:	5" Sonic Core	**DRILLER:**	Tony Palomeque
SAMPLING METHOD(S):	5' Sonic Cores	**GEOLOGIST:**	M Dascoli & R Doshi
		REVIEWED BY:	

DEPTH FEET	STRATA	VISUAL IMPACT	SAMPLE	PID (ppm)	RECOVERY (inches)	USCS	MATERIAL DESCRIPTION	REMARKS	WELL CONSTRUCTION
0					60"	FILL	Sidewalk/ concrete 0'-5' Handcleared 0'-5' FILL - dk brown coarse, angular gravel with fine- coarse sand, few silt at 2' moderate mothball-like odor, dark gray color at 3' water seeping in from the sides. Boulder		FLUSH MOUNT PROTECTIVE CASING AND LOCKABLE CAP
-5				391	32"	MH	5'-7' Dk gray SILT, few fine-med sand & some gravel & brick pieces @ 6.5'- light brown NAPL stringer, 35% saturation	Wet	20 ft of 6" STAINLESS STEEL SCREEN SLOT SIZE: 0.020"
			1	780		SP	7'-10' med brown fine SAND, few silt & gravel @ 9'- med brown NAPL stringer, 40% saturation	Dry	SCH.40 PVC Casing, Stainless Steel Screens, statinless steel sump 6" Inch Diameter
				1123					
-10				284	32"	CL	10'-12' dense, med brown silty CLAY, few gravel 12'-12.5' med dense, med brown fine-med SAND, few silt		BENTONITE (BENSEAL) INSTALLED
			2	485					
				1445		SP	12.5'-14.5' loose, dk brown- black fine SAND with dk brown NAPL of 75-100% saturation, strong mothball-like odors	Wet	
				>15000					
				>15000			14.5'-15' med brown very fine SAND w/ black staining, burnt odor	Dry	
-15				676	36"	GP	15'-20' no odor in soil, drilling water has mothball-like odor 15'-16' dk brown very fine-fine SAND with mica & silt	Wet	
			3	1582		ML	16'-17' loose, dk gray, fine-coarse angular GRAVEL, with some cobbles and some silt 17'-20' very dense, medium brown, SILT with few clay and few fine to medium sand		SAND PACK #0
-20				141	51"	CL	20'-25' no odors in soil, drilling water has mothball-like odor 20'-22.5' medium dense, medium red-brown CLAY	Dry	20 ft of 6" STAINLESS STEEL SCREEN SLOT SIZE: 0.020"
			4	77					
				359			22.5'-23.5' dense, medium brown silty CLAY with few fine-med sand and few fine gravel, trace coarse gravel		
				288					
-25				1406			23.5'-25' dense, same as above with red-brown		

COMMENTS:

BORING NO. : NRW-01R

Boring Log

AECOM

PROJECT:	National Grid Williamsburg
PROJECT LOCATION:	Midpoint of N 11th St, w of Kent Ave/~20' from NRW-02
CLIENT:	National Grid
DRILLING CONTRACTOR:	ADT
DRILLING METHOD:	Sonic
DRILL RIG TYPE:	Fraste XL Max
DRILL BIT SIZE/TYPE:	5" Sonic Core
SAMPLING METHOD(S):	5' Sonic Cores

BORING NO. :	NRW-01R
SHEET:	2 OF 3
JOB NO. :	
TOTAL DEPTH OF BOREHOLE:	60 ft. bgs
GROUND ELEVATION:	
DATE STARTED:	5/14/2019
DATE FINISHED:	5/21/2019
DRILLER:	Tony Palomeque
GEOLOGIST:	M Dascoli & R Doshi
REVIEWED BY:	

DEPTH FEET	STRATA	VISUAL IMPACT	SAMPLE	PID (ppm)	RECOVERY (inches)	USCS	MATERIAL DESCRIPTION	REMARKS	WELL CONSTRUCTION
-25			5	767 1382 >15000 >15000 >15000	60"		and med brown banding at 25'- boulder 25'-26' same as 23.5-25' 26'- 30' very dense, medium gray CLAY with some silt at 27-27.5' lense of dk gray fine SAND with 100% NAPL saturation at 27.5' - 27.75' Iron colored staining, with some fine sand, 50% saturation at 28'-30' with few fine-coarse angular gravel		
-30			6	52.6 680 134 142 177	48"		30'-35' very dense, med gray CLAY with some silt, few fine to medium angular gravel throughout at 31' - cobble at 35' - boulder	Wet	TIME RELEASE BENTONITE PELLETS 10 ft of 6" STAINLESS STEEL SCREEN SLOT SIZE: 0.020"
-35			7		25"	ML	35'-40'- Mothball-like odors throughout interval. No free product. 35'-36.5' CLAY with some silt and little sand 36.5'-40' very dense, gray SILT with few sand, few gravel/ cement-like pieces.	Saturation Level Not Recorded	
-40			8	870 2300 1325 1600	36"	SP ML	40'-41.5' fine SAND with few silt, few gravel and mica, mothball- like odors 41.5'-43.5' brown fine SAND with some silt, mothball-like odors 43.5'-44.5' gray fine SAND with some silt and mica. Trace blebs of brown NAPL visible, strong mothball-like odor. 44.5'-45' light gray SILT with some sand, strong mothball-like odor		
-45			9	>1000 715 695	32"	SP	45'-46' very fine SAND with mica. 90% NAPL saturation, strong mothball-like odor. 46'-48.5' brown very fine SAND with some silt and mica. 35% NAPL saturation. Mothball-like odor. 48.5'-50' fine SAND with mica and trace silt. 20% NAPL saturation.		SAND PACK #0 15 ft of 6" STAINLESS STEEL SCREEN SLOT SIZE: 0.020"
-50									

COMMENTS:

BORING NO. : NRW-01R

Boring Log

AECOM

PROJECT:	**National Grid Williamsburg**	**BORING NO. :**	**NRW-01R**
PROJECT LOCATION:	**Midpoint of N 11th St, w of Kent Ave/~20' from NRW-02**	**SHEET:**	**3 OF 3**
CLIENT:	**National Grid**	**JOB NO. :**	
DRILLING CONTRACTOR:	**ADT**	**TOTAL DEPTH OF BOREHOLE:**	60 ft. bgs
DRILLING METHOD:	**Sonic**	**GROUND ELEVATION:**	
DRILL RIG TYPE:	**Fraste XL Max**	**DATE STARTED:**	5/14/2019
DRILL BIT SIZE/TYPE:	**5" Sonic Core**	**DATE FINISHED:**	5/21/2019
SAMPLING METHOD(S):	**5' Sonic Cores**	**DRILLER:**	Tony Palomeque
		GEOLOGIST:	M Dascoli & R Doshi
		REVIEWED BY:	

DEPTH FEET	STRATA	VISUAL IMPACT	SAMPLE	PID (ppm)	RECOVERY (inches)	USCS	MATERIAL DESCRIPTION	REMARKS	WELL CONSTRUCTION
-50			10	15000 640 690 129 30	40"	ML CL	50'-51' find SAND. 100% black NAPL saturation. 51'-52.5' SAND with few silt. 35% black NAPL saturation. 52.5'-53.5' brown SILT with some clay. Faint petroleum-like and mothball-like odors. 53.5'-55' grayish brown CLAY with some silt. No odors noted.		
-55			11	3.0 2.0	60"	SP	55'-57.5' hard, grayish brown CLAY. No odors noted. 57.5'-59' brown SAND with some silt and clay. No impacts. 59'-60' hard, dark gray CLAY. No impacts.		5 ft of 6" STAINLESS STEEL SOLID PIPE SUMP*Centrali Installed at 56' bgs TIME RELEASE BENTONITE PELLETS
-60				5.0		CL			

COMMENTS:

BORING NO. : NRW-01R

URS Corporation

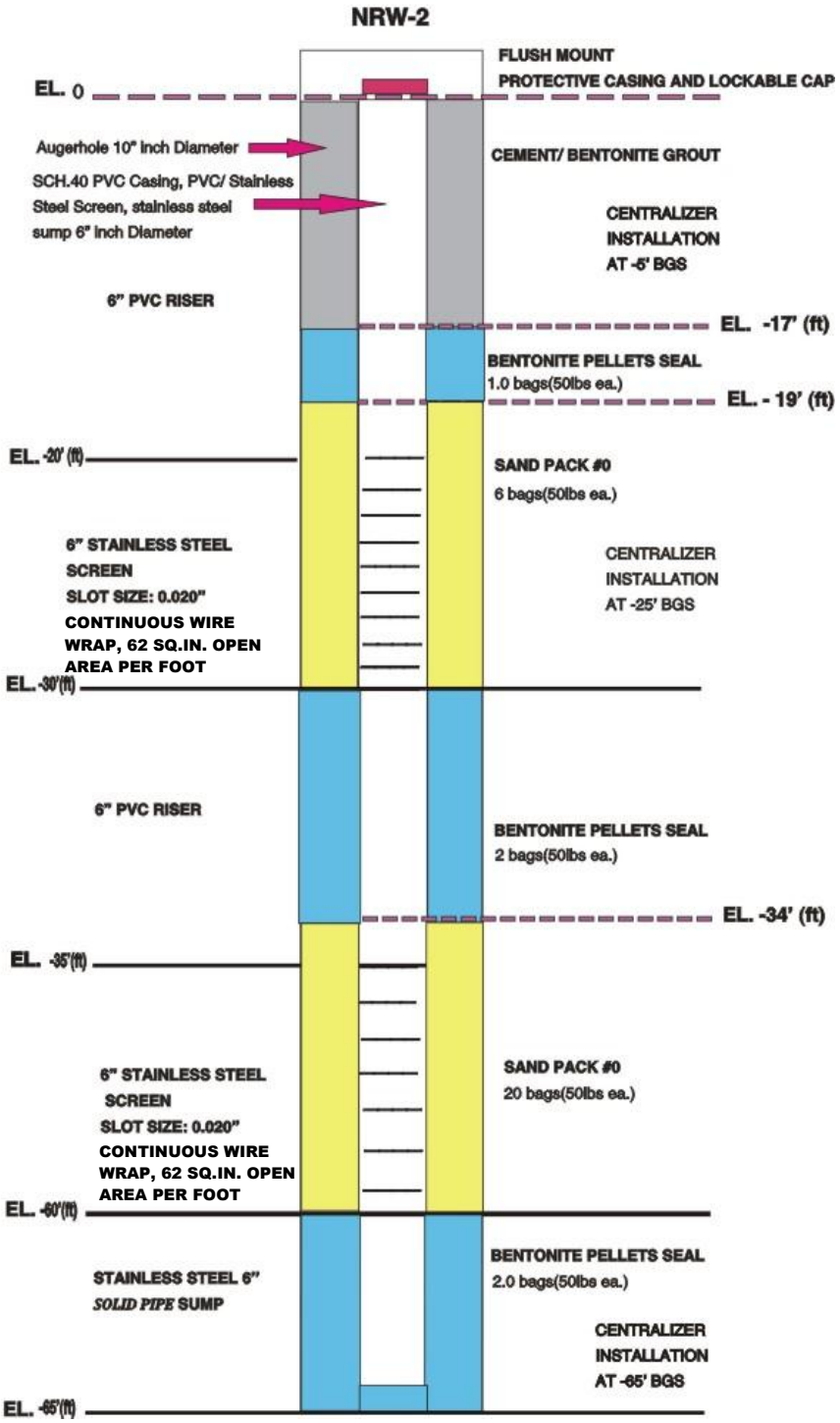
Client: National Grid

Location: 50 Kent Ave.,
Williamsburg, Brooklyn, New York
Project No.11176638.00019

DRILLING SUMMARY

GEOLOGIST: ANDREAS PAPANEOCLEOUS
DRILLING COMPANY: CASCADE
DRILLER: JOHN GRAGLIA
DRILLING RIG TYPE: SONIC
DATE: 03-17-2014

Recovery Well Construction Details



URS

50 KENT AVENUE PROPERTY, BROOKLYN KINGS COUNTY, NEW YORK

URS Corporation

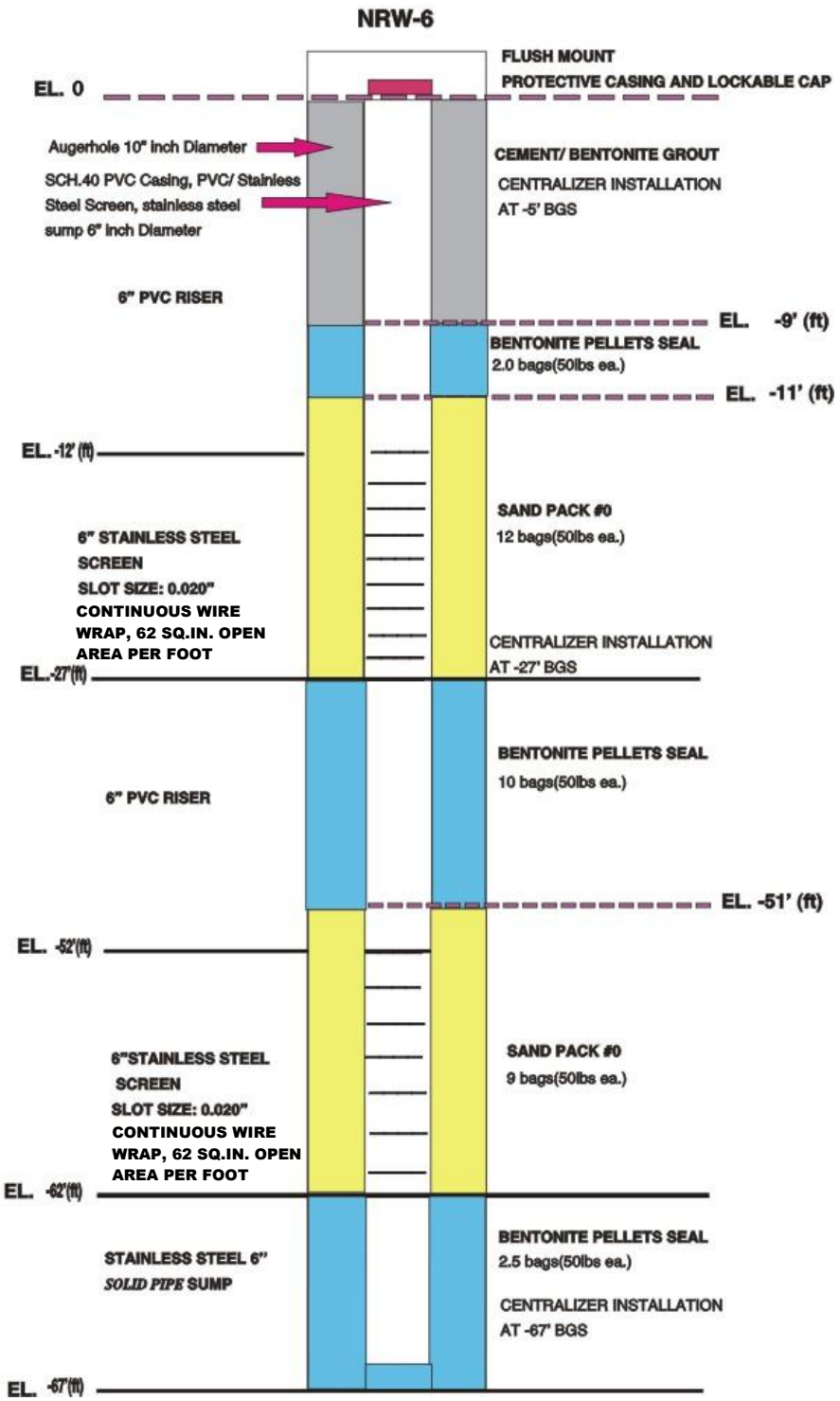
Client: National Grid

Location: 50 Kent Ave.,
Williamsburg, Brooklyn, New York
Project No.11176638.00019

DRILLING SUMMARY

GEOLOGIST: ANDREAS PAPANEOCLEOUS
DRILLING COMPANY: CASCADE
DRILLER: JOHN GRAGLIA
DRILLING RIG TYPE: SONIC
DATE: 04-02-2014

Recovery Well Construction Details



URS Corporation

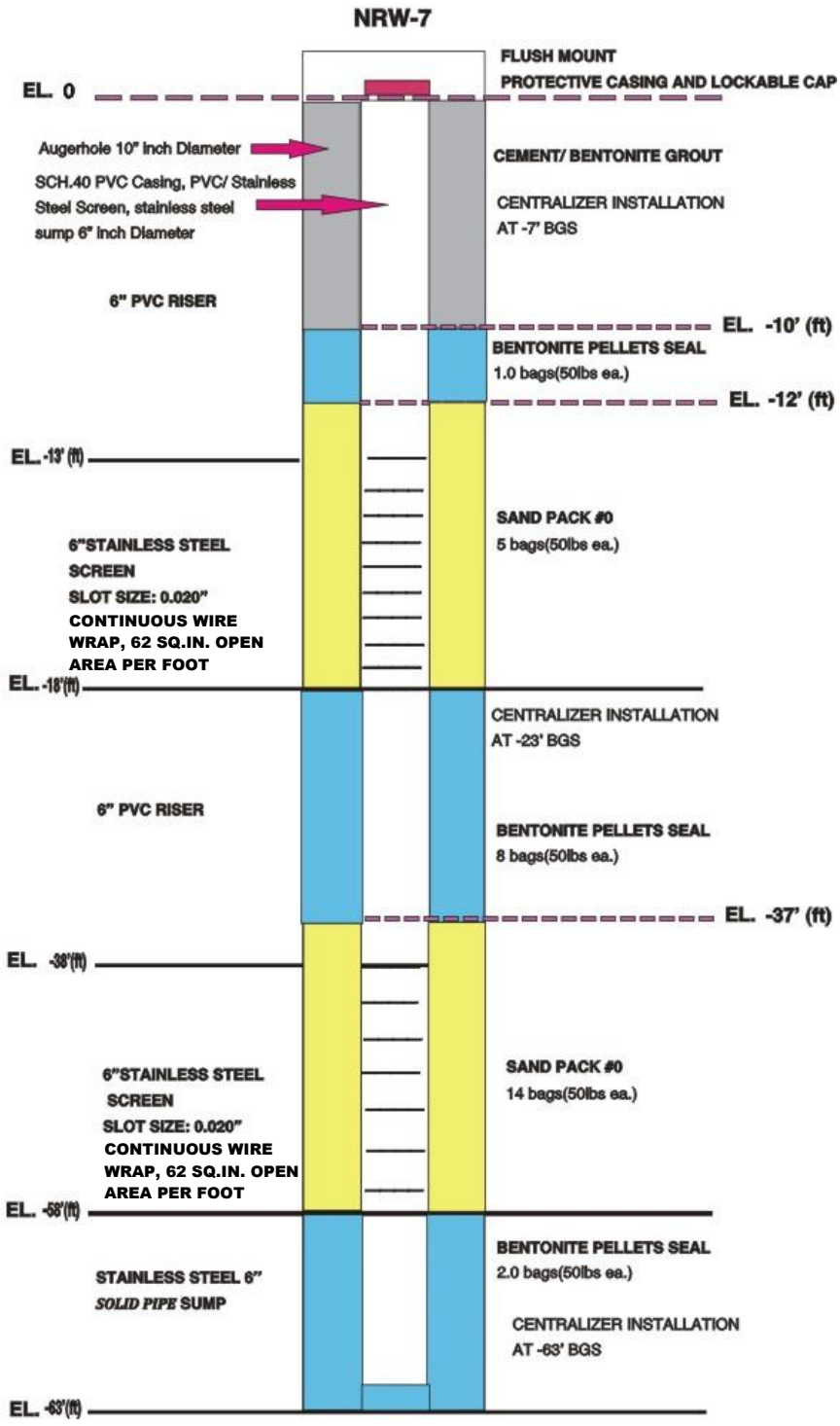
Client: National Grid

Location: 50 Kent Ave.,
Williamsburg, Brooklyn, New York
Project No.11176638.00019

DRILLING SUMMARY

GEOLOGIST: ANDREAS PAPANEOCLEOUS
DRILLING COMPANY: CASCADE
DRILLER: JOHN GRAGLIA
DRILLING RIG TYPE: SONIC
DATE: 04-03-2014

Recovery Well Construction Details



AECOM

Boring Log

BORING NO. : NRW-08R

PROJECT:	National Grid Williamsburg
PROJECT LOCATION:	Mid-way down N 12th St, west of Kent Ave.
CLIENT:	National Grid
DRILLING CONTRACTOR:	ADT
DRILLING METHOD:	Sonic
DRILL RIG TYPE:	Fraste XL Max
DRILL BIT SIZE/TYPE:	5" Sonic Core
SAMPLING METHOD(S):	5' Sonic Cores

SHEET: 1 OF 3	
JOB NO. :	
TOTAL DEPTH OF BOREHOLE:	60 ft. bgs
GROUND ELEVATION:	
DATE STARTED:	5/142019
DATE FINISHED:	5/24/2019
DRILLER:	Tony Palomeque
GEOLOGIST:	M Dascoli & R Doshi
REVIEWED BY:	

DEPTH FEET	STRATA	VISUAL IMPACT	SAMPLE	PID (ppm)	RECOVERY (inches)	USCS	MATERIAL DESCRIPTION	REMARKS	WELL CONSTRUCTION
0					60"	FILL	4" Sidewalk/ concrete 0'-5' Handcleared 0'-5' FILL - medium brown sand and silt, trace brick with some gravel and few cobbles, no odor or staining noted at 4' with medium gray color		FLUSH MOUNT PROTECTIVE CASING AND LOCKABLE CAP
-5			1	0.2 0.2 0.3 11.5 25.6	55"	ML	5'-10' medium gray, soft 5'-9' SILT with few sand and clay, trace gravel 9'-10' same as above with some clay, with black silt, possible staining 10'-12' same as above	Wet Dry	15 ft of 6" STAINLESS STEEL SCREEN SLOT SIZE: 0.020" BENTONITE (BENSEAL) INSTALLED
-10			2	44.3 29.0 50.0 109 131	45"	SP ML	12'-12.4' 4" layer of fine SAND with 100% NAPL saturation, dark brown NAPL, burnt, acrid odor 12.4'- 15' alternating layers of brown and black, very soft, SILT, some clay, trace sand and gravel	Wet Dry	SCH.40 PVC Casing, Stainless Steel Screens, statinless steel sump 6" Inch Diameter
-15			3	15.0 49.5 217 196 925	31"		15'-17' dark gray SILT 17'-18' possible weathered rock with mica and silt, mothball-like odor 18'-19.5' crushed boulder, dry 19.5'-20' medium brown, very fine SAND & SILT, strong mothball-like odor, about 15% NAPL	Wet	SAND PACK #0 15 ft of 6" STAINLESS STEEL SCREEN SLOT SIZE: 0.020"
-20			4	290 151 307 234 75.1	48"	SP/ML CL	20'-21' Hard, medium brown CLAY, trace gravel, dry 21'-22.5' dark brown, stained, very fine SAND, trace medium sand, 20% NAPL saturation, strong mothball-like odor 22.5'-25' same as 20'-21' (Hard, medium brown CLAY, trace gravel, dry) at 23.5'-25' with some coarse gravel and trace cobble	Dry	
-25									

COMMENTS:

BORING NO. : NRW-08R

AECOM

Boring Log

BORING NO. : NRW-08R

PROJECT:	National Grid Williamsburg
PROJECT LOCATION:	Mid-way down N 12th St, west of Kent Ave.
CLIENT:	National Grid
DRILLING CONTRACTOR:	ADT
DRILLING METHOD:	Sonic
DRILL RIG TYPE:	Fraste XL Max
DRILL BIT SIZE/TYPE:	5" Sonic Core
SAMPLING METHOD(S):	5' Sonic Cores

SHEET:	2 OF 3
JOB NO. :	
TOTAL DEPTH OF BOREHOLE:	60 ft. bgs
GROUND ELEVATION:	
DATE STARTED:	5/142019
DATE FINISHED:	5/24/2019
DRILLER:	Tony Palomeque
GEOLOGIST:	M Dascoli & R Doshi
REVIEWED BY:	

DEPTH FEET	STRATA	VISUAL IMPACT	SAMPLE	PID (ppm)	RECOVERY (inches)	USCS	MATERIAL DESCRIPTION	REMARKS	WELL CONSTRUCTION
-25			5	27.8 21.6 167.1 6.3 24.8	60"		25'-28' dark gray, CLAY, few gravel, stiff, dry, no odor at 27'-30' chemical-like odor noted 28'- 29' very stiff, brick red CLAY, dry 29'-30' hard, dark gray CLAY, few coarse gravel		
-30			6	2.5 2.6 2.8 3.0 3.1	40"		30' - 35' hard, dark gray CLAY, few gravel		
-35			7	28 7.2 77.9 11.3 36.3	48"	SP CL	35'-35.5' Boulder 35.5'-38' dark brown very fine SAND and few silt, few mica, faint chemical-like odor 38'-40' hard, dark gray CLAY, some fine to coarse gravel	Wet Saturation Level Not Recorded	
-40			8	538 366 988 736 658	38"	SP	40'-45' medium brown very fine SAND with few silt, very strong mothball-like odor throughout @ 43.5'-43.75' dark brown NAPL, ~20% saturation @ 44.5'-45' medium brown NAPL, ~20%, with layer of black staining		SAND PACK #0
-45			9	1270 618 1154 2065 1726	41"	ML SP	45'-50' very loose, medium brown, very strong mothball-like odor 45'-47' SILT with mica, 5% NAPL saturation 47'-47.25' sub-rounded coarse SAND, 50% lt brown NAPL sat. 47.25'-49' very fine SAND with few medium-coarse sand, 50% light brown NAPL saturation 49'-50' find SAND, with some silt, staining, 100% dark brown NAPL saturation		TIME RELEASE BENTONITE PELLETS 20 ft of 6" STAINLESS STEEL SCREEN SLOT SIZE: 0.020" 20 ft of 6" STAINLESS STEEL SCREEN SLOT SIZE: 0.020"
-50									

COMMENTS:

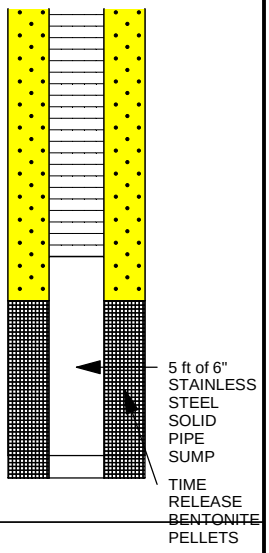
BORING NO. : NRW-08R

Boring Log

AECOM

		BORING NO. :	NRW-08R
PROJECT:	National Grid Williamsburg	SHEET: 3 OF 3	
PROJECT LOCATION:	Mid-way down N 12th St, west of Kent Ave.	JOB NO. :	
CLIENT:	National Grid	TOTAL DEPTH OF BOREHOLE:	60 ft. bgs
DRILLING CONTRACTOR:	ADT	GROUND ELEVATION:	
DRILLING METHOD:	Sonic	DATE STARTED:	5/142019
DRILL RIG TYPE:	Fraste XL Max	DATE FINISHED:	5/24/2019
DRILL BIT SIZE/TYPE:	5" Sonic Core	DRILLER:	Tony Palomeque
SAMPLING METHOD(S):	5' Sonic Cores	GEOLOGIST:	M Dascoli & R Doshi
		REVIEWED BY:	

DEPTH FEET	STRATA	VISUAL IMPACT	SAMPLE	PID (ppm)	RECOVERY (inches)	USCS	MATERIAL DESCRIPTION	REMARKS	WELL CONSTRUCTION
-50			10	340.8 391 386.6 99.9 51.6	55"	ML	50'-55' strong mothball-like odor 50'-52' medium gray very fine SAND with 15% light brown NAPL saturation @51'-51.5' with 50% NAPL saturation 52'-54' dark gray SILT @52.5'- 1/2" of very fine SAND with 100% dk brown NAPL sat. 54'-55' medium brown very find SAND with some silt		
-55			11	470 62.3 30.5 12.5 12.0	50"	SP CL	55'-56.5' loose, medium brown, very find SAND, trace silt 56.5'- 61.5' hard CLAY of various colors- medium brown with red and white streaking throughout		
-60									



COMMENTS:

BORING NO. : NRW-08R

DRILLING SUMMARY

Geologist:
J. Christopher

Drilling Company:
ADT

Driller:
G. Rivera

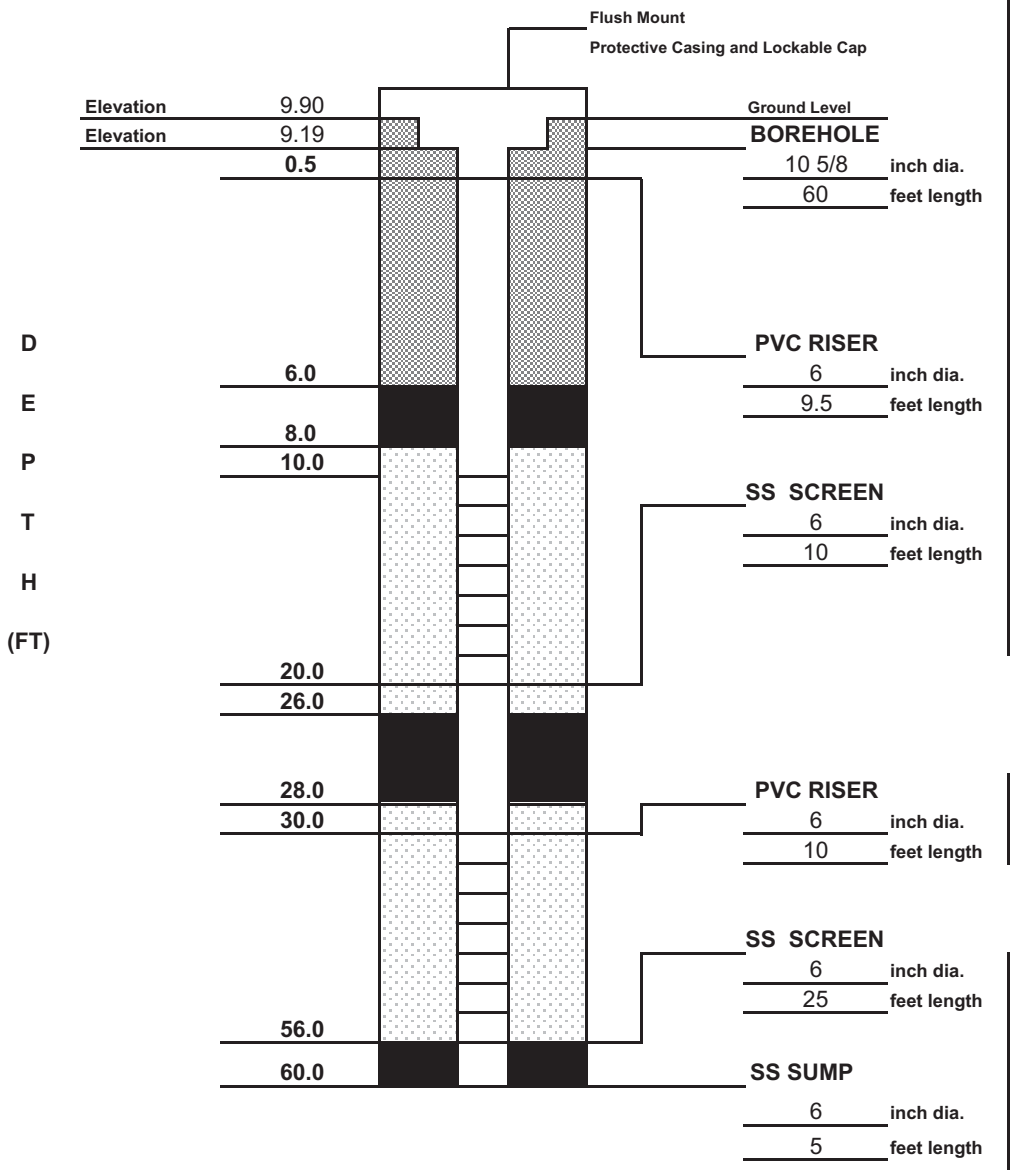
Rig Make/Model:
Fraste Sonic XL Max 250 MS

Date:
3/28/17

GEOLOGIC LOG

Depth(ft.)	Description
	See Boring Log for Lithologic Description.

WELL DESIGN



CASING MATERIAL		*SCREEN MATERIAL*		*FILTER MATERIAL*		
Surface:	12" Flush mount steel grade box	**Type:**	6" Continuous Wrap Stainless Steel	**Type:** #0 Sand	**Setting:**	8.0-26.0 ft 28.0-56.0 ft
Riser:	6" Schedule 40 PVC	**Slot Size:**	0.020"	*SEAL MATERIAL*		
				Type: Bentonite Chips	**Setting:**	6.0-8.0 ft 26.0-28.0 ft 56.0-60.0 ft

COMMENTS:
Seal Material

Bentonite Chips: 6'-8'/26'-28'/56'-60'

LEGEND

- Concrete
- Bentonite
- Silica Sandpack

Client: **National Grid**	**Williamsburg Works** **Former MGP Site**	**Project No.:** **J1144**
Sevenson	**MONITORING WELL CONSTRUCTION DETAILS**	**Well Number:** **NRW-09R**

URS Corporation

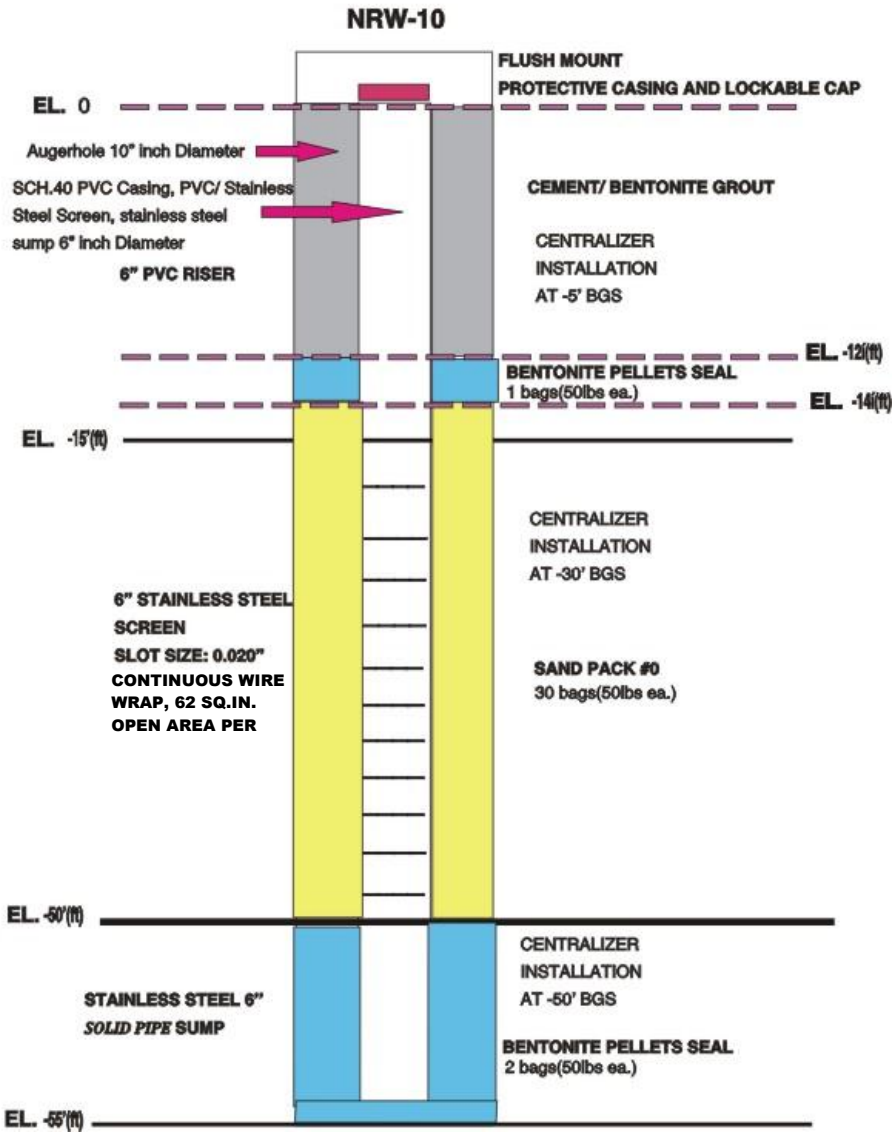
Client: National Grid

Location: 50 Kent Ave.,
Williamsburg, Brooklyn, New York
Project No.11176638.00019

DRILLING SUMMARY

GEOLOGIST: ANDREAS PAPANEOCLEOUS
DRILLING COMPANY: CASCADE
DRILLER: JOHN GRAGLIA
DRILLING RIG TYPE: SONIC
DATE: 03-20-2014

Recovery Well Construction Details



DRILLING SUMMARY

Geologist:
M. Dascoli

Drilling Company:
ADT

Driller:
G. Rivera

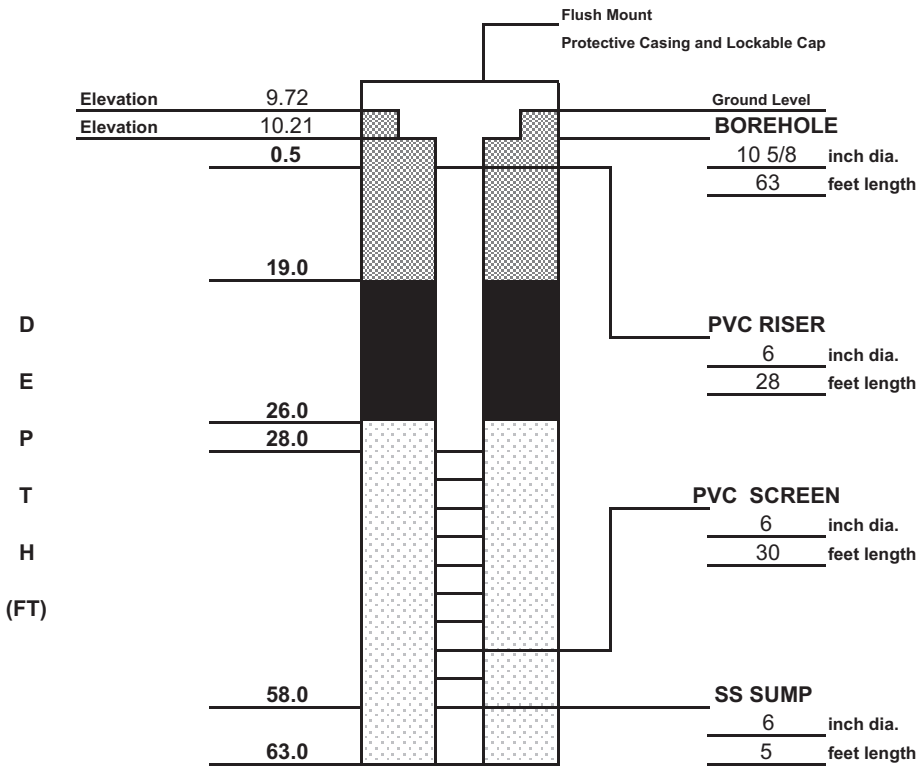
Rig Make/Model:
Fraste Sonic XL Max 250 MS

Date:
3/24/17

GEOLOGIC LOG

Depth(ft.)	Description
	See Boring Log for Lithologic Description.

WELL DESIGN



CASING MATERIAL

Surface: 12" Flush mount

Riser: 6" Schedule 40 PVC

SCREEN MATERIAL

Type: 6" Continuous Wrap Stainless Steel

Slot Size: 0.020"

FILTER MATERIAL

Type: #0 Sand **Setting:** 26.0-63.0 ft

SEAL MATERIAL

Type: Bentonite Chips **Setting:** 19.0-26.0 ft

COMMENTS:

LEGEND

Concrete

Bentonite

Silica Sandpack

Client: National Grid	**Williamsburg Works** **Former MGP Site**	**Project No.:** J1144
Sevenson	**MONITORING WELL CONSTRUCTION DETAILS**	**Well Number:** NRW-11R

URS

50 KENT AVENUE PROPERTY, BROOKLYN KINGS COUNTY, NEW YORK

URS Corporation

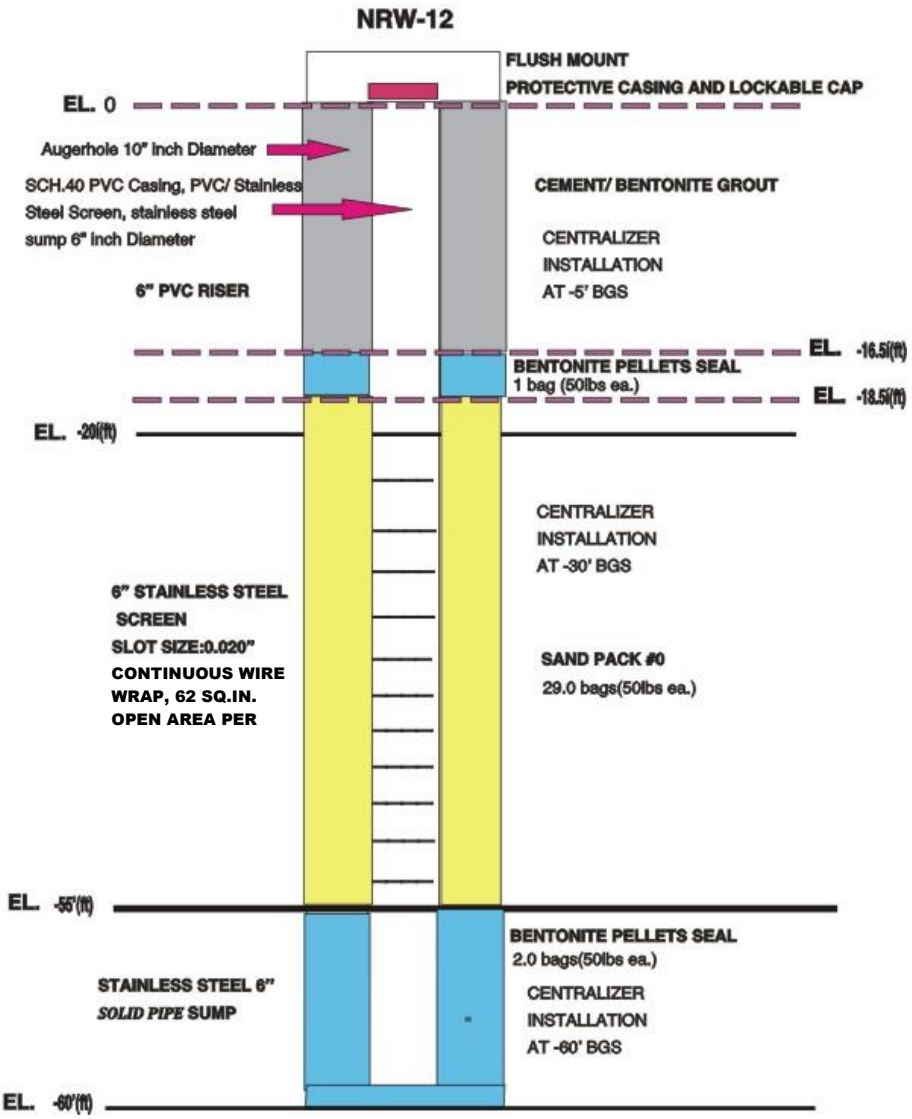
Client: National Grid

Location: 50 Kent Ave.,
Williamsburg, Brooklyn, New York
Project No.11176638.00019

DRILLING SUMMARY

GEOLOGIST: ANDREAS PAPANEOCLEOUS
DRILLING COMPANY: CASCADE
DRILLER: JOHN GRAGLIA
DRILLING RIG TYPE: SONIC
DATE: 03-27-2014

Recovery Well Construction Details



URS Corporation

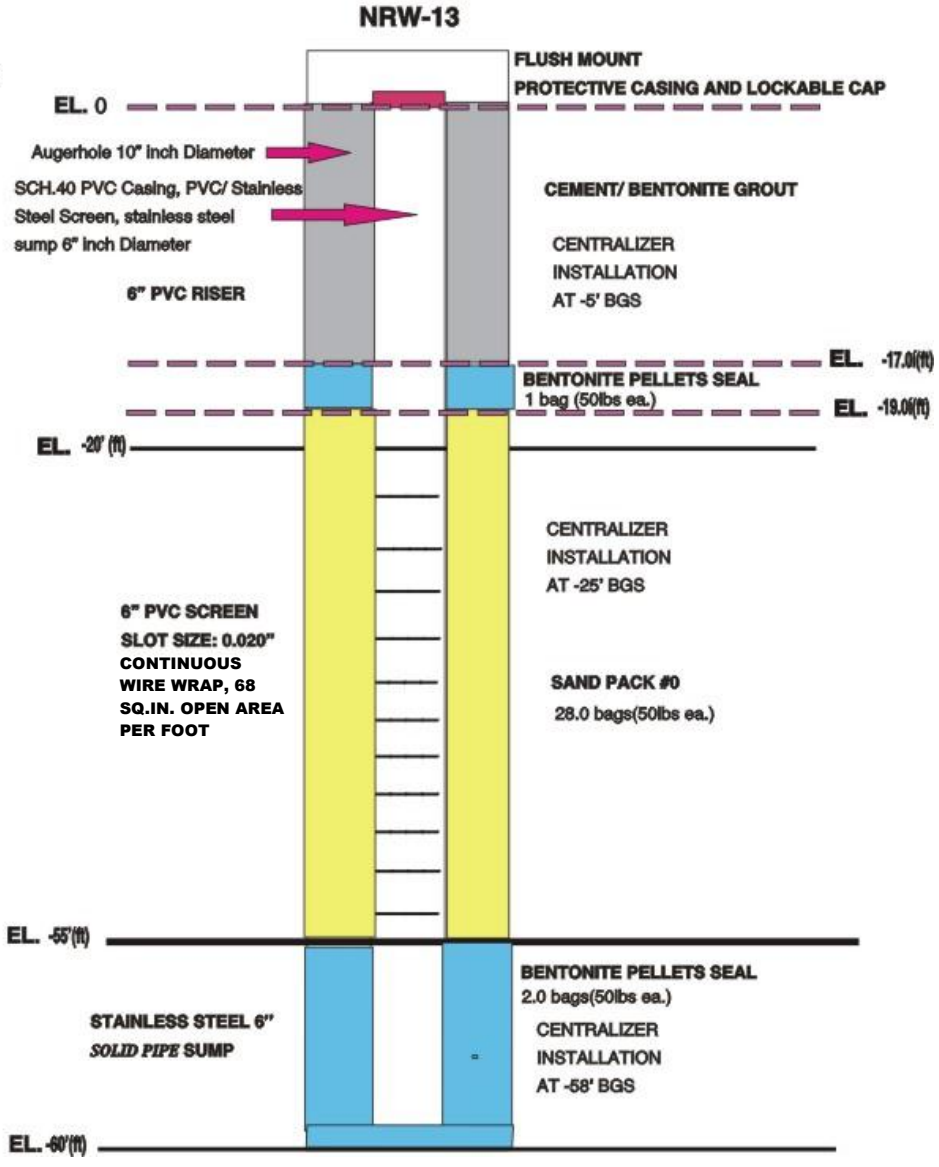
Client: National Grid

Location: 50 Kent Ave.,
Williamsburg, Brooklyn, New York
Project No.11176638.00019

Recovery Well Construction Details

DRILLING SUMMARY

GEOLOGIST: ANDREAS PAPANEOCLEOUS
DRILLING COMPANY: CASCADE
DRILLER: JOHN GRAGLIA
DRILLING RIG TYPE: SONIC
DATE: 03-28-2014



Appendix B – NAPL Recovery Checklist

AECOM Imagine it. Delivered.

NAPL Recovery Checklist

Date: _____ Day: _____ Prepared By: _____

Action Items	Yes	No	NA	Comment/Reason
Fuel generator				
Ensure field equipment is hired as required and is in good working order.				
Pick up drums.				
Check field consumables are in adequate supply and re-order as required.				
Inform your Site point of contact when you get to the Site and check in routinely during the day.				
Note down arrival time, date, weather, and objective in the field book.				
Review tasks for the day and associated hazards. Note down safety topic for the day in the field book. Complete Task Hazard Assessment.				
Calibrate PID and note down readings for 0 and 100 in the book.				
Put poly and absorbent pads around the well to be gauged and pumped.				

Action Items	Yes	No	NA	Comment/Reason
Wear all appropriate PPE, including Tyvek while working with NAPL.				
Gauge wells and note Well ID, NAPL thickness (measure coating on the string with a tape), and depth to bottom in the field book.				
Refer to available sump height for each well and remove NAPL from the wells that require pumping. Note which wells were pumped in the field book.				
Measure height of NAPL in the drum after removing NAPL from each sump (use either (1) a steel yard stick and decon following use, or (2) a weighted string and measure against a tape for accurate reading). Do this after each well to inform the calculation of volume recovered from each well. Note this in the field.				
Note down if there are any issues or observations at the Site, or with NAPL gauging or recovery and inform the Project Manager.				
Label drums appropriately.				
Note how many product and PPE drums were created.				
Note down time of drum pick up.				
Call your Site point of contact when you leave the Site.				

Action Items	Yes	No	NA	Comment/Reason
Scan or take pictures of field notes and forms and send to the Project Manager at the end of the day.				

Appendix C – Recovery Well Field Form

AECOM Imagine it. Delivered.

RECOVERY WELL FIELD FORM
50 KENT AVENUE PROPERTY

AECOM TECH: _____
AECOM TECH: _____
DATE: _____
WEATHER: _____

SAFETY MEETING
ATTENDEES: _____

TOPICS COVERED _____

	Gauging Details				Recovery Details				
Recovery Well	**Date of Gauging**	**Depth to Water (ft)**	**Product Thickness w/ String (ft)**	**Measured Well Depth (ft)**	**Total Liquid Removed (gal)**	**Volume of Water in Tube (gal)**	**Product Removed (gal)**	**DNAPL Thickness, After Recovery (ft)**	**Comments/Observations**
NRW-01R									
NRW-02									
NRW-06									
NRW-07									
NRW-08R									
NRW-09R									
NRW-10									
NRW-11R									
NRW-12									
NRW-13									
					TOTAL PRODUCT REMOVED		***0.0***		

Notes:
All depths are recorded as feet below Top of Riser, unless otherwise noted.
x - No Data
NM - Not Measured
NA - No Access
NP - No Product
ND - Not Detected

Appendix D – Health & Safety Plan

Appendix E – Standard Operating Procedures for NAPL Recovery

Standard Operating Procedures for NAPL Recovery

Waste Containers

- On the day before the NAPL recovery event, talk to waste hauler to confirm drum pick up. Do not recover NAPL if drum pickup cannot be scheduled.
- Empty drums shall be picked up from a local dealer on the morning of the NAPL gauging and recovery event.
- Two additional drums shall be maintained in the off-site rented storage area in case the local drum dealer does not have drums in stock for a day.
- Since there is no on-site storage, drum pick up shall be scheduled with advanced notice for the same day as the NAPL recovery event.

Well Gauging

Equipment needed

- Screwdriver and 15/16” ratchet to open wells (and drums)
- Interface Probe (IP), 100’
- Cotton string with a stainless-steel weight on bottom
- Environment-friendly cleaning products and supplies for cleaning NAPL off of equipment (e.g., Simple Green)
- Plastic sheeting and oil absorbent pads

Steps

- Set up PID (for worker protection)
- Don required PPE (nitrile gloves, safety glasses, etc.)
- Lay down spill pads around well
- Open well
- Using an IP or weighted string, measure NAPL thickness, if present
- Once per month, use IP or weighted steel tape to measure depth to bottom of well
- Record measurements
- Lower string down slowly until it hits the bottom, but don’t allow string to slacken as the measurement may be skewed
- Wind string back up and measure length of product staining on string
- Record measurement
- Decontaminate tape, weight and IP, as needed
- Cut off stained string and reattach weight
- Close and secure well

NAPL Recovery

Equipment Needed- General

- Rental truck or van to hold equipment
- Hand truck (for moving drums when stored on-site)
- At least two 5-gallon containers or 55-gallon drums with closable tops
- Appropriate tubing
- Screwdriver and ratchet to open wells
- Environment-friendly cleaning products (for cleaning NAPL from equipment)
- Plastic sheeting and oil absorbent spill pads
- Heavy duty garbage bags
- Weighted bailer and string
- Drum wrench with 15/16” bit
- Traffic safety barriers/cones and caution tape
- In winter: Snow shovels, salt, non-slip footwear

Needed for Peristaltic Purging

- Peristaltic pump with two external batteries (rental)
- Tubing for peristaltic pump
- Hose clamps for intake and discharge on pump

Needed for Waterra Purging

- Waterra pump (rental)
- Generator (rental)
- Tubing and check valves for Waterra pump
- Extension cord
- Spare check valves

Peristaltic Purge Steps

- Lay 6 mil plastic sheeting and place equipment on it
- Don PPE, including poly-coated Tyvek suit or Tyvek apron with sleeves if there are concerns for heat exhaustion
- Set up cones and lay out plastic and spill pads around well
- Open well
- Set up 55-gallon drum or 5-gallon buckets, with spill pad underneath bucket or edges of drum
- Set up peristaltic pump powered by external battery or car battery
- Connect hose to dedicated tubing and secure hose clamps
- Insert tubing into bucket or drum and secure with a clamp
- Turn on the pump and pump well until product is pumped out- until water being pumped out is relatively NAPL free (during pumping: reduce odors by covering well and bucket)
- Disconnect and pack up equipment, clean area if needed

- Record volume of liquid removed by using markings on side of container or measure with weighted string (1” in a 55-gallon drum = 1.6 gallons)
- Close up bucket or drum and well.

Waterra Purge Steps

- Lay 6 mil plastic sheeting and place equipment on it
- Don PPE, including poly-coated Tyvek suit or apron
- Set up cones and lay out plastic and spill pads around well
- Open well
- Set up 55-gallon drum or 5-gallon buckets with spill pad underneath
- Set up wooden stand and Waterra pump
- Start generator and connect extension cord to Waterra
- Insert tubing into bucket or drum and secure with a clamp
- Turn on pump and pump well until product is pumped out- until water being pumped out is relatively NAPL free
- Disconnect and pack up equipment, clean area if needed
- Record volume of liquid removed by using markings on side of container or measure with weighted string (1” in a 55-gallon drum = 1.6 gallons)
- Close up bucket or drum and well.

Containerization Steps

- All efforts shall be made to prevent spills, splashes, or drips of NAPL onto ground or personnel.
- Spill pads and plastic sheeting shall be laid on the ground around the NAPL recovery wells and pumping activities.
- Direct all extracted NAPL to a 55-gallom drum.
- Drums shall be moved from well location to well location using a hand truck.
- A 5-gallon bucket may be utilized in lieu of a drum for select wells:
    - The 5-gallon buckets shall be fully closed prior to transport to the drum.
    - The contents must be transferred to a 55-gallon drum using a peristaltic pump or siphon pump to reduce splashing.
    - The 5-gallon buckets shall be wiped with a spill pad at the end of each collection event to remove NAPL.

After NAPL Recovery

- Put impacted waste, i.e. used PPE and supplies, in a heavy duty trash bag. Impacted waste should be placed in dedicated 55-gallon drum for disposal at the end of each event. Transfer recovered liquid from buckets to 55-gallon drums by using a peristaltic pump or siphon pump working as cleanly as possible.
- If the drums are left at the Site unattended for some time (i.e. while taking a break to use the restrooms), attach an appropriate Hazardous Waste Label to each NAPL drum and secure them by closing the drum lid, moving them to the side of the road inside the fenced area, and locking the access gate.
- Generator’s address, and Generator’s EPA ID #:

The Brooklyn Union Gas Co. d/b/a National Grid NY One MetroTech Center

Brooklyn, NY 11201

EPA ID # NYD986872265

- Site name and address:

  Williamsburg Works Manufactured Gas Plant (MGP) Site

  50 Kent Avenue

  Brooklyn, NY 11249

- Since there is not an on-site storage area, drum pick-ups MUST occur on the same day as the NAPL recovery.
- Clean-off IP, equipment, and vehicle as needed with environment-friendly cleaning supplies.
- Call equipment rental company to end equipment rental.

End of Event

- Return cleaned vehicle and arrange for rental equipment pick-up.
- Assign one person to enter data electronically.

FOREWORD

National Grid's vision is to be a world-class safety organization with zero injuries every day. This includes working to help ensure the safety of our employees, contractors and the community. National Grid is committed to delivering operational excellence, including excellent levels of safety internally and in cooperation with the external contractors we rely on.

The Executive Safety Committee provides review and input for Safety Policies and Procedures through the Safety Policies and Procedures Subcommittee.

The Safety department is the owner of this procedure and is responsible for maintaining and implementing this procedure, soliciting comments from stakeholders and revising as necessary.

This document, "Contractor Safety Requirements", represents the current contractor safety requirements that are unique to operations and various functional groups at National Grid. This document does not specifically reference actions that are required by OSHA, other laws, rules, or regulations. These are requirements that should be understood by the contractor and contractor compliance with all applicable federal, state and local laws, rules, and regulations is expected by National Grid as a contractual condition.

Questions regarding this procedure should be referred to the National Grid Safety Department.

This document will be updated as necessary to communicate all aspects of National Grid's contractor safety to bidders, current contractors and to reflect changes in National Grid's Safety Policies and Procedures.

Date of Review/Revision:

Revision	Date	Description
1	8/5/2004	Initial
2	3/2/2005	Additions
3	1/30/2007	Additions
4	8/1/2008	Additions
5	8/1/2010	Additions
6	2/1/2011	Audit recommendations included

Date of Review/Revision Continued:

Revision	Date	Description
7	9/11/2013	Additions included OH; technical changes; Compliance Monitoring; Ethics; Job Briefs
8	11/2/2015	Additions include Audit & IA recommendations; ISN alignment; technical changes, 1910. 269 updates
9	8/17/2016	Format update and technical changes
10	3/29/2017	Additions to sections 2.2.6 and 6.5
11	2/26/2018	Process Safety, PM&CC Electric and PM&CC Vegetation Additions
12	3/12/2019	Contaminated Site Work Additions
13	10/24/2019	Job brief, Hi-Vis clothing, ladder use, and air gap revisions
14	1/13/2020	Hi-Vis clothing and ladder use revisions; Fatigue Risk Addition in HASPs
15	3/10/2021	EH rated work boot and Dielectric (DI) footwear definitions and requirements; OSHA 1910.136(a) reference; requirement not to wear loose clothing; Hi-Vis vest or garment requirements
16	3/24/2021	One HASP form; HASP revisions; self-assessments; qualifications; and notice of subcontractors

17	6/14/2021	Loose garments/items for heavy equipment operators revision; addition of heavy equipment definition
18	5/4/2022	Removed requirements to upload contractor orientation/pre-construction meeting documents to ISN; Removed requirement to upload forestry training qualifications to ISN; Clarified that medium/high risk contractors acknowledge N1402 requirements by signing the N1402 acknowledgment form in ISN; Added additional examples to the medium/high risk exposure category; Revised the pre-construction meeting/contractor orientation requirement from “may” to “shall”; Changed Corporate Safety team references to Safety Policies & Programs

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1.0 CONTRACTOR SAFETY AT NATIONAL GRID

1.1 Definitions

Adverse Public Impact
Incident that disrupts service to the public or results in adverse public reaction.

Bulk Commodity Transportation
Activities involved in the movement of bulk commodities via truck, rail, plane or water vessel onsite and offsite on behalf of National Grid that if released could have safety and / or environmental consequences. Examples include but are not limited to: gasoline, oil, boiler chemicals, LNG, Nitrogen.

Compliance Assessments (CAs)
An act of observing and engaging in discussion with employees at a job site or work area locations. Compliance Assessments are documented using the Compliance Assessment checklist for each segment of operation and are not considered anonymous. Compliance Assessments are utilized to comply with internal policy and external regulatory requirements.

Contracted Services
Contracted Services refers to any activity that is conducted by an organization or individual under the terms of a purchase order or through other financial arrangements (Procurement Card or credit card) between a National Grid representative and a contractor. Contracted services may include all types of construction and maintenance services, tree trimming, building maintenance and demolition, electrical structure dismantling, site restoration, engineering design, recycling and waste disposal, drilling, rigging, electrical, and utility pole/structure maintenance.

Contractor
An independent person or company that undertakes a contract to provide materials or labor to perform a service or do a job and are responsible for the safety of his/her employees and subcontractors.

Contractor Orientation
Contractor orientation is intended to serve as a resource in order to provide the contractor with the tools necessary to educate their employees and subcontractors. The session is not intended to train the contractor management, their employees or subcontractors. The extent and content of the orientation session shall be commensurate with the scope and type of the contractor's activities.

Dielectric (DI) Footwear
This term describes either boots or overshoes that are labeled in accordance with ASTM F1117, marked clearly and permanently with the name of the manufacturer or supplier, the size and AC voltage rating. The footwear shall meet dielectric strength testing prescribed in ASTM F1116. Dielectric footwear shall have a minimum rating of 15kV.

Effective Safety Discussion (ESD)
A discussion with an individual or group about their safety programs, issues or concerns (safety plans, tools, equipment, procedures, etc.). They are safety discussions amongst employees that share similar work environments…office to office, field to field.

EH Rated Work Boot
ASTM F2413 EH rated work boots are the minimum foot protection standard. This boot protects against impact, compression, and low voltage exposure.

Health & Safety Plan (HASP)
Contractors who perform high or medium risk-ranked services shall submit a project-specific HASP prior to the start of the project. In this plan, the contractor shall identify all significant tasks, their anticipated hazards and mitigation steps.

Hazardous Conditions
A condition that can and is rectified immediately by the person who identified the hazard.

Heavy Equipment
Maintenance and construction equipment including excavators, compact (mini) excavators, backhoe loaders, towable compact backhoes, front end loaders, skid-steer loaders, compact loaders, digger derricks, boom trucks, cranes and bulldozers.

Incident
An unplanned event that has a human component and results in or could potentially result in harm to people, damage to property and/or adverse public impact.

Incident Management System (IMS)
National Grid's online incident management tool that allows the company to report safety, environmental and asset-related incidents, perform incident analysis, generate safety reports and monitor the organization's safety performance.

ISNetworld, Inc. (ISN or ISN System)
Third party contractor that is a global resource for connecting Hiring Clients with safe and reliable contractors and is a contractor information management system currently contracted with National Grid.

Job Brief
A planned interactive discussion that covers, but is not limited to, potential hazards associated with the job including situational awareness (assets or other items which may impact the job at hand), work procedures involved, special precautions, and personal protective equipment requirements. The discussion should include all contractor employees, sub-contractors and team members working on a job that occurs just prior to a job, task or project. A new job brief shall be conducted for each of the following events: prior to a change in planned work specific to the job site, changes in weather conditions, extended breaks (i.e. lunch breaks) or when a new worker or company joins the crew. When possible and reasonably practical, a National Grid Representative should be present at contractor job briefings. Truck drivers for daily, non-hazardous material deliveries such as stone, gravel, concrete material or porta john cleaning are exempt from completing a job brief unless there are potential hazards associated to the driver or delivery. A National Grid representative shall talk to the driver to determine if a job brief is needed.

Major Hazard Asset (MHA)
A class of assets at National Grid, including Compressed Natural Gas (CNG), Gas Transmission (≥ 125 psig), Power Generation sites, Liquefied Natural Gas (LNG) plants, and LNG Trucking, in which any condition, or set of conditions, presents potential for a major accident to occur. Also referred to as process safety assets.

Major Accident
An event involving the release of potentially dangerous materials, the sudden and uncontrolled release of large amounts of energy (such as fires and explosions), or both. These can have catastrophic effects and can result in multiple injuries and fatalities, as well as substantial reputational, economic, property, and environmental damage

Operator Qualification (OQ)
As defined in the Code of Federal Regulations, Transportation, 49 Subpart 192.801 through 192.809 and/or DOT pipeline qualified for gas contractors doing work at National Grid. Additional state requirements pursuant to the state the contractor is working may be required.

Process Safety Management
Method of focusing and mitigating concerns of major hazards impacting safety, environmental damage and business losses. It is an organized effort to identify and analyze the significance of hazardous situations associated with a process or activity to aid management in making critical safety decisions

Project Representative
National Grid Owner's Representative or designee who is assigned to certain contracted projects and communicates regularly with the contractor during the course of the contracted service. This person also ensures the work is being performed in accordance with the contract, including the safety requirements.

Purchase Order (P.O.)
An agreement/contract between National Grid and a contractor to provide services and/or materials. The P.O. is set up by Procurement. The term "Contract" and "P.O." are similar and may be used interchangeably. A "Blanket P.O." is set up for contractors whose work is on-going. A "one-time P.O." is set up for project work.

Qualified Electrical Worker
Those who are knowledgeable in the construction and operation of the electric power generation, transmission and/or distribution equipment involved, along with the associated hazards.

Qualified Gas Worker
Any contractor who performs covered tasks in accordance with National Grid's Operator Qualification Program and the Northeast Gas Association are required to be knowledgeable and meet all regulatory standards.

Risk Assessment
A risk assessment is the process of identifying hazards and calculating or ranking the associated risks according to: the likelihood of occurrence, the severity of the harm from the hazard, and the amount of time of exposure to the hazard.

Safety Observer
A person who is responsible for alerting the work team to any potential unsafe conditions or lack of compliance with approved work practices, procedures or guidelines.

Transportation Advisor
Third party agency specializing in federal and company mandated drug and alcohol testing programs.

1.2 Introduction

Safety performance is a prime consideration in the selection of contractors. National Grid will stipulate safety performance requirements and responsibilities in our contracts, purchase orders (POs) and will hold the contractor accountable for meeting the contractual requirements.

National Grid's goal is to establish a long-term working relationship with contractors who share the same safety values and demonstrate those values through their work performance.

Contractor safety at National Grid involves three broad areas:

1. **The Contractor Procurement (Selection) Process**
   Contractor safety begins with the selection of contractors who have demonstrated a strong safety record. National Grid will complete a review during the procurement process that involves determining a contractors' risk and the scope(s) of work involved. National Grid currently uses ISNetworld, Inc. as a third (3rd) party assessment process for assisting with contractor procurement. The 3rd party entity will vet and continually monitor individual contractors' compliance with applicable safety and/or risk and insurance program requirements.

2. **Safety Communication**
   Safety communication covers all the avenues and forums in which National Grid and the contractor communicates safety. Communication begins early in the bidding phase and is on-going as an integral part of the contractor-customer relationship. The goal is to ensure clarity, transparency and to limit misunderstandings.

3. **Safety Compliance**
   Safety compliance is the process of ensuring that the necessary technical provisions of the contract are being followed. National Grid will assign a project representative or other designee to provide guidance and oversight. The Contractor is responsible for their employees and subcontractors and shall be held accountable for ensuring compliance with all applicable safety rules while working on National Grid property, rights of way (ROWs) and our assets. Primary contractors are required to notify National Grid of any subcontractors and ensure that there is an appropriate contractual relationship in place in line with the terms and conditions of their contract.

1.3 Risk Ranking of Work

1. National Grid characterizes and ranks risk by the scopes of work performed. The categories are classified as high, medium or low risk. Prior to being considered for work at National Grid, contractors who perform High or Medium Risk work must be pre-qualified in ISN. See Appendix A for more information regarding the National Grid Contractor Risk Matrix.

2. Activities that are designated as “high risk” means that catastrophic event can result if safety measures are not followed. Activities designated as “medium” risk present certain opportunities for moderate to significant injuries, property or reputational damage, and/or loss of service and/or possibly business continuity. Activities designated as “low” risk may still require safety compliance and control measures, although the contractor performing the work does not necessarily need to be enrolled in ISN, if that is the only classification of work that contractor performs for National Grid.

3. The designation High Risk, Medium Risk, or Low Risk, refers only to the inherent risk associated with the work activity and is not an opinion on the ability of a contractor to work safely.

4. If ,at any time, the risk changes from low to medium/high, per the risk matrix, then the medium/high risk process shall be followed. It’s the contractor’s responsibility to identify if the risk changed and to escalate to National Grid personnel.

5. The Procurement Agent will notify the bidder/contractor at the beginning of the procurement process if their contracted service has been ranked as high or medium risk.

1.4 Bidder Information Request – High and Medium Risk Work

1. Any contractor bidding on high or medium risk work shall be required to complete a questionnaire regarding the Contractor’s safety program, compliance and history of occupational illnesses and injuries (ISNetworld New Vendor Onboarding application form, located on the ISNetworld website). Contractors will also be required to demonstrate in ISN that all employees, including subcontractors, are qualified to perform the scope of services.

2. ISNetworld then thoroughly reviews contractors’ qualifications against a prerequisite list of National Grid criteria. National Grid has established that contractors performing high or medium risk work MUST HAVE and MAINTAIN a grade of “C” or better in the ISN system to perform work and services for National Grid. ISN will track and manage the National Grid pre-

qualified contractor bidder lists. This bidder list is the first step for a contractor in establishing a working relationship with National Grid. For active ISN contractors, ISN will request updated information monthly. Contractors who do not have a current PO, contract, or authorized scope of work with National Grid will be considered as a Prospective bidder and will be asked to submit information quarterly. It is understood that insurance may not be maintained within National Grid standards, however, once a contractor is awarded a contract, proper and adequate insurance must be provided to ISNetworld to achieve a passing grade. Lack of insurance or inadequate insurance is an immediate "F" grade in the ISN system per National Grid criteria.

3. Project representatives may request an exemption or variance from requiring a contractor to be placed in ISNetworld for various reasons. A Supplier Exemption Request form (located in the safety policies and procedures section of Grid:home) shall be completed, documented and signed by the business unit VP and Safety Policies & Programs Director prior to contract award.

4. The information that the Bidder provides National Grid via ISN serves as the basis for assessing safety qualification. For this reason, it is important for contractors to maintain transparency throughout the process. National Grid and ISN will review all submitted information. Any effort in avoiding complete disclosure will disqualify the Bidder from bidding work at National Grid.

1.5 Safety Compliance

1. Medium/high risk contractors certify that they have been informed of National Grid safety requirements, that employees and subcontractors have the appropriate qualifications to perform the work, and agree to comply with all applicable safety requirements. This will be accomplished by the contractor signing the N-1402 Contractor Safety Requirements Acknowledgment Form in ISN annually and when there are revisions to N-1402.

2. National Grid representatives evaluate contractor compliance by conducting routine site visits, Compliance Assessments (CA's), Effective Safety Discussion (ESD) visits and attending periodic contractor safety meetings. Contractors should also perform and document safety self-assessments to ensure compliance to federal, state, local and National Grid regulations. This combined effort enhances, solidifies safety compliance and has the added benefit of quality control / quality assurance of the work performed.

3. Contractors bidding on new work shall provide worker qualifications to the National Grid procurement representative via the “Bidder Information Request” form and/or ISN National Grid On-boarding form.

4. If a safety violation is observed by a National Grid representative, the violation will be discussed with the contractor at the time of discovery.

5. Contractor employees enrolled in ISNetworld that are involved in any accident, incident or significant near-miss event, will be required to lead an investigation and root cause determination process. In addition, the contractor must implement corrective actions and establish measures to prevent a recurrence through an incident investigation process and document the details within ISN.

6. Individual contractor personnel who habitually violate any safety rules should be identified, and the contractor should remove the individual(s) from the project. National Grid reserves the right to remove any contractor employee(s) who violate safety rules or procedures; pose a safety risk to themselves, other contractors; our employees; or the general public.

7. If a contractor is observed to be operating in a manner that creates an imminent danger to persons or property, it is the responsibility of all individuals observing the hazard to cease the hazardous operation impacted until the issue has been resolved to the satisfaction of National Grid, the Owners Representative or Safety Representative.

8. Contracts/POs shall require the contractor to immediately forward any citations, notices, or OSHA reportable cases per 29 CFR 1904.39 from a National Grid project, upon receipt to the appropriate project representative and/or ISN. The project representative shall distribute copies of the citation or notice to senior management, Safety, Procurement, and the Legal Department.

9. Willful and/or repeat violations of safety requirements by the contractor may be considered a breach of the contract and reason for contract termination.

10. If the contractor’s overall safety performance is viewed as being unsatisfactory or noncompliant with contract provisions, and if the contractor is unwilling to demonstrate satisfactory program improvement, the result may be considered a breach of the contract and reason for contract termination.

11. National Grid project managers and/or construction supervisors shall document safety compliance by completing a “Contractor Performance Evaluation” for each project. This documents both positive and negative

safety performance or behaviors and this feedback will be used in the decision process for awarding future contracts.

2.0 GENERAL SAFETY REQUIREMENTS

2.1 Introduction

1. All contractors are required, and expected to comply with all applicable requirements of the Occupational Safety and Health Administration (OSHA), and all other applicable federal, state and local laws, ordinances, regulations, and other project and site-specific permits unless superseded by identified National Grid procedures.

2. This document represents policies and safety-related work methods unique to National Grid and they may be more stringent than OSHA regulations. Contractors must follow these requirements as well as their own rules or regulations that meet or exceed OSHA and other regulatory requirements.

3. National Grid will provide more detailed information and guidance regarding specific procedures prior to commencement of work.

4. Per OSHA 1910.136(a) general requirements, the employer shall ensure that each affected employee uses protective footwear when working in areas where there is a danger of foot injuries due to falling or rolling objects, or objects piercing the sole, or when the use of protective footwear will protect the affected employee from an electrical hazard, such as a static-discharge or electric-shock hazard, that remains after the employer takes other necessary protective measures.

2.2 Applicability

Applies to: All contractors, as needed

1. In any contracted task, where a safety observer is required, it is the responsibility of the contractor to provide that person and ensure that he/she is qualified to perform the role when needed.

2. A 4:1 pitch shall be maintained when using an extension ladder or the ladder shall be tied off and/or secured and 3 points of contact shall be maintained by the climber. If both hands are needed to perform work, then fall protection is required.

3. Although not preferred, if hard hats are worn backwards, the suspension adjuster must always face the rear. Class E hard hats are required for all electrical work.

4. ASTM F1117 Dielectric (DI) footwear is required when:
    - Workers on the ground are working within 50’ of the master ground connection point to earth.
    - Operating a wire trailer and pulling/tensioning machine.
    - Operating a winch truck or reel trailer with its payout in an energized area that may result in inadvertent contact.
    - Hand digging in close proximity to energized cables within the tolerance zone.
    - Making repairs in a trench to a faulted primary cable without de-energizing any adjacent energized primary cables within close proximity.
    - Using approved live line tools to move energized primary cables in a trench.
    - If removing underground cable rubber covering or arc suppression blankets from an energized cable.
    - Working within minimum approach distance (MAD) of downed electrical wires or foot patrolling for such wires.
    - If setting poles in proximity to energized lines or equipment and using truck controls from the ground.

5. National Grid expects that all cargo will be secured in accordance with U.S. DOT requirements.

    - As of January 2004, the Federal Motor Carrier Safety Administration (FMCSA) within the U.S. DOT published Cargo Securement Rules 393.100-136 Subpart I – Protection Against Shifting and Falling Cargo.

6. Chaps are required to be worn by ANY person using a chainsaw to make a cut on the ground or assisting in that cut and within striking distance. Other situations where cut off machines are used, chaps designed for the purpose of providing durable protection from abrasion, spatter and sparks from cutting ferrous metals shall be required; however, a hazard assessment should be completed to determine the need. Always use proper cutting techniques and push blades away from the body when using tools that may slip or inadvertently make contact with the leg. Never leave any equipment running while not in use.

7. All applicable contractors must meet the requirements of drug and alcohol testing in accordance with FMCSA DOT 49 CFR Part 40 and Pipeline and

Hazardous Materials Safety Administration (PHMSA) DOT 49 CFR Part 199. National Grid shall monitor contractor compliance to the drug and alcohol regulatory requirements through Transportation Advisor or ISNetworld as needed.

8. Contractors who drive regularly in delivery of service for National Grid shall:

   a. Have a safe motor vehicle operations policy which must be communicated to their employees before they begin driving for company business. The contractor is expected to follow National Grid's *Safe Motor Vehicle Operations* policy to include the following:
      - Prior to moving any vehicle, the driver shall perform a "circle of safety" inspection. This is to confirm not any person, animal, equipment, or property will be injured or damaged when the vehicle is moved.
      - Drivers should back into or pull through a parking space so that when you re-enter the vehicle, the first move is forward.
      - No driver shall use a hand-held mobile telephone while driving a vehicle for National Grid business.
      - The driver shall eliminate or minimize sources of potential driving distractions to include, eating, smoking, reading, writing, grooming, use of any electronic devices, mirror or seat adjustment. These shall be done when the vehicle is not in motion.

   b. Comply with all requirements of all federal, state and local regulations regarding safe motor vehicle operations.

   c. Ensure that new and existing employees have a valid Driver's License in accordance with requirements of specific job duties and classification/type of the vehicle they are operating. Contractors must have an acceptable driving record. If their driving record is unacceptable, the driver shall not be permitted to operate a vehicle on behalf of National Grid.

   d. Provide vehicles in safe operating condition, in accordance with federal state and local regulations. The vehicle should be equipped with proper safety equipment as appropriate for the vehicle type and its intended use.

e. Track and evaluate any vehicular accidents or incidents experienced by their employees. Corrective actions, such as driver coaching, corrective action driver training and medical/vision tests should be recommended and acted upon where appropriate. All accidents or near misses while performing work for National Grid shall be communicated to the National Grid project representative or designee and documented in the ISN system.

f. For more information, contact a National Grid representative for a copy of the National Grid Safety Policy *Safe Motor Vehicle Operations*

9. All contractors that require the use of heavy equipment shall ensure that competent, appropriately licensed, skilled and qualified personnel are in control of this equipment at all times. In addition, contractors shall ensure the following:

- Equipment is inspected for safety and use at the beginning of the work period of shift. All failing or defective equipment and components shall be removed from service.
- Equipment is under the control of trained operators who are always aware of their location and the locations/presence of persons working near the equipment, its swing zones and blind spots.
- While operating heavy equipment, operators shall ensure that loose fitting vests, jackets or other garments/items shall not be worn that could inadvertently get caught on equipment controls. Upon exiting the heavy equipment, the operator shall immediately put on their hi-vis vest/garment.
- Equipment is kept free of debris, water, oil, grease, mud or anything that could create a slip/fall hazard inside the cab.
- Keep hands, feet, and clothing away from power-driven and moving parts.
- Equipment cab windows should be kept clean and free of mud, ice, snow and/or fog for maximum visibility.
- Never carry passengers on heavy equipment or any equipment unless it is equipped to do so.
- Ensure that stabilizers are extended prior to starting a task.

- Before making a swing, operators shall always look out the windows and mirrors for confirmation that the area is clear. If visual confirmation is impaired or the operator is unsure due to weather, lighting or other interferences, the operator shall cease operation until an independent spotter can check the swing area and confirm it is clear.

- All excavations shall have signs posted, demarcation and controlled to prevent unauthorized persons from entering and falling inadvertently into the excavation. Excavations shall only be opened under the supervision of a competent person for excavation.

- All pot holing/test holing and exploratory excavations shall utilize vacuum excavation whenever near known or the possibility of unknown hazards such as live electrical or gas conveyances. When using vacuum excavation in combination with air blowing/air knife tools, all persons in the immediate area shall be wearing safety glasses in addition to a full face shield.

- No one is to work under a suspended load.

- Never use a bucket to lift personnel.

- Ensure stabilizers are in the upright and stored position before moving equipment.

- Operators shall not leave heavy equipment running unless the following requirements are met:

    - Parking break is engaged and wheels are chocked (if applicable)

    - Surroundings create no hazard of unqualified personnel entering unattended equipment

    - Vehicles and equipment idling limited to that designated state and local environmental regulations (generally, 3 to 5 minutes maximum). See table below for additional information

Region	Vehicles	Idling Limit	Exemptions Include
New York	Diesel trucks	5 minutes	• Traffic conditions • Temperatures < 25°F and motionless for two hrs • Hybrid electric engine charging battery vehicles • To provide power to auxiliary sources
NYC	All Motor vehicles	3 minutes	• Emergency vehicles • Loading/unloading • Temperatures <40°F
New Hampshire	Diesel/ Gas vehicles	5 minutes >32°F 15 minutes -10°F to 32°F No Limit <-10°F and no nuisance created	• Traffic conditions • Emergency vehicles takeoff power for auxiliary uses • Vehicles being serviced or repaired • Operated solely to defrost windshield
Massachusetts	All Motor Vehicles	5 minutes	• Vehicles being serviced or repaired • Vehicles in operation for which associated power is needed • Delivery vehicle in which engine power is needed
Rhode Island	Diesel Motor Vehicles	5 minutes	• Traffic conditions • Operate defrosting, heating, or cooling equipment to ensure health and safety of the driver or passenger. • Temperatures between 0 & 32°F - 15 minutes per hour. If < 0°F idling as needed for heat • To provide power to auxiliary sources • Vehicles being serviced or repaired
Vermont	All Motor Vehicles	5 minutes within any 60-minute period	• Emergency/public safety vehicles while engaged in "official operations" • Idling necessary to operate safety equipment • Vehicles in operation for which associated power is needed • Vehicles being serviced or repaired

- All lifts that occur on National Grid properties, ROWs or near critical assets require formal lifting plans developed by the contractor and reviewed with the National Grid project representative. Some lifts will also require formal critical lifting plans and this may include PE or geotechnical assessments to ensure a stable lifting base for the crane or other apparatus.

10. All temporary, metal fencing installed or located under transmission lines shall be grounded and have signage according to National Grid grounding standards. Contact a National Grid representative for a copy of the Engineering Documents ST 03.05.001ST 03.06.001 and SP 08.00.001.

3.0 ADMINISTRATIVE SAFETY REQUIREMENTS

3.1 Worker Qualification Assurance

1. In order to meet National Grid safety requirements, the contractor must describe how workers, including subcontractors, are qualified. The contractor must supply information concerning the type of skills assessment performed, training programs and how they ensure that employees

demonstrate competencies. National Grid reserves the right to review this information and request additional training requirements. All documents shall be uploaded and maintained in the ISN system for high/medium contractors. For work on process safety assets, the contractor shall ensure all workers and sub-contractors are trained and receive appropriate refresher training to maintain their appropriate level of certification and qualifications needed to perform work safely.

2. For low-risk contractors who perform activities that require PPE, which excludes office-based contractors and/or consultants, or other non-physical low-risk contractors, the contractor is required to watch an on-boarding video annually prior to any jobs starting for that year. The contractor employees and subcontractors are required to watch the video to be clear on safety expectations. Contractor to ensure that any new employees performing services for National Grid watch the on-boarding video if they hadn't watched it in the annual release. A link to the video can be obtained from the Project Representative.

3. Medium/high risk contractors shall complete an annual in-person on-boarding hosted by National Grid supervisor or project manager. The on-boarding shall emphasize required qualifications, HASP requirements, and requirements on revisions to HASPs when changes to the scope of work on the site or changes to risk occur. The National Grid supervisor or project manager are to conduct the on-boarding and determine the appropriate material to be used to communicate and emphasize the expectations.

4. Contractors shall conduct their own safety self-assessments.

Periodic field visits and/or verbal contact shall be conducted by the National Grid supervisor or project manager who are familiar with the work and existing scope. The National Grid supervisor or project manager shall review the work performed during the field checks and/or verbal contact and can ask the contractor to provide qualifications upon request.

During the field visits/verbal contacts, National Grid supervisor or project manager shall also review existing HASPs and/or job briefs as applicable for current work scope and require any revisions based on observations. The field checks/contacts are to be documented using Compliance Assessments, Contractor Evaluations, or ESDs.

If HASP or job brief does not cover observed hazards and risk mitigation, work shall be stopped until a revised HASP or job brief and approval of the revision occurs, which is required before work can continue.

The frequency of the field visits/verbal contacts are based on risk perception of the job, including variability of conditions, and if there is greater chance of serious injury or fatality based on high-energy presence (gravity, pressure, energy). Higher volume of visits should be conducted if it's a new contractor, based on contractor's performance (review IMS, Compliance Assessments, etc.), or if variations exist including: change in project scope, weather, change in crew and/or subcontractors, change in equipment on site, new high energy factors are present (greater chance of SIF), and long duration job.

5. The contractor shall provide management personnel qualifications through resumes or other documents. National Grid may interview and/or approve management personnel if considered necessary.

6. For work on Process Safety assets (Gas Transmission, Generation, LNG, LNG Transportation and CNG), contractors shall provide a description of their experience in the business asset and specific tasks including similar projects, lists of licenses/certifications, and references from previous similar projects. Contractors shall be made knowledgeable of National Grid process safety requirements that are relevant to their specific work activities by the business hiring them.

3.2 Meetings

Applies to: All contractors; as needed

1. The pre-bid meeting is coordinated by National Grid Procurement to provide bidders with an opportunity to become acquainted with contractual requirements and specific safety issues concerning the project, including company-specific safety rules and known site conditions.
   a. For contractors working on Major Hazard Assets, contractual language including designation of site medical facilities, locker rooms, bathrooms, etc. should be discussed by the project team with the contractor at this time.

2. At this time, Procurement will notify the prospective bidders of the following:

   a. If they are required to submit a project safety plan (HASP) prior to the pre-construction meeting

b. The cost of specific safety equipment, practices and personal protective equipment shall be factored into their bid/proposal.

3.3 Project Health & Safety Plan (HASP)

Applies to: Contractors performing high or medium risk work

All HASPs shall be submitted to the National Grid project owner for review and approval before work commences. The National Grid project owner shall ensure the HASP meets National Grid criteria and includes all aspects of the project prior to a review by Field Safety (if applicable). The project owner shall review the HASP. Field Safety shall also review the HASP after the business conducts its review only if the work is unique, there's a new project manager or supervisor, the work involves PHAs, or there's unfamiliarity with the project or safety standards.

If changes are required, a new HASP shall be created and rereviewed.

If the scope of work on the job site changes from the approved HASP, work shall be stopped. The HASP shall be revised and rereviewed by National Grid Business (Field Safety review as applicable), and work can continue once the revised HASP has been reviewed for risk controls of changed scope. Until the HASP is updated work shall remain stopped. Failure to update the HASP will be considered a violation of safety requirements in line with section 1.5. It's the contractor's responsibility to inform National Grid personnel if the scope changes.

1. Contractors who perform high or medium risk-ranked services shall submit a project-specific HASP plan prior to the start of the project and/or at pre-construction meeting. The HASP is to be followed by the contractor's employees and its subcontractors.
2. At a minimum, the HASP shall include the following elements:
   a. Roles and Responsibilities
   b. Scope of Work
   c. For contractors working on Major Hazard Assets - List of all equipment contractor is expected to use in work activities and indication that it meets regulatory and National Grid requirements
   d. For contractors working on Major Hazard Assets - List of contractor materials to be brought onto work site for review and approval by National Grid

e. Task and hazard identification and risk assessment of the hazards

f. Hazard mitigation/control procedures and work methods

g. Incident investigation and reporting

h. Compliance and monitoring

For an example of a HASP, a National Grid representative can provide related policies and procedures under the *Contractor Safety* website in Grid:home.

3. The following requirements shall be included in the HASP for all work at contaminated sites. The HASP shall be site-specific and meet the requirements of 29 CFR 1910.120(b)(4)(ii). The HASP must include at a minimum:

a. A safety and health risk or hazard analysis for each site task and operation

b. Personal Protective Equipment to be used by employees for each of the site tasks and operations

c. Medical surveillance requirements

d. Frequency and types of air monitoring and personnel monitoring to be used

e. Site control measures

f. Decontamination procedures

g. An emergency response plan for safe and effective responses to emergencies, including the necessary PPE and other equipment

The contractor/National Grid project representative shall contact the Environmental Department for guidance on site requirements and to initiate any required regulatory notifications.

For contractors performing bulk commodity transportation activities, a risk assessment including the potential consequences, frequency and safeguards to be used shall be performed and included in the HASP. If a preexisting National Grid requirement is in place for managing bulk commodity transportation activities, one shall follow those requirements, with no additional risk assessment being required.

Every contracted and subcontracted employee, including those working alone, performing work on the project shall review the HASP to ensure steps in the plan are adhered to in order to mitigate hazards during the pre-job orientation. These mitigation steps shall be incorporated into all work plans and job briefs.

Truck drivers for daily, non-hazardous material deliveries such as stone, gravel, concrete material or porta john cleaning are exempt from completing a job brief unless there are potential hazards associated to the driver or delivery. A National Grid representative shall talk to the driver to determine if a job brief is needed.

In addition, all workers shall sign an attendance sheet during the pre-job orientation that they have reviewed the plan, will adhere to the mitigation steps and they fully understand the plan. This document will be kept at the job site and available for review as needed and if requested by any National Grid representative, or any other parties.

A. Roles and Responsibilities

The HASP shall identify who is providing project oversight and how they are qualified. For example, if the work requires excavation, there must be someone on-site who is qualified as an excavation competent person.

For multi-employer work-sites, the general contractor is responsible for all their employees and subcontractors. The safety plan shall clearly state this responsibility.

If requested to do so, Contractors shall designate a competent person to participate in or conduct a process hazard analysis (PHA) regarding a portion or the entirety of the project. National Grid will not be responsible for training the contractor on the PHA methodology.

B. Scope of Work

The Contractor shall clearly and briefly state the scope of work as provided by National Grid. The plan must specifically address the project or services requested by National Grid.

C. Task and Hazard Identification and Risk Assessment

The contractor shall perform a risk assessment by identifying all significant tasks, the anticipated hazards and hazard mitigation procedures.

If, at any time, the risk level changes on the job site, the contractor is to stop work until a revised HASP or job brief is created and discussed on site and reviewed by National Grid personnel.

Contractors performing work where their employees are exposed to fatigue, shall assess fatigue risk in their HASPs and identify the mitigations they will take to manage the risk to their employees.

The contractor's cost to provide adequate safety measures and to comply with National Grid requirements must be considered and budgeted in the bid/proposal.

D. Hazard Mitigation Procedures and Work Methods

For each hazard, the contractor shall specify measures that will be taken to eliminate, control or mitigate these hazards.

A table below is an example of a method to simply and clearly organize and present the task, hazard, and mitigation steps:

Location: Substation Yard		
Task	**Hazard**	**Mitigation Steps**
Material Handling	Contact with overhead energized lines/equipment	Off load in the clear and have a safety observer present

E. Incident Investigation and Reporting

All work related incidents involving injury or illness to employees, the public or property damage (including contractor vehicle accidents) shall be reported to the National Grid project representative and documented in the ISN system.

F. Compliance Monitoring

To ensure that both contractor employees and subcontractors will achieve safety compliance, jobs with over 100 workers at any point in time or in excess of $1 million will require a full time safety professional hired by the contractor. This safety professional must be qualified, competent and be on site anytime work is performed. Qualifications of this safety representative must be acceptable to National Grid prior to hire by the contractor and may be documented in the ISN system.

For other jobs that don't meet the above criteria, contractors shall monitor jobs in line with their safety management system.

G. Environmental Compliance

Unless otherwise specified and based on the scope of work, any potential environmental risks shall be determined and addressed by the contractor following all applicable National Grid procedures. For more information, contact a National Grid representative regarding Environmental Procedure No.6 *Contracted Services* and Environmental Procedure No.25 Appendix A, *Environmental Screening Checklist.*

3.4 Contractor Orientation/Pre-Construction Meeting

Applies to: All contractors, as needed

1. A National Grid project representative, construction supervisor, or other designated National Grid representative that hires the contractor shall hold a contractor orientation and/or pre-construction meeting prior to the contractor working for National Grid. Other attendees may include: the Safety department, Environmental representatives, as well as contractor management as needed.

2. It is intended to serve as a method to provide the contractor with the tools necessary to educate their employees and subcontractors on National Grid's procedures and requirements. The session is not intended to train the contractor management, their employees or subcontractors.

3. All contractors are required to attend a National Grid orientation program specific to the type of work they will be performing. Contractor management representation shall also be present meeting and all documentation of attendance shall be kept at the job site and available to any National Grid representative. For visitors and contractors working on Major Hazard Assets, site orientation shall at a minimum include the following:

   - General site hazards
   - Specific hazards involved in each task the employee may perform
   - Safety policies and work rules, including Process Safety policies
   - Location of emergency equipment like fire extinguishers, eyewash stations, and first-aid supplies
   - Smoking regulations and designated smoking areas if applicable
   - Steps to take following an accident or injury

- Proper reporting of emergencies, accidents, and near misses
- Selection, use, and care of personal protective equipment
- Emergency evacuation procedures, routes, and security systems
- Safe housekeeping rules
- Safe use of tools and equipment
- Hazardous materials in use and location of safety data sheets

Site access shall not be granted to contract employees working on process safety assets until orientation is conducted.

4. The contractor's Project Health & Safety Plan will be discussed at this meeting including a final review of the safety hazards checklist to ensure proper hazard identification and mitigation plan has been implemented.

5. These hazard mitigation measures shall be reviewed and work shall not commence until these hazards have been adequately addressed. The National Grid project representative will discuss the methods by which compliance will be achieved to National Grid safety requirements with the contractor.

6. An Emergency Call List shall be exchanged with the National Grid project representative for high or medium risk projects or as applicable. This list must contain 24-hour contact information for key contractor and project personnel, including the project representative and Safety representatives. This list should be distributed to all concerned, as determined by the project team, prior to the start of work. For contractors working on process safety assets who have an emergency response role, the emergency response plan shall be updated to clarify the contractor's role in the event of an emergency on site.

7. For routine maintenance services, a review of associated safety issues and specific facility issues, restrictions or practices, such as evacuation procedures, shall be discussed with the contractor upon initial hiring. Any changes in the facility that may affect the safety of contractor or National Grid employees or third parties must be communicated immediately.

3.5 Job Safety Briefs

Applies to: All contractors; as needed

1. Job safety briefs shall be documented in writing. Written job safety briefs, permits, and/or plans shall be available at the job site for inspection and retained for 30 days after the job is completed.

2. National Grid reserves the right to perform a safety stand-down with any contractor for purposes including, but not limited to: recent injuries, incidents or near misses; identified hazards at job site or equivalent, and for other reasons to communicate with the contractor crew.

3. Each crew shall conduct these job safety briefs prior to commencing work at the job location. A new job brief is required when there are changes to the day's work order or plan, when there are changes in weather conditions, when a new worker or company joins the crew, and if the crew members take any extended breaks (i.e. lunch breaks). Working alone: A contractor working alone need not conduct a job brief; however, the contractor must review the hazards associated with the job as if a formal job brief had been performed.

4. Each worker must have the opportunity to voice concern. The work cannot begin until each worker signs off on the job safety brief stating that they have discussed the work, raised any questions, and agree with the plan.

5. Visitors to the work site shall be asked to read and sign the job brief acknowledging they understand contents. Contractors shall review the job brief and discuss the elements of the hazards and mitigation steps with each visitor prior to entering the job site. If a visitor refuses to sign, the general foreman will note it on the brief and will not allow the visitor to enter.

6. SITE SIGNAGE: An assessment of the work site should be conducted by the National Grid project representative overseeing the work with the contractor to determine if site signage will be needed to protect site visitors, the public or any other persons entering the work site. If Site Signage is required at the site, the signage shall be posted at the main entrance to the work site. The sign shall direct all visitors to check in with the Person in Charge (PIC), be escorted to the designated safe area and advised of all work currently in progress. The visitor is expected to comply with all related safety requirements and sign off on the Job Brief before entering the work site.

3.6 Safety Meetings

1. In addition to job safety briefs, the contractor shall have regular safety meetings with their employees and subcontractors. Contractors performing high or medium risk work shall have weekly safety meetings, while low risk contractors, at a minimum, shall have safety meetings monthly and attendance must be documented.

2. The safety meetings shall include the following topics: statistics, incidents, near misses, updates on old business and new business raised. It will include the round table discussion by the workers and the action items discussed. Meeting minutes must be documented and shall include specific action items, their due dates, persons responsible and a completion date. This documentation shall be available for inspection during the project period, and for 30 days after the project is completed. For contractors working on Process Safety assets, meeting minutes from contractor shall be shared and discussed with National Grid site management.

3. Routine Safety meetings/calls between National Grid and the Contractor shall be coordinated on a regular basis. Safety meetings may include but are not limited to ESD/Compliance Assessments, Safety Briefs, Safety Day discussions and regularly scheduled calls to promote safety and best safety practices. Contractors working on Process Safety assets for more than 6 months shall schedule leadership visits to discuss process safety topics.

4. Contractors are to perform their own safety self-assessments.

5. Contractors working on process safety assets for greater than three (3) months, or as needed, shall hold project planning meetings to discuss short term and long term work items. Project planning meetings shall include safety performance monitoring against project targets and should include a National Grid SHE representative for jobs on Major Hazard Assets in addition to a National Grid site representative.

3.7 Incident Investigation

Applies to: All contractors (regardless of risk ranking)

1. All contractors are required to report any work-related incidents involving injury or illness to employees, the public or property damage to the National Grid project representative. The first priority is to ensure that anyone injured receives medical treatment. Examples of incidents may include, but is not limited to: injury, property damage, adverse public impact, near miss, a hazardous condition and road traffic collisions (RTC).

2. Contractors will then be responsible to perform an incident investigation immediately following the incident and document root cause/corrective actions in the ISN system and to National Grid.

Incident Response Steps

In the event of an incident, the contractor shall provide details of the incident to National Grid that follows the steps below.

1. Contractor supervisor collects basic information about the incident from the employee or witnesses:
    - What happened?
    - Who and how many people were injured?
    - What treatment was administered?
    - What was the nature and seriousness of the injury?
    - Where did the incident occur?
    - When did the incident occur (date, time of day)?
    - Were there any witnesses?

2. Contractor supervisor immediately calls the project representative or other National Grid point of contact. All incidents shall be entered into the Incident Management System (IMS) as soon as possible by the National Grid project representative or National Grid designee. When dialing 1-866-322-5594, the caller will be prompted to select option 2 for anything other than an employee injury.

3. Contractor shall conduct an investigation within 24 hours of the incident that will identify contributing factors and root cause analysis relating to the incident and the corrective actions that will be taken to prevent future occurrence. This information will be documented in the ISN system.

4. Contractor vehicle accidents occurring during the performance of work will also be investigated and reported to National Grid.

Other Reporting

National Grid may periodically request the following annualized data for all work activities limited to National Grid operations:

- Lost Time Incident (LTI) rate for workers
- Restricted Work rate
- OSHA Recordable Incident (ORI) rate

4.0 TECHNICAL SAFETY REQUIREMENTS

4.1 Personal Protective Equipment (PPE) Requirements – General

Applies to: All contractors (regardless of risk ranking)

1. The contractor and their employees, including subcontractors are expected to follow the same rules and protocols as National Grid personnel. Basic PPE attire at construction sites and other similar work zones include, at a minimum:

   - Hard hat
   - ASTM F2413 EH rated safety shoes
   - Safety glasses with side shields
   - Any contractor who is exposed to vehicular traffic shall wear ANSI 107 certified class 3 hi-vis vest or garment.
   - All contractors who are exposed to vehicular traffic and are exposed to energized electrical equipment or live gas are required to wear ANSI 107, class 3 hi-vis vest or garment, that also meets ASTM 1506 FR standard with a minimum Arc rating of HRC 1. All FR vests must be lime green/yellow. When FR clothing is required the FR vest shall be worn over appropriately rated FR clothing. Please reference the Gas PPE Matrix.
   - All contractors that are exposed to vehicular traffic, but will never be exposed to energized electrical equipment or live gas shall wear at a minimum ANSI certified class 3 vest or garment that is orange OR wear the FR vest in lime green/yellow.
   - ASTM 1506, HRC Category 1 FR vests must be in lime green or yellow. Any vest that does not meet the ASTM 1506, HRC 1 FR rating must be orange.

Storm contractors that do not have a Contractor of Choice contract should follow their existing practices and rules. All other contractors shall refer to the US Department of Transportation's Manual on Uniform Traffic Control Devices (MUTCD) to determine the correct class of hi-vis clothing / vests.

2. The contractor shall ensure that their employees and subcontractors use protective safety toe footwear when working in areas where there is a danger of foot injuries due to falling or rolling objects, or objects piercing the sole, and where such employee's feet are exposed to electrical hazards. In

addition, during inclement weather conditions or adverse events, the addition of anti-slip footwear or outer foot wear may be appropriate.

3. Guidance for additional PPE is referenced in other sections of this document.

4.2 Flame Resistant Clothing Requirements

Applies to: All contractors; as needed

1. Flame Resistant (FR) clothing shall be worn when personnel work on energized equipment/lines or when distance and position will expose the worker to electric arc or flame hazards. FR clothing shall also be worn during live gas work as outlined in the gas PPE Matrix (Gas Policy SHE01001) and within LNG operations locations as required. FR clothing also includes arc- resistant rain gear. This additional ensemble may also be required as part of the job for contractor personnel. Contact a National Grid representative for a copy or to view the PPE matrix.

2. FR clothing shall be worn as the outermost layer of clothing and when workers measure voltages, test or ground electrical equipment/lines.

3. FR clothing shall be worn when work requires the use of rubber protective equipment or the use of insulated live line tools.

4. FR clothing shall be worn when workers control/operate electrical equipment over 50 volts at the device location or are within 10 feet of equipment which is being physically operated/ worked on by another worker.

5. Visitors are not required to wear FR clothing in substations or production plants unless they are engaged in electrical work. The National Grid project representative will be able to determine whether FR clothing will be required based on the specific contractor task. Note: Gas contractor FR requirements may differ slightly. Please refer to National Grid PPE Matrix for Gas operations within Gas Policy SHE01001 as needed.

6. FR clothing shall meet a minimum arc rating of 8 cal/cm^2 (HRC 2) for energized electrical equipment unless otherwise specified based on increased potential exposure as indicated in the Arc Flash Tables in H-807 *Arc Flash Analysis and Mitigation* program.

7. Additional FR clothing protection is required when performing work on the distribution system in NY North and New England (legacy National Grid) stations. Contact a National Grid representative for a copy. (NG

Employees: If the link does not work, copy and paste the URL into your internet browser) Arc Flash Awareness and Mitigation (sharepoint.com)

8. Contractors who may be involved with tasks requiring the implementation of this program shall be informed by National Grid. Contractors will be required to follow all aspects of OSHA and any other applicable regulation as it applies to the tasks they perform.

4.3 Rubber Gloves and Sleeves

1. Rubber glove use is required for work on all electrical apparatus at 50 Volts or greater. Rubber gloves shall be donned before the worker leaves the ground and shall be worn until the worker returns to the ground (commonly referred to as “ground to ground”, “cradle to cradle”)
2. Class 0 gloves are required for exposures up to 1000 Volts.
3. Class 2 gloves are required for voltages between 1000-15,000 Volts.
4. Rubber sleeves must be worn where work is conducted within the MAD of primary electrical apparatus that is not tested, de-energized and grounded.
5. For voltages 23 kV and above, workers can use specialized equipment or work practices as long as these workers have been appropriately trained and qualified. National Grid may request training records from the contractor.
6. Rubber glove exceptions for specific jobs (other than those listed in this section) are permitted only with the dated, written approval of a Division Director.
7. It is the contractor’s responsibility to wear class 2 rubber gloves when grounding trucks or equipment due to a possible difference in potential.

Exceptions

No rubber gloves are required:

- When working in a properly established equi-potential zone.
- When the operator remains at the same potential as the equipment by being off the ground and on the equipment.

- When a qualified worker performs transmission “hot stick” work on lines 69 kV or greater and no other energized wires are on the pole or structure below the worker.

- When work is performed on transmission structures carrying only energized conductors (115kV and above) and the Live Line Techniques are not being employed. While performing these activities, the worker shall utilize conductive clothing such as conductive gloves, boots, leg straps and/or any other applicable conductive clothing.

- When climbing a steel structure to perform structural reinforcements while maintaining MAD from energized conductors or apparatus.

- When climbing a steel structure to access an area that has been properly grounded.

4.4 Isolation of Energized Apparatus

1. **Non-Reclosing Criteria and Live-Line Maintenance and Construction:** The appropriate interrupting devices (breakers, reclosers, circuit switches, etc.) will be placed on NON-RECLOSING in accordance with National Grid tagging procedures.

2. **Tagging Out Lines or Apparatus**

   The National Grid Construction Supervisor or designee shall coordinate all switching and tagging in accordance with the most current EOP on Clearance and Control.

   Upon receipt of Clearance, the project representative will present the Contractor’s Person in Charge with the “Contractor Permission to Work Form” (Form NG0060), which states the specific apparatus that has been de-energized and that certain device(s) are tagged in the Protective Position and will remain so until the Contractor’s Person in Charge informs the construction supervisor or designee of the completion of the work utilizing the “Contractor Completion of Work” section of the “Contractor Permission to Work” form.

   The original transferred copy needs to be returned after the completion of work section is filled out & signed. In some cases the tailboard is outside & is susceptible to elements & damage; a copy shall be utilized in the field instead of the original.

No work will be performed until the “Contractor Permission to Work Form” is received from the construction supervisor stating that the equipment has been de-energized and a clearance to work has been given. The Contractors Permission to Work Form and a written grounding plan shall be attached to the crews Job Briefing and be kept at the work location.

After the “clearance” is received from the National Grid Construction Supervisor, the various substation conductor bus and equipment to be worked will be tested and “Grounds” installed. Grounds shall be rated for the fault current of the line/equipment being grounded. (Note: Rubber Gloves and FR clothing are required when installing and removing grounds). The contractors “Person in Charge” (Construction Supervisor/General Foreman) shall be responsible for determining the location and number of grounds.

Vehicles and equipment may utilize a single 4/0 cu for grounding inside the substation. Employees working on de-energized lines and equipment shall always work between grounds.

Prior to the application of any personal protective grounds, the circuit to be worked on must be tested for the presence of voltage using an approved potential detector. The worker must verify the detector is in operating order prior to and after testing for voltage. MAD must be maintained during the testing, and appropriate PPE shall be worn. Testing for voltage shall be done at the point where the grounding devices are to be attached. All phases of the circuit to be worked on shall be tested at each location that grounds are installed.

When an Air Gap is required to create a work zone, the component (a tap) shall be removed in whole from the system unless removal of the component is impracticable or creates an additional hazard based on National Grid management in charge of the job. If the component (a tap) is deemed impracticable to be removed in whole it shall be disconnected from one end, isolated from all other conductors and properly secured to ensure accidental energization will not create a hazard. When National Grid switches out lines or apparatus, any grounds that may be installed shall only be considered a visual reference, and shall not be considered a means to protect the Contractor’s employees. The Contractor is responsible to install their personal grounds, in accordance with all OSHA, Federal, State and local safety procedures. National Grid may provide guidance on the minimum size of the grounds to be used based on circuit available fault current. Refer to *Electric Operating Procedure D002,* for applicable grounding size. Ground rods shall be fully driven into the earth away from

the workers and work area. T-Bar ground rods are not to be used on National Grid property.

The National Grid Construction Supervisor shall review the contractor's plan for the quantity and locations of grounds, ensuring that the work the contractor is performing is between grounds, covering all potential sources. All three phases shall be grounded. (In stations, from each phase to the station ground grid). Grounds shall be placed as close to the work area as reasonably possible, between the work area and all potential sources of inadvertent energization. A copy of the grounding plan shall be kept with the job safety brief.

It is the contractor's responsibility to account for all their grounds. The contractor shall provide, maintain, and enforce a ground tracking program suitable to National Grid. In the instance of a zone expanding/collapsing, remaining grounds shall be listed on the Contractor Permission to Work Form and verbally communicated to the construction supervisor.

3. Grounding Mobile Equipment

When mobile equipment requires grounding, it shall be solidly grounded by means of appropriate sized copper cable while using rubber gloves. The cable shall be fastened to a securely attached clean metallic portion of the equipment, or shall be fastened to a grounding stud provided for the purpose at one end and an adequate ground at the other end.

Non insulated booms such as digger derricks that have the possibility of encroaching the MAD shall be grounded and barricaded. The ground is to trip the circuit and the barricade is to protect anyone who may become in contact with the truck during this energization.

4. Minimum Approach Distance (MAD)

Refer to OSHA 29 CFR 1910.269 for more information and details regarding qualified and unqualified workers.

4.5 Appointment of a Safety Observer

A safety observer shall be required if an employee (operator) determines that it is difficult to accurately determine the distance between the equipment (minimum approach distance) and energized parts. The Safety Observer shall never be a substitute for minimum approach distance (MAD), personal protective equipment

(PPE), insulate/isolate techniques or work area identification as a form of employee protection.

The person in charge of the work (contractor or National Grid), shall appoint a qualified employee or employees to perform the task of a safety observer. The personal in charge shall:

1. Ensure a documented job brief is completed and includes the name of the safety observer, additional subjects such as the location of gas lines, energized equipment, in or adjacent to the work area and the limits of any de-energized work area
2. Discuss the scope of work and communication techniques used to warn or notify the equipment operator of hazardous conditions.
3. Communicate any changes to work and job completion to the safety observer
4. Select another safety observer if there is a need for the existing observer to have break in service.

The safety observer is a qualified employee who has been appointed by the person in charge based on the hazard assessment and the job brief. The safety observer shall:

1. Observe the worker performing the task/activity until all hazards have been eliminated or the task/activity has been completed
2. Have shown proficiency in the task/activity being observed and have a full understanding of the job and the hazards associated with the task/activity.
3. Remain continuously focused on the task/activity being performed and not perform or assist any other job activities while observing the worker performing the task/activity
4. Notify the person in charge if there is a need to have a break in service. Work must stop until a new observer is appointed or the safety observer returns.

A safety observer shall also be required when a critical lift is being performed. A critical lift plan shall be required during the following circumstances:

1. An object is lifted over energized apparatuses or assets where a failure of the lifting equipment or rigging could result in a significant safety hazard or cause significant disruption in service to National Grid customers.
2. The crane or other lifting apparatus is anticipated to be operated above 80% of its rated capacity for the specific load chart for the lift.

3. A man basket (pinned or suspended) is to be utilized. All fall protection rules shall be followed when in a man basket.
4. Two cranes will be used in concert to lift a single object
5. Internal substation construction involving all power transformers, control houses, capacitor banks and transmission breakers.
6. Lifts in LNG or Gas plants where a hazard assessment or job brief identifies a significant risk.
7. The lifted load will be less than twice the minimum approach distance (MAD) of the nearest energized part. Until a qualified electrical worker confirms the MAD, loads and equipment shall maintain a 20 foot distance. Once nominal voltage is established, the MAD will be according to OSHA tables.
8. The lifted load is hoisted over buildings or the general public.

4.6 Work Zone Traffic Control

1. If work activity is on or near a road, the contractor and their subcontractors shall comply with all applicable parts of the most current US Department of Transportation's Manual on Uniform Traffic Control Devices (MUTCD), state, local Work Zone Traffic Control requirements and the National Grid Work Zone Traffic Control Manual. Please contact your National Grid representative for a copy of the manual found in the Safety Homepage on the Grid:home.

2. If pedestrian traffic is disrupted, pedestrians should be provided with a path that is reasonably safe, convenient and accessible. Pedestrians should not be led into conflicts with work site vehicles, equipment or operations.

3. If working in areas covered by state permits issued to National Grid, contractors shall comply with the provisions (work practices and notifications) of the permit language. These permits must be available on the job site upon request.

4.7 Qualified Gas Worker

Applies to gas projects/activities

1. Gas contractor employees will be operator qualified as required and defined according to the Code of Federal Regulations, Transportation, 49, Subpart 192.801 through 192.809.

2. Until these qualified employees have demonstrated proficiency in the work practices involved, they are considered employees undergoing on-the-job training and must be under the direct supervision of a qualified person at all times. According to the definition of a “qualified employee”, the employee also must have demonstrated an ability to perform work safely at his or her level of training.

3. National Grid requires contractors with gas qualified employees to provide documentation on how they qualify their workers.

4. Additionally any qualifications’ of contractor personnel shall be in full accordance with the Company’s Operator Qualification written plan, (OQ Plan) Refer to the most current list of covered tasks in accordance with National Grids’ Operator Qualification Program and the Northeast Gas Association, (NGA).

4.8 Qualified Electrical Worker

Applies to electrical projects/activities

1. According to 1910.269(a)(2)(ii), a qualified electrical employee must be trained and competent in the following prior to starting work:

    - The skills and techniques necessary to distinguish exposed live parts of electrical equipment
    - The skills and techniques necessary to determine the nominal voltage of exposed live parts
    - The MAD specified in 1910.269 corresponding to the voltages to which the qualified employee will be exposed
    - The proper use of special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools for working on or near exposed energized parts of electrical equipment

2. Until these qualified employees have demonstrated proficiency in the work practices involved, they are considered employees undergoing on-the-job training and must be under the direct supervision of a qualified person at all times. According to the definition of a “qualified employee”, the employee also must have demonstrated an ability to perform work safely at his or her level of training.

3. National Grid requires contractors with electrically qualified employees to provide documentation on how they qualify their workers.

4.9 Qualifying Non-Electrical Worker

Applies to: All qualifying non-electrical contractors working near energized lines and equipment; as needed

1. The contractor shall provide orientation for non-electrical workers entering and working within restricted areas such as a substation and those working near energized lines and equipment.

2. The information provided to these workers must meet the requirements of paragraph 1910.269(a)(2)(ii). However, the orientation and training may not be as comprehensive as the qualified electrical worker would be.

   They must know:

   - What is safe and not safe to touch in the specific areas they will be entering;
   - The maximum voltage of the area;
   - The MAD for the maximum voltage within the area;
   - Proper use of personal protective equipment and in the work practices necessary for performing their specific work assignments within the area.

3. Until these workers have demonstrated proficiency in the work practices involved, they are considered to be employees undergoing on-the-job training and must be under the direct supervision of a qualified person at all times.

4.10 Asbestos, Lead and other Hazardous Materials

1. Asbestos and lead materials associated with electrical and gas equipment includes, but is not limited to: cement-type cable covering, cable wrap, wire coatings, coal tar pipe wrap, and transite panels and conduits. Asbestos and lead materials may also be present in building materials including but not limited to: paint, mastics, caulking, insulation and roofing materials.

2. Where asbestos and other hazardous material is present and likely to be disturbed, the National Grid project representative and contractor shall coordinate how the asbestos, lead or other hazardous materials will be

managed and shall consult National Grid's Safety & Environmental department as appropriate.

3. Removal of this material must be done by individuals specifically trained and qualified to handle asbestos and lead. Refer to National Grid Safety Procedures, F-615, F-617 and F-619 for guidance on asbestos and lead handling and removals. For more information, contact a National Grid representative for a copy of these procedures.

Note: Contractors who will encounter asbestos or lead as part of their work shall reference in their safety plan how they will address this hazard.

4.11 Lift Plans for Work Near Energized Electrical Equipment

1. All work involving hoists, cranes or other lifting equipment **within 10' of energized electrical equipment** must have a detailed lift plan/procedure.

2. As a minimum Lift Plans shall include the following:

    a. Designated Operator and Signal person

    b. Detailed travel and flight path that ensures the boom and material being raised is controlled 100% of the time and will maintain the appropriate clearance

    c. Designated cover up and isolation to ensure employee and equipment safety in the event of an unplanned action or failure

    d. Emergency action plan with detailed instructions to respond to unplanned/uncontrolled event during the lift or positioning of the lifting equipment.

    e. Documented load weight and equipment lifting limits

    f. Rigging equipment and methods that will be used during the lifting. Sign off/approval from the management official responsible for the work

4.12 Fall Protection

1. Fall protection or fall restriction devices shall be used when working at heights over 4 feet. When using portable straight and extension ladders,

three points of contact shall be maintained. If 3 points of contact cannot be maintained a work positioning belt is required.

Step ladders shall be set up on level and stable surfaces, fully open with braces locked. Work positioning belts are not required for properly set up step ladders.

2. All fall protection shall be inspected before use each day to determine if equipment is in good working condition. Defective equipment shall not be used and shall be removed from service.

3. A worker may enter or exit an aerial lift (at heights above four (4) feet) provided that fall protection such as guardrails or a fall arrest system is used while the worker moves between the lift and the working surface. Before any such transfer is made, the employee shall be properly tied-off to an adequate support, the pole or structure prior to and in the direction of the transfer.

Exceptions to fall protection shall be in accordance with Federal & State requirements.

4.13 Herbicide Application

1. Vegetation spraying shall be conducted unescorted only by contractor employees who have been designated as a Qualified Electrical Worker, where applicable.

2. The spray applicator shall have ID cards issued by Security with background checks available from the contractor.

3. National Grid management shall require a schedule of the spraying in their areas.

4. Once spraying begins, the contractor must contact local management on a daily basis to inform them of progress or changes to the schedule.

5. The contractor shall post all stations with dated signs indicating when the station was sprayed. These signs should not inhibit access to the station.

6. The contractor shall ensure that any stored materials and equipment do not get covered with “overspray”. Overspray represents a substantial safety hazard and cannot be allowed.

7. When applying herbicides, contractor employees shall wear appropriate PPE in accordance with product labels.

5.0 UNDERGROUND OPERATIONS WORK

In addition to the other requirements referenced in this document, this section covers requirements that are specific to underground operations work.

5.1 PPE Requirements

All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0.

5.2 Enclosed Space Assessment, Ventilation, Entry and Rescue

Refer to the National Grid EOP-UG006 *Underground Inspection and Maintenance* and National Grid Safety Procedure I-902 *Enclosed Space Procedure* for more information regarding enclosed space requirements.

1. Contractors are required to follow all procedures in this document in regards to enclosed spaces (manholes, sidewalk vaults, etc.), including assessment, ventilation, entry and rescue.

2. Each enclosed space shall be tested prior to removing manhole lids and entry. Atmospheric testing shall be continuous for the duration of the entry using a calibrated, industry approved atmospheric tester.

3. When performing hot lead work or when indicated by atmospheric monitoring, engineering controls such as forced mechanical ventilation shall be used when working in National Grid manholes at all times.

4. All contractors who are qualified electrical workers will treat these spaces as “enclosed spaces” and follow non-entry rescue provisions.

5. In some situations a boom is allowed for retraction from an enclosed space. Refer to Safety Procedure I-902 for more information.

6. Steel cable or wire rope for non-entry rescue is prohibited.

5.3 Equipment Safety Inspection

1. Inspect underground facilities (manholes, vaults, hand holes, splice boxes, junction boxes, pad mount transformers, switchgear and submersible equipment, etc.) each time a crew performs work at one of these facilities. All separable components in these facilities shall be inspected by infrared instrumentation. A National Grid representative can provide details from the

National Grid EOP-UG001 *Infrared – Non-Contact Thermometer Inspection Requirement for Underground Equipment* for more information.

2. The infrared (IR) thermometer or camera shall, at a minimum, have a range of -25°F to 1400°F with a plus or minus 1% accuracy. For more details and current operating procedures, contact a National Grid representative regarding EOP UG001.

3. The format for data collected shall follow the National Grid EOP UG006 *Underground Inspection and Maintenance* requirements. Please contact a National Grid representative for more information.

4. "Touch Potential" testing of metal street lighting poles is required as a part of any maintenance work. For more information, a National Grid representative can provide a copy of the National Grid EOP G016 *Elevated Equipment Voltage Testing* and National Grid Work Methods Bulletin #04-26 *Touch Potential Testing of Metal Street Lighting Poles.*

5. Touch Potential testing results shall be recorded on the job safety brief and the manhole inspection form which shall be given to the National Grid Construction Supervisor or designee.

6. All contractors working for National Grid shall use materials and equipment in accordance with the manufacturing guidelines. It is the contractors' responsibility to understand the manufacturers' limits and prescribed use of their tools and equipment before each use.

7. Workers shall test and verify that the underground cable is de-energized and guillotine the cable if needed from outside the hole. Rubber gloves shall be worn at all times while performing this task.

6.0 OVERHEAD LINE WORK

In addition to the other requirements referenced in this document, this section covers requirements that are specific to overhead line work.

6.1 PPE Requirements

All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0. In addition, contractors will follow ground-to-ground and cradle-to-cradle use of rubber gloves while performing work on energized overhead lines. Any foreign wire, including those on a pole or structure constitutes

an energized source and requires the use of rubber gloves (ex: Cable TV, telephone, fire alarm wire, etc.).

6.2 Fall Protection

All contractors who climb structures such as wood poles or transmission towers shall utilize enhanced fall protection equipment (fall arrest devices) and techniques (ex: *Buckingham Buck-Squeeze, Miller StopFall* or *Jelco Pole Choker*). When working on wooden and steel structures, a full body harness and lanyard shall provide 100% fall protection at all times (100% tie off, Shepperd's Hook, etc.). Climbers shall never be allowed to drop or slide down a pole or structure more than two feet.

Exceptions to fall protection shall be in accordance with Federal & State requirements.

6.3 Pole/Structure Inspection

Contractor shall ascertain the structural integrity of the pole or other structure prior to installation, removal, repair or modification of the equipment on the structure.

1. Prior to climbing any pole, an inspection and test of the condition of any pole being climbed shall be performed. The weight of the employee, the equipment being installed and other working stresses (such as the removal or re-tensioning of conductors) can lead to the failure of a defective pole or one that is not designed to handle the additional stresses.

2. If the pole is found to be unsafe to climb or to work from, it must be secured so that it does not fail while an employee is on it. The pole can be secured by a line truck boom, by ropes or guys, or by lashing a new pole alongside it. [29 CFR 1910.269(q)] If measures cannot secure the pole, the contractor must cease operations and notify the National Grid Construction Supervisor or designee

6.4 Electrical Work Methods

1. Jumpers of any type shall not be used to keep transformers, risers or transformer banks energized for the purpose of changing potted porcelain cutouts. A National Grid representative can provide information to the National Grid Electric Operation Procedure (EOP) D001 *Cutouts – Open Type* for more information.

2. Potted porcelain cutouts must be changed out when work is being completed on a pole even if this is not planned in the scope of the work provided.

3. Properly rated and inspected slings, chains or tongs shall be utilized to move poles and equipment. Winch lines must not be wrapped around poles or looped around transformer ears to lift without a sling or chain.

6.5 Transmission Overhead Lines

1. For work on transmission circuits, red tape shall be placed around any energized pole, pole structure, or tower adjacent to the de-energized line.

2. When one circuit of a double circuit pole or tower line is de-energized for work, a red or orange flag shall be placed on the energized side of the pole or tower nine feet below the lowest energized conductor. In addition, a red or orange flag shall be placed on the lower cage on the side toward the energized circuit at each arm level as employees work on them or pass them.

3. All contractors using ATV's, UTV's or RTV's for transmission or forestry work, are required to follow all local OHRV requirements for PPE and driving safety. Training shall include classroom and in-field instruction as well as a formal driving assessment on an annual basis for each type of vehicle planned for use: i.e. UTV specific training for UTV's and ATV specific training for ATV use. All contractor employees must be fully trained and qualified before use. Proof of individual operator training certifications for each operator shall be available at all times. US DOT rated helmets and safety glasses/goggles are required for any vehicle that does not have a seatbelt and a roll cage. In equipment with a roll cage and seatbelt, operators can utilize a hard hat and chin strap.

4. At the end of each day, unless other arrangements have been made for an extended outage, grounds will be removed and the National Grid project representative will be notified that all personnel are "clear" of the conductor bus work and equipment.

5. Wherever transmission line workers "touch" wires, a personal ground shall be installed at the work area to establish an equipotential zone, unless workers are engaged in live-line barehand work (29 CFR 1926.964)

7.0 SUBSTATIONS

In addition to the other requirements referenced in this document, this section covers requirements that are specific to substations work.

For additional information, a National Grid representative can provide a copy of the National Grid Substation Maintenance Procedure SMP 499.01.2 *Protective Grounding Procedure* under the Substation Work Methods Grid:home page for specifics regarding substation grounding practices.

Grounding plans for substation, major distribution and transmission projects will be submitted to the National Grid construction supervisor a minimum of 1 week prior to construction for review. This plan will show the steps, work area limits and ground cable size and amount. Once reviewed with the National Grid and prior to starting the job, the plan will be reviewed by the contractors with all employees and subcontractors on the project.

The use of an “Equipotential” step/platform or a conductive mat is required for access and egress from the following:

a. Crane or any other equipment, including aerial lift equipment, that is connected to the substation ground grid and/or bonded to transmission line conductors when working outside of the station fence
b. In the rights-of-way
c. In areas inside the substation where there is no ground grid present.

When work is performed inside the substation and there is a ground grid available, the “Equipotential” step/platform or conductive mat is not necessary.

All vehicles shall be grounded and barricaded per OSHA standards and the National Grid Electric Operating Procedure G026 *Mechanized Equipment Grounding*.

Proper clearances shall be maintained from adjacent energized substation bus, energized portions of substation equipment and other transmission lines at all times.

Use of proper insulated tooling (shotguns and sticks) shall be utilized per NECA standard maintaining MAD.

7.1 PPE Requirements

1. All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0.

2. Contractors who perform any ground breaking activities in a substation within a pre-marked area will require Dig Safe marks to be in place; otherwise, the job must be suspended and the National Grid construction supervisor or project representative shall be notified of the condition.

3. When using non-insulated man-lifts, and if provided by the manufacturer, a secure point of attachment for lifelines, or lanyards or deceleration devices shall be utilized, independent of the means to support or suspend the employee. Workers feet shall also always remain on the floor.

7.2 Notification of Control Authority When Entering a Substation

1. When a contractor enters and exits a National Grid substation, the contractor shall ensure that the System Control Center is notified. While work is being conducted, gates must be monitored at all times or the gates shall be locked. For more information, contact a National Grid representative regarding National Grid EOPG022 *Substation Security*.

2. Unescorted entry in substations can only be provided to contractors who provide assurance that their employees and subcontractors are electrically qualified as specified in 29 CFR 1910.269. Refer to Section 4.0 of this document

3. All National Grid specifically identified bulk power stations will require NERC-CIP training, certification and approval prior to entry to those sites.

7.3 Substation Work Area Identification (SWAI)

1. Contractors who will be working in substations shall follow the SWAI procedure. National Grid will provide a copy of this procedure if required by the project. For more information, contact a National Grid representative regarding National Grid SMP499.10.2 *Substation Work Area Identification Procedure*.

2. Qualified contractors as referenced in section 4.8 of this document shall install their own work area identification. National Grid shall arrange work area identification for non-qualified workers as required.

3. Designated storage areas for items not being used will be posted in the yard and should be the only place these items are kept.

8.0 GAS OPERATIONS WORK

In addition to the other requirements referenced in this document, this section covers requirements that are specific to Gas operations work. For more information, contact a National Grid representative regarding National Grid General Safety Requirements SHE1001 *Gas Policy* which can be found following this link:
http://dc-gasweb1/MelSite/WMSafetyAll.asp .

8.1 PPE Requirements

1. All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0.

2. The contractor shall wear all appropriate PPE and Class 2 rubber gloves for personal protection when digging or probing within 2 feet of known electrical conductors and when the location of energized conductors is unknown.

8.2 Gas Operations

1. Any contractor who performs covered tasks shall be operator qualified (OQ) as defined in the DOT Title 49 CFR, Subpart N and all applicable state requirements pursuant to the state the contractor is working in. Additionally, any qualifications of contractor employees shall be in full accordance with the Company's Operator Qualification written plan, (OQ Plan) Refer to the most current list of covered tasks in accordance with National Grids' Operator Qualification Program and the Northeast Gas Association, (NGA).

    a. The Operator Qualified status of contractor employees must be regularly updated and accessible through the ISN system. This listing must detail employees' current tasks they are qualified for, the next recertification date, associated documentation and a documented annual acknowledgement in ISN on their qualified workers as referenced in section 3.1 of this document.

    b. Contractor personnel involved with covered tasks may require certification by National Grid and an orientation of the involved tasks and National Grid Company standards. National Grid reserves the right to validate contractor qualifications prior to performing Live Gas work.

    c. Atmospheres are to be tested with a properly calibrated Combustion Gas Indicator (CGI) or Gas Measurement Instrument

(GMI) in accordance with National Grid excavation procedures as required.

d. Each employee in an excavation shall be protected from cave-ins by an adequate protective system, such as sloping, benching or an appropriate shoring system. For more information, contact a National Grid representative regarding National Grid Safety Procedure M-1301 *Standards for Working in Excavations.*

9.0 FORESTRY AND VEGETATION MANAGEMENT

In addition to the other requirements referenced in this document, this section covers requirements that are specific to vegetation management work.

9.1 PPE Requirements

1. All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0.

2. Flame Resistant Clothing is not required per the applicable OSHA Forestry standard. Forestry contractors must instead wear natural fiber clothing when working within 10 feet of energized equipment.

3. Forestry contractors must wear a properly adjusted full-body fall protection harness connected to an appropriate lanyard when working from an aerial lift. The lanyard must connect to an attachment anchored to either the boom or bucket mounting hardware. Attachment points anchored through only the fiberglass portion of the bucket are not acceptable.

4. Forestry contractors will be required to wear chaps while operating a chainsaw or when assisting and/or working in close proximity to a chainsaw that is being operated.

5. Saws shall not be left unattended with the engine running.

6. When a contractor employee carries a saw, the engine shall be off and/or covered or the saw shall be carried with the blade to the rear and locked.

7. Tree crews will not be allowed to fly their buckets in between the primary and secondary cables if the MAD will be violated in process of doing so.

9.2 Equipment and Work Methods

1. Forestry contractors shall utilize fiberglass sticks and stick saws for work around energized equipment. Additionally, integrity tests shall be performed and documented annually. Test results and expirations shall be available on each vehicle as needed.

2. Forestry contractors shall perform and document dielectric testing of all aerial units annually. Test results and expirations shall be available on each vehicle as needed.

3. For lump sum or unit price mileage trimming projects, a single foreman may supervise up to four (4) bucket trucks on the same project. The minimum qualifications for the "lead" person on each of the other trucks shall be a Journeyman Tree Trimmer or equivalent (Qualified Line Clearance Tree Trimmer). At least one other employee on the truck shall be an OSHA defined, Qualified Line Clearance Tree Trimmer Trainee. For Upstate New York only, it is understood that a Qualified Line Clearance Tree Trimmer shall carry the title, wage and benefits as outlined in IBEW LU 1249's existing contract of a Journeyman Treeman and that a Qualified Line Clearance Tree Trimmer Trainee shall carry, at a minimum, the title, wage and benefits as outlined in IBEW LU 1249's existing contract of a Treeman Trainee, 2nd year.

9.3 Training

1. Forestry contractor management will be required to attend safety council meetings hosted by National Grid as required. The contractor shall ensure that all appropriate safety personnel for the National Grid territory are in attendance.

2. Forestry contractors shall implement and provide the required training and certification programs necessary to provide OSHA defined Qualified Line Clearance Tree Trimmers or Qualified Line Clearance Tree Trimmer Trainees. Contractors shall be able to provide the documentation relative to these training and certification programs upon request by National Grid. Forestry contractors shall provide an updated HASP by April 1st of each year for all work being conducted at National Grid.

3. All contractors using ATV's, UTV's and RTV's for transmission or Forestry work are required to follow all local OHRV requirements for PPE and Driving safety

10.0 LNG PRODUCTION, TRANSPORT AND HANDLING

In addition to the other requirements referenced in this document, this section covers requirements that are specific to LNG Production facilities.

All contractors working at LNG plants will sign in and out of plants daily in the contractors log book. All other gas supply facilities and subcontractors require authorization under the contractor management official. If required by the project, trained National Grid plant personnel shall initially, and as needed, review and re-issue as needed, a work permit process which shall which describe the work being performed, valves with their locations and Lock-out/Tag-out numbers.

10.1 PPE Requirements

1. All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0 and shall include FR outer clothing.

2. Cryogenic protective gloves/gauntlets and face shields are required when making connections to load / unload LNG. National Grid retains the right to enhance PPE requirements as conditions warrant. The use of additional PPE shall be based on the task performed and the PPE matrix for work in production plants.

10.2 Training

1. Contractors who transport LNG/propane at National Grid facilities are required to be certified in first aid/CPR and are required to complete frost-bite awareness training. Documentation of training records shall be maintained in the ISN system.

2. National Grid expects contractors working at LNG plants to meet the requirements of 49 CFR 193 Subpart H for health, training or experience and/or any applicable National Grid procedures that supersede the above requirements. Contractors shall provide documentation on their qualified workers, as referenced in section 3.1 of this document.

3. All Contractor personnel performing work in LNG plants must meet the requirements of the National Fire Protection Association (NFPA), part 59.

11.0 ELECTRIC GENERATION

In addition to the other requirements referenced in this document, this section covers requirements that are specific to Electric Generation.

11.1 PPE Requirements

1. All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0

2. Hearing protection is required when working anywhere inside a generation plant and/or outside the plant where noise may be excessive. Acoustic barriers shall be maintained by the contractor as needed.

3. Safety shoes with a minimum height of six-inches are required in Generation plants.

4. Contractors working in generation plants are required to wear 8-Cal clothing protection. For additional guidance, a National Grid representative can provide reference to Electricity Distribution Operations Grid:home webpage under Electric Generation's Policies and Procedures EGO-028 *Personal Protective Clothing* & EGO-029 *Personal Protective Equipment*.

11.2 Training

1. Required training may include; PCB's, asbestos, mercury, confined space awareness and excavation competent person requirements. HAZCOM is required by contractors working in generation plants as applicable.

2. Contractors who work at a National Grid Generation Station shall attend an orientation regarding plant safety and as required, US Coast Guard Maritime Security (MARSEC) policies.

3. Equipment training is required per federal, state and local regulations and National Grid procedures. Operators of any powered industrial vehicle must be qualified and documentation shall be documented.

11.3 Equipment & Excavations

1. All excavations shall be performed in accordance with EGO-0005 *Procedure for Excavation in National Grid Generation Facilities* and National Grid Safety Procedure M-1301 *Standards for Working in Excavations.* For additional information, contact a National Grid representative for copies.

2. Gasoline and diesel powered fork trucks shall NOT be used inside the plant or other enclosed facility. Only propane/electric fork trucks are permitted except where additional hazards may exist.

3. All wood products necessary for the work must be made of flame retardant material.

11.4 Equipment Isolation

For isolation of hazardous energy sources while working in Generation plants, please contact a National Grid representative regarding EGO-0010, *Control of Hazardous Energy Sources-Work Permit System.*

12.0 CIVIL CONSTRUCTION

In addition to the other requirements referenced in this document, this section covers requirements that are specific to civil construction work.

12.1 PPE Requirements

1. All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0.

2. Rubber gloves shall be worn while carrying out work in and around energized or identified direct buried lines, live duct banks, transformer enclosures, manholes, switch gear and other electrical apparatus when performing civil investigations, installations or repairs.

12.2 Enclosed Space Assessment and Ventilation

Contact a National Grid representative regarding the National Grid EOP-UG006 *Underground Inspection and Maintenance* and National Grid Safety Procedure I-902 *Enclosed Space Procedure* for more information regarding enclosed space requirements.

1. Contractors are required to follow all procedures in this document in regards to enclosed spaces (manholes, sidewalk vaults, etc.), including assessment, ventilation, entry and rescue.

2. Each enclosed space shall be tested prior to removing manhole lids and entry. Atmospheric testing shall be continuous for the duration of the entry using a calibrated, industry approved atmospheric tester.

3. When performing hot work or when indicated by atmospheric monitoring, engineering controls such as forced mechanical ventilation shall be used when working in National Grid manholes at all times.

7. All contractors who are qualified electrical workers will treat these spaces as “enclosed spaces” and follow non-entry rescue provisions.

8. In some situations a boom is allowed for retraction from an enclosed space. Refer to Safety Procedure I-902 for more information.

9. Steel cable or wire rope for non-entry rescue is prohibited.

12.3 Equipment Safety Inspection

All contractors shall comply with the applicable equipment safety inspection procedures referenced in Section 5.3

12.4 Excavation Requirements

All excavation work shall be performed under the control of a competent person. All soils in National Grid territories are to be considered class “C”, considered unstable and shall require all excavations be performed in accordance with OSHA 1926.651, EGO-0005 *Procedure for Excavation in National Grid Generation Facilities* and National Grid Safety Procedure M-1301, *Standards for Working in Excavations.* For more information, contact a National Grid representative for a copy.

Crews that are performing Excavations shall include an excavation log with their job brief that states the soil type, expected depth and length as well as final depth and length. All required steps need to prevent collapse will be documented on this form as well prior to entry.

Protective systems shall be used for certain manhole installations. These scenarios are covered below:

- The hazard assessment, competent person and/or National Grid supervisor deems it necessary
- If an excavation for a manhole in a roadway is completed and installation of manhole and backfill is not able to be done before the day is complete, a protective system will be required before road plating
- Installation of any manhole 3 way or greater in size/

Where trench boxes are required to be built on site, the contractor shall submit a PE stamped plan and the location shall be designated on the excavation drawings.

All lifts (not limited to materials and equipment) shall be planned and rigged by a competent person. A lift plan shall be provided for all “critical lifts” and must be submitted by a qualified professional to the National Grid representative prior to the lift taking place.

12.5 Cable fault finding and replacements

For excavation work needed to support faulted cables and emergency cable locates, the use of Cable Avoidance Tooling (CAT) shall be used in addition to Dig Safe requirements as an added safeguard to further pin point unidentified buried cables.

For excavations within the tolerance zone, all hand digging in and around direct buried cables shall require basic PPE, non-metallic handled shovels, rubber gloves, FR clothing and EH rated work boots with Dielectric (DI) over shoes.

All excavation equipment shall be grounded in accordance with NG EOP G026. For additional information, contact a National Grid representative.

The use of GPR (Ground Penetrating Radar) shall also be required to verify the Dig Safe/811 locates after award of the project and prior to excavation. This shall include electric URD, UCD and Substation projects.

12.6 Technical Review

Where and when applicable, all trench and excavation work shall be reviewed and stamped by a civil PE in the state of record and will be executed under the supervision of a trenching and excavation competent person. All leading edges of trenches and excavations shall be appropriately demarcated, clearly posted and controlled to prevent unauthorized persons from entering and inadvertently falling into the excavation. All trenches and excavations shall be closed as soon as practical/possible. All excavations shall be fully controlled for the duration of the exposure by adequately substantial means to withstand the environment and conditions expected to be present.

All pot holing/test holing and exploratory excavations shall utilize vacuum excavation whenever near known underground utilities or hazards, and when the potential for unknown hazards such as live electrical or gas conveyances exist. When using vacuum extraction in combination with air blowing/air knife tools, all persons in the immediate area shall be wearing safety glasses in addition to a full face shields.

13.0 CONSTRUCTION PROJECTS AT CONTAMINATED SITES

In addition to other requirements referenced in this document, all work on contaminated sites must be conducted per the requirements of 29 CFR 1910.120, including the worker qualification and training requirements of 1910.120(e).

14.0 AVIATION

1. Helicopter Crews of two or more shall perform a preflight documented job brief.

2. Helicopter work shall require the use of aviation helmets for both the pilot and passengers.

3. Helicopter pilots and passengers shall participate in the "Flying in the Wire and Obstruction Environment" training prior to flight.

4. Helicopter pilots shall meet the following minimum flight time experience:
    a. 2000 hours as Pilot in Command or Second in command of a rotor craft
    b. 1000 hours in a turbine rotorcraft / helicopter
    c. 100 hours in a helicopter of the make and model to be utilized at National Grid
    d. 300 hours flight time in Wire Environments

For more information, contact a National Grid representative for a copy of EOP T012 *Helicopter Utilization & Notifications.*

15.0 TRANSPORTATION RISKS

Contractor shall define transportation related activities that can have potential process safety consequences. National Grid shall determine if additional risk assessment is needed and contractor shall participate in the assessment. Contractor shall modify their process to mitigate risk that is determined to be intolerable.

APPENDIX A: NATIONAL GRID CONTRACTOR RISK MATRIX

National Grid Contractor Risk Matrix			
Category	**Description of Work**	**Impact of Work**	**Examples to be included in this category (including, but not limited to)**
Medium / High Risk Exposure **Tier I** **Inclusion in ISN Program is Required**	Physical Work, activity, or service that is performed on National Grid property site or is performed off-site where Owner Client has responsibility and is liable for work performed. Includes, but is not limited to, any activity requiring confined space entry, elevated work, work on operating systems involving hazardous energy, work on contaminated sites, and most work requiring a general work permit, hot work permit, or confined space permit.	Work, activity, or service having: • A potential for causing a catastrophic operational incident; • Access to operations; and/or • A direct role in site operations or maintenance, where failure could result in serious harm to employee or public well-being, company assets, or the environment Also includes any Contractor personnel's job function which has no direct or very limited supervision for operational checks.	• Maintenance, Construction and demolition contractors • Chemical cleaning, tank cleaning • Electricians and Instrumentation Technicians • Movers • Welding • Heavy equipment operations • Well drilling and testing • Environmental investigation, remediation, monitoring activities • Hazardous waste handling and/or transport • Excavation • Food service and handling • Equipment Inspection (e.g., X-ray & other NDT) • On-site sampling / gauging activities (not including escorted storm water sampling) • Common carriers transporting Owner Client-owned LNG or petroleum products • Landscaping services • Snow Removal • Janitorial services

			• Vacuum truck affecting/involving process operations • Oil Spill Response Organizations (OSRO) • Work conducted in a high-risk area (i.e. substations, LNG plants, etc.) • Working at elevations greater than 4 ft (includes, but is not limited to): ○ Working in buckets (includes technical advisors) • Working on ladders (straight ladders, extension ladders or step ladders taller than 4ft)
Low Risk Exposure **Tier II** **Inclusion in ISN Program is NOT Required**	Work that is office based such as: • Consultants that do not perform work or activities as described in the Medium/High Risk exposure category • Offsite services • On-site vendor pick-up/delivery and repair services • Work performed by public and private utilities	Work, activity, or service having an indirect role and no, or limited, access to operations or maintenance where failure could result in serious harm to employee or public well-being, company assets, or the environment.	• Mail/package/part delivery or pick-up (e.g. UPS, Fed EX, vendor-specific) • Samples pick-up by laboratory/courier • Office machine servicing (copiers, printer, computer, etc.) • Laboratory apparatus servicing • Storm water Sampling Labs/Contractors (When Escorted by Owner Client personnel) • Deliver/supply services (vending machine, bottled water, laundry) • Municipal waste pick-up • General trash removal services • Off-site repair/fabrication shops (such as pump, safety valve, piping, vehicle)

	• Personnel on-site with Visitor Status, when escorted		• Telephone, electric, local municipal utility services • Regulatory representatives • Technical representatives • Engineering services (when escorted by Owner) • Auditors
A SHE VP can require any contractor to be part of ISN when deemed as a potential risk to National Grid			

Effective Safety Discussion

#1821137 ✔ Draft Save Draft Submit Exit

Date, Facilitators, & Participants

Discussion Date*

Time

Facilitator(s)* Add Myself

Select to Add Facilitator

Participant Type*

○ Employees ○ Contractors

Participant Department

Type Department Name to Search

☐ By Emp.

Location

MHA Site

○ Yes ○ No

Discussion Site*

Type

◉ Field ○ Company Location

Address Lookup *

Type Address & Select Result

Site Name

Street address City State Zip

Originating Crew Location

Company Location Lookup

Type Address / Name to Filter

Street address City State Zip

Discussion Detail

Discussion Topics*

- ☐ Excavation Safety
- ☐ Manual Handling - Soft Tissue Injury
- ☐ Risk Assessment & Communication
- ☐ Tools & Equipment
- ☐ Vehicles & Mobile Equipment
- ☐ Work Zone Safety
- ☐ Office Safety

Facilitator Comments* Spell Check

Participant Feedback*

☐ Process Safety
☐ Pipeline Safety

Additional discussion or topics raised by the participant

☐ Share Best Practice

For Field Safety Only

— Serious Injury & Fatality (SIF) Precursor Analysis

Task: *Select Task*

☐ Precursor analysis completed but none found

Precursor Category	Description
☐ **Safe Work**	Workers cannot express the core elements of the safe/standard workplan for their task.
☐ **Hazard Recognition**	Workers do not recognize hazards or properly evaluate the severity of risks.
☐ **Departure from Routine**	Unfamiliar or unforeseen task or job site conditions that depart from a well-established routine.
☐ **Plan to Address Work Change**	Workers do not stop and reassess conditions when work changes from what is planned (i.e., switch to plan B).
☐ **Safety Attitudes**	Workers demonstrate priority of productivity, heroic tendencies, invulnerability, fatalism, or summit fever.
☐ **Rules and Procedures**	Adequate rules and procedures are documented and communicated but not followed by workers. The correct procedure is documented and communicated to workers, but they are not followed.
☐ **Familiarity with Task**	Workers are not familiar with task expectations or performance standards because of a lack of experience or significant procedural change.
☐ **Risk Normalization**	Lower perception of risk or higher risk tolerance resulting from repeated exposures. Tied to procedural drift.
☐ **Productivity Pressure**	Workers feel an unusual amount of pressure to work quickly and complete their task.
☐ **Perceived Safety Culture**	Lessons learned from previous projects and events are not incorporated into planning and execution.
☐ **Stop-Work Execution**	Workers do not have the ability, or management does not encourage, stopping work to address hazards.
☐ **Workers Inactive in Safety**	Workers are not engaged with or diligently participating in safety activities.
☐ **Pre-Task Plan**	Workers have not completed an adequate pre-task safety plan.
☐ **Fatigue**	Degradation of a person's physical or mental abilities caused by a sickness, disease, or debilitating injury Lack of adequate physical rest to support acceptable mental alertness and function.

Follow-up Items

+ Add Follow Up Refresh

Edit	Record#	Type	Follow-up Item	Assigned To	Due Date*	Complete Date	Remove

There are no Follow-ups Recorded

Photos

Attach any photo(s) Select

	Size	

No files have been uploaded.

Created by Campbell, Donald on 3/28/2022 12:42:59 PM - Last edited by Campbell, Donald on 3/28/2022 12:42:59 PM

FORWARD

National Grid's vision is to be a world-class safety organization, with zero injuries every day. A critical component of achieving this vision is the careful development, implementation and maintenance of safety procedures. This guidance document, COVID-19 Health and Safety Plan, describes pandemic response measures, taken by National Grid, to help prevent the spread of COVID-19.

Questions regarding this guidance should be referred to National Grid's Safety Department.

Record of Change

Revision	Date	Description
Initial	04/28/2020	Initial creation
1	5/6/2020	Updated Job Brief Checklist to reflect current face covering requirements, vehicle cleaning guide correction
2	5/27/21	Updated face covering guidelines

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1.0 SCOPE OF HEALTH & SAFETY PLAN

National Grid has developed this Health & Safety Plan (HASP) to uniformly apply pandemic response measures to help prevent the spread of the COVID-19 virus. National Grid field personnel and crews have been provided this information and communications.

2.0 PROJECT PERSONNEL

2.1 Roles and Responsibilities

National Grid shall be responsible for the safety of all its employees and shall ensure COVID-19 pandemic measures are in place. Key National Grid personnel are as follows:

Incident Command Structure

The National Grid Incident Command Structure (ICS) has been activated within all Business Units of National Grid's US Operations to respond to the COVID-19 pandemic. Members of the ICS review and approve all operational decisions, with the Incident Commander ultimately responsible for these decisions. The Incident Commander relies upon subject matter experts within the ICS, including the Operations Officer, the Safety and Health Officer, to help set standards and guidance for protective measures to be used to limit the spread of the COVID-19 virus. These Officers, in turn, utilize the expertise of other members of the organization within Operations, Safety, and Health, to assess risks associated with the work being performed and provide guidance on the most effective measures to be used by employees to protect themselves, their coworkers, our customers, and members of the public.

Field Supervisor

The Field Supervisor shall have the responsibility for monitoring and enforcing National Grid COVID-19 pandemic measures and shall ensure that all employees have received and reviewed this Health & Safety plan.

- Serve as the appointed supervisor to oversee field personnel and ensure pandemic measures are being followed
- Ensure field personnel have the appropriate pandemic supplies
- Disseminate all new National Grid COVID-19 communications to all field employees
- Where non-compliance is observed, take prompt corrective action; and
- Have the authority to order a safety stop in the event of a serious safety issue.

Crew Leader

The National Grid crew leader shall be in charge of the day-to-day details of the work to be performed. They shall ensure that work is performed in accordance with National Grid COVID-19 pandemic measures. They will:

- Walk the job site at the start of each day to ensure a safe work environment;
- Where non-compliance is observed, take prompt corrective action; and
- Have the authority to order a safety stop in the event of a serious safety issue.
- Perform the daily job safety briefing before commencing work, whenever a visitor arrives to the job site, and if there is a significant change in the work or when an extended break occurs. As part of the COVID-19 pandemic response, the COVID-19 job brief checklist (Appendix A) shall be used in addition to the applicable departmental job brief form.

Employees

National Grid employees are responsible for following all COVID-19 pandemic measures;

- Each employee is responsible for reporting to supervision any symptoms of COVID-19, of any direct contact with an individual confirmed to have COVID-19, or in contact with a person in quarantine.
- Each employee is obligated to call a safety stop when a hazardous condition is observed.
- All lone workers shall conduct a self-assessment utilizing the COVID-19 job brief checklist (Appendix A) and adhere to the guidance outlined in this plan.

National Grid Field Safety Representative

National Grid Field Safety Representatives conduct routine and random crew visits to National Grid job sites. The National Grid Field Safety Department shall act as a resource for National Grid field personnel to effectively implement this COVID-19 Health & Safety Plan and will be available on an as-needed basis for inquiries related to this HASP.

3.0 COVID-19 PANDEMIC RESPONSE MEASURES

3.1 COVID-19 Symptoms

COVID-19 Symptoms may include the following:

- Fever
- Cough

- Shortness of Breath
- Chills
- Repeated shaking with chills
- Muscle Pain
- Headache
- Sore Throat
- New loss of taste or smell

3.2 Hygiene and Social Distancing

- Wash your hands often with soap and water for at least 20 seconds, especially after using the restroom, before eating, and after blowing your nose, coughing, or sneezing. Hand washing is the best way to prevent the spread of viruses.
- If soap and water are not readily available, use an alcohol-based hand sanitizer with at least 60% alcohol. Always wash hands with soap and water if hands are visibly dirty.
- **Proper hand washing/sanitizing products will be provided to all employees**
- Maintain a minimum of 6' social distance from other employees on site while performing work and during routine breaks. When work tasks prevent this, ensure proper face coverings are continued to be worn and proper hygiene
- Avoid touching your eyes, nose, and mouth.
- Cover your cough or sneeze with a tissue, then throw the tissue in the trash.
- Clean and disinfect frequently touched objects and surfaces using a disinfecting cleaning spray or wipe; if not available, use a soap and water solution.
- All cleaning product trash and potentially contaminated PPE will be stored in a trash bag and immediately disposed of at a National Grid facility at the end of each shift. Trash should not accumulate in any National Grid vehicle. Immediately wash hands upon disposing of trash bag.

3.3 COVID-19 PPE and Face Coverings

Effective June 1, 2021, National Grid will be revising its <u>outdoor face covering</u> policy to align with recent state guidelines and CDC recommendations. All other COVID protocols, including those related to indoor face covering requirements, will remain in place. The Company will continue to monitor federal and state guidance and will revisit the remaining protocols within 30 days.

Outdoors:
Face coverings will **<u>not</u>** be required outside in public for **fully vaccinated persons** or **where 6 ft socially distancing** can be accomplished. Employee that prefer to continue to mask- up even if fully vaccinated are encouraged to do so.

Indoors:
Face coverings are required inside National Grid facilities and must be worn upon entry. They can be temporarily removed while seated and working alone at a desk/cubicle with 6 ft of distance from

others. Face coverings must be put back on when standing up, moving about or when a coworker is standing or walking in their vicinity. Face coverings can also be removed when an employee is working alone in an enclosed room with a door, such as an individual office. Face coverings cannot be removed in enclosed spaces, including individual offices, conference rooms, training rooms, huddle rooms, storm rooms, locker rooms or any other such space when occupied by more than one person, regardless of ability to social distance within the room.

3.4 COVID-19 Virus Risk Assessment and Adopted Measures

National Grid's prescribed measures (work practices, PPE, hygiene) were selected based upon the risk assessments completed by subject matter experts and reported up through the ICS for approval. They are based upon the Centers for Disease Control & Prevention (CDC) and OSHA guidance, as well as input from Operations, Safety, and Health team members. They are believed to address all risks posed to our workforce, as well as to our customers and members of the public, when jobs are conducted in public places. These measures are reviewed on a continuous basis, for both effectiveness and to ensure the latest guidance is incorporated, with changes made, as necessary, after these reviews.

4.0 COVID-19 REPORTING PROCESS

4.1 COVID-19 Job Brief Checklist

In addition to the applicable departmental job brief form, all crew leaders shall utilize the COVID-19 job brief checklist to facilitate crew discussion regarding symptoms of COVID-19 and allow for discussion to help facilitate the reporting of a COVID-19 incident. All visitors to the job site will be required to have the job brief and COVID-19 checklist reviewed with them by the crew leader prior to entry on the job site.

Remember to maintain social distancing while conducting the job brief

4.2 COVID-19 Incident Reporting

To ensure the safety of all employees and the public, any employee shall immediately contact their Supervisor and National Grid Employee Services if one of the following conditions occur:

- Employee is exhibiting symptoms of COVID-19
- Employee has been in close contact of another individual with COVID-19
- Employee has been in close contact of another individual who is currently being quarantine for a suspected case of COVID-19

Close contact is defined as being within 6' of a sick/quarantined individual for more than 15 minutes.

Please refer to the COVID-19 Suspected/Confirmed Positive Process guidance document in Appendix A.

Appendix A – National Grid COVID-19 Communications

A Message from John Bruckner

National Grid US Coronavirus Incident Commander

Updated Guidance on Face Coverings

April 16, 2020



The state of New York and the state of Rhode Island recently issued executive orders requiring all essential employees who are working in public places to wear face coverings when distance from the public or co-workers cannot be maintained. As a result, we are updating our company policy to align safety standards for all employees.

We had previously communicated that wearing a face covering was voluntary based on CDC recommendations. We are now **requiring** National Grid employees to wear face coverings in the situations below. Please note that this applies to both **office** and **field-based** employees, and applies across **all jurisdictions**.

Face coverings must be worn:

- ✓ When working in public places
- ✓ When working in a customer's premises
- ✓ When social distancing is not able to be maintained with a co-worker, customer or member of the public in a National Grid facility, barn/yard, work location or company vehicle.

- This directive is effective at 8:00 pm this evening for all New York employees.
- It is effective starting this Saturday for all Rhode Island and Massachusetts employees.
- If you are working from home, our company guidance remains: If you can work from home, you should.

What qualifies as a face covering?

Employees may use either a company-issued or a personal face covering, depending on preference and availability. These include:

- Disposable masks, which need to be changed daily or if significantly dirty.
- Reusable FR Balaclavas, which need to be laundered daily, according to CDC cleaning guidance.
- Reusable FR neck warmers, which need to be laundered daily, according to CDC cleaning guidance.
  - Please note: Face pieces must be made from Flame Resistant (FR) material if they are worn when working in an energized zone or there is potential for a gas ignition.

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How to get a face covering:

Our procurement and warehouse teams are working directly with teams to ensure a steady supply of face coverings.

It is our intention to provide company-supplied face coverings widely, but in instances where one is not available or preferred, a personal covering may still be used.

Operations teams should work through their normal channels to order face coverings. We will be providing further guidance to office-based colleagues on where they can access face coverings.

CDC guidance on personal face coverings can be found here:

- https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/cloth-face-cover.html
- https://www.cdc.gov/coronavirus/2019-ncov/downloads/DIY-cloth-face-covering-instructions.pdf

Face coverings should:

- Fit snugly but comfortably against the side of the face
- Be secured with ties or ear loops, if provided
- Include multiple layers of fabric
- Allow for breathing without restriction
- Be removed from behind head or ears to minimize hand contact with face
- Be laundered and machine dried if reusable

Cleaned, dried coverings can be kept in a clean plastic bag until needed for use

It is important to note that face coverings, whether company-issued or personal, are not a substitute for taking measures that are known to be effective in stopping the spread.

Handwashing, and maintaining a social distance of 6 feet apart from others remains the most critical guidance that we can follow.

Sincerely,

John Bruckner

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COVID-19 Job Brief Checklist

Please Distribute

During this trying time it is important that we maintain our same level of focus at work locations conducting hazard assessments and identifying risks prior to the start of each task. Prior to beginning work at every location, when conditions, job focus or crew members change, after each meal period and after any prolonged interruption to the work, a **Job Briefing** shall be held.

The work to be performed shall be discussed and assigned, and the safety aspects of the job shall be reviewed. The National Grid protocol to screen all individuals to determine who may have been exposed to COVID-19 outside of work **must be reviewed** at the start of the workday and Job Briefing.

(Employees working alone shall conduct a self-assessment to determine if they may have been exposed to COVID-19 outside of work or should their condition change during the workday)

The questions are:

- ☐ Are you feeling ill in any way? For instance, do you have any of the following symptoms: A fever? A cough? Shortness of breath? Chills? Repeated shaking with chills? Muscle pain? Headache? Sore throat? New loss of taste or smell?
- ☐ Have you had close contact with a symptomatic person (e.g., fever, cough, and/or shortness of breath, chills, repeated shaking with chills, muscle pain, headache, sore throat, new loss of taste or smell) within the last 14 days?
- ☐ Have you had close contact with a person who was tested with results pending or positive for coronavirus within the last 14 days?
- ☐ Have you recently been out of state for non-work related travel (within the last 14 days)?

*Employees who answer **"YES"** to any of these questions must distance themselves from others, not enter the work area, and immediately contact their supervisor privately for further instruction.*

The employee must also contact the National Grid Employee Services Hotline 1-888-483-2123.

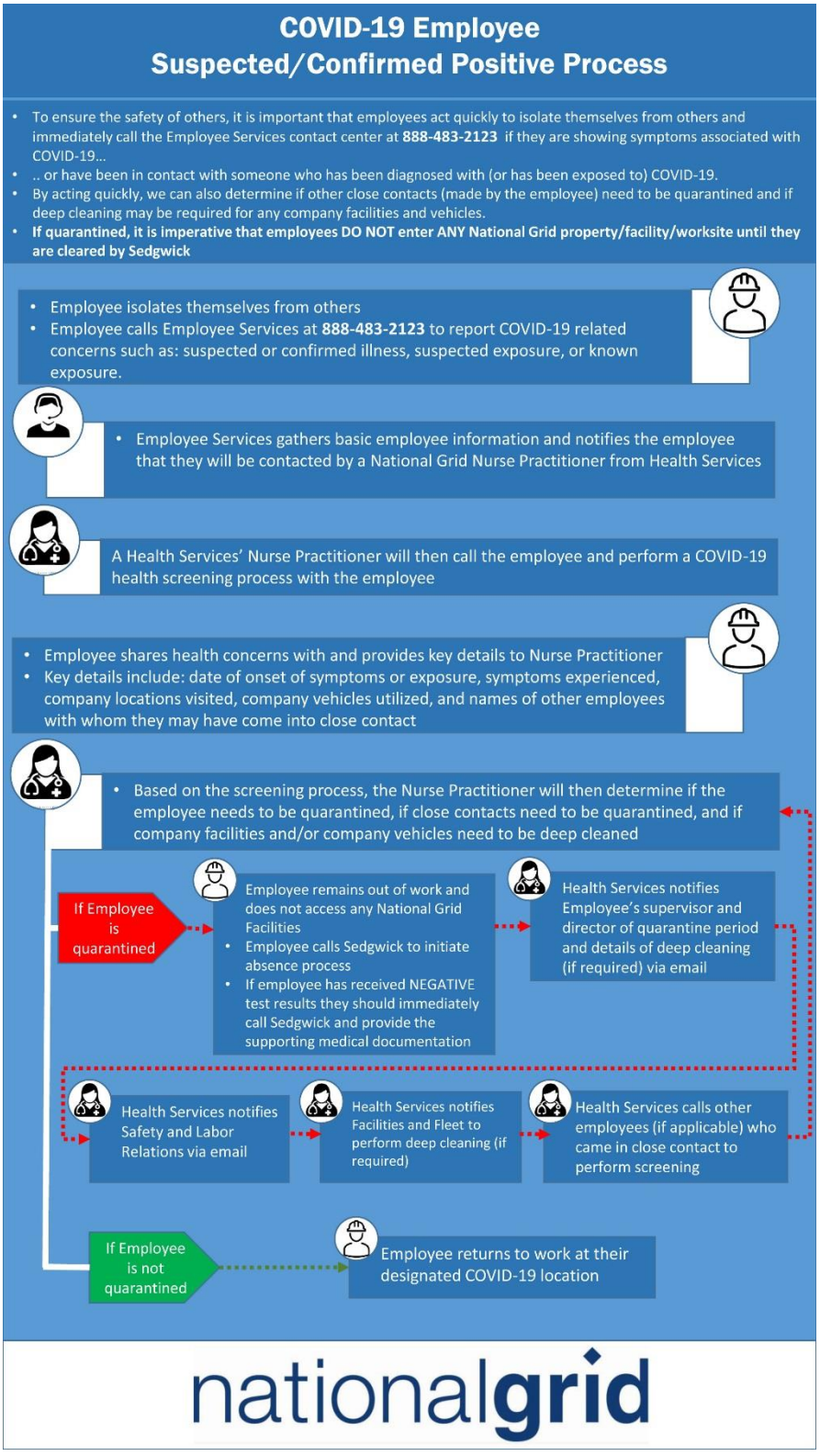
Employees who answer **"NO"** to all of these questions proceed with work activities as planned.

Please note on the Job Brief that you asked these COVID-19 Screening Questions.

To reduce multiple people handling the job brief during the COVID-19 pandemic crew leaders should handle all documentation and record who is present on site after they have reviewed the job brief with each employee or visitor.

REMINDER - Please be sure to follow CDC recommendations

- Maintain a minimum 6' social distance from other people
- Employees must wear a face covering: when working in public places, when working in a customers premise, or when social distancing is not able to be maintained with a co-worker, customer, or member of the public in a National Gird facility, barn/yard, work location, or company vehicle.
- Avoid touching your eyes, nose, and mouth.
- Clean and disinfect frequently touched objects and surfaces using either a EPA registered disinfectant (Lysol, Clorox, etc.), soap and water, or a bleach and water mixture (1/3rd cup bleach per gallon of water)
- Use the fold of your arm to cover a sneeze or cough
- Wash your hands often with soap and water for at least 20 seconds, especially after going to the bathroom; before eating; and after blowing your nose, coughing, or sneezing.
    - If soap and water are not readily available, use an alcohol-based hand sanitizer with at least 60% alcohol. Always wash hands with soap and water if hands are visibly dirty.


COVID-19 Employee
Suspected/Confirmed Positive Process
To ensure the safety of others, it is important that employees act quickly to isolate themselves from others and immediately call the Employee Services contact center at 888-483-2123 if they are showing symptoms associated with COVID-19...
.. or have been in contact with someone who has been diagnosed with (or has been exposed to) COVID-19.
By acting quickly, we can also determine if other close contacts (made by the employee) need to be quarantined and if deep cleaning may be required for any company facilities and vehicles.
If quarantined, it is imperative that employees DO NOT enter ANY National Grid property/facility/worksite until they are cleared by Sedgwick
Employee isolates themselves from others
Employee calls Employee Services at 888-483-2123 to report COVID-19 related concerns such as: suspected or confirmed illness, suspected exposure, or known exposure.
Employee Services gathers basic employee information and notifies the employee that they will be contacted by a National Grid Nurse Practitioner from Health Services
A Health Services' Nurse Practitioner will then call the employee and perform a COVID-19 health screening process with the employee
Employee shares health concerns with and provides key details to Nurse Practitioner
Key details include: date of onset of symptoms or exposure, symptoms experienced, company locations visited, company vehicles utilized, and names of other employees with whom they may have come into close contact
Based on the screening process, the Nurse Practitioner will then determine if the employee needs to be quarantined, if close contacts need to be quarantined, and if company facilities and/or company vehicles need to be deep cleaned
If Employee is quarantined
Employee remains out of work and does not access any National Grid Facilities
Employee calls Sedgwick to initiate absence process
If employee has received NEGATIVE test results they should immediately call Sedgwick and provide the supporting medical documentation
Health Services notifies Employee's supervisor and director of quarantine period and details of deep cleaning (if required) via email
Health Services notifies Safety and Labor Relations via email
Health Services notifies Facilities and Fleet to perform deep cleaning (if required)
Health Services calls other employees (if applicable) who came in close contact to perform screening
If Employee is not quarantined
Employee returns to work at their designated COVID-19 location
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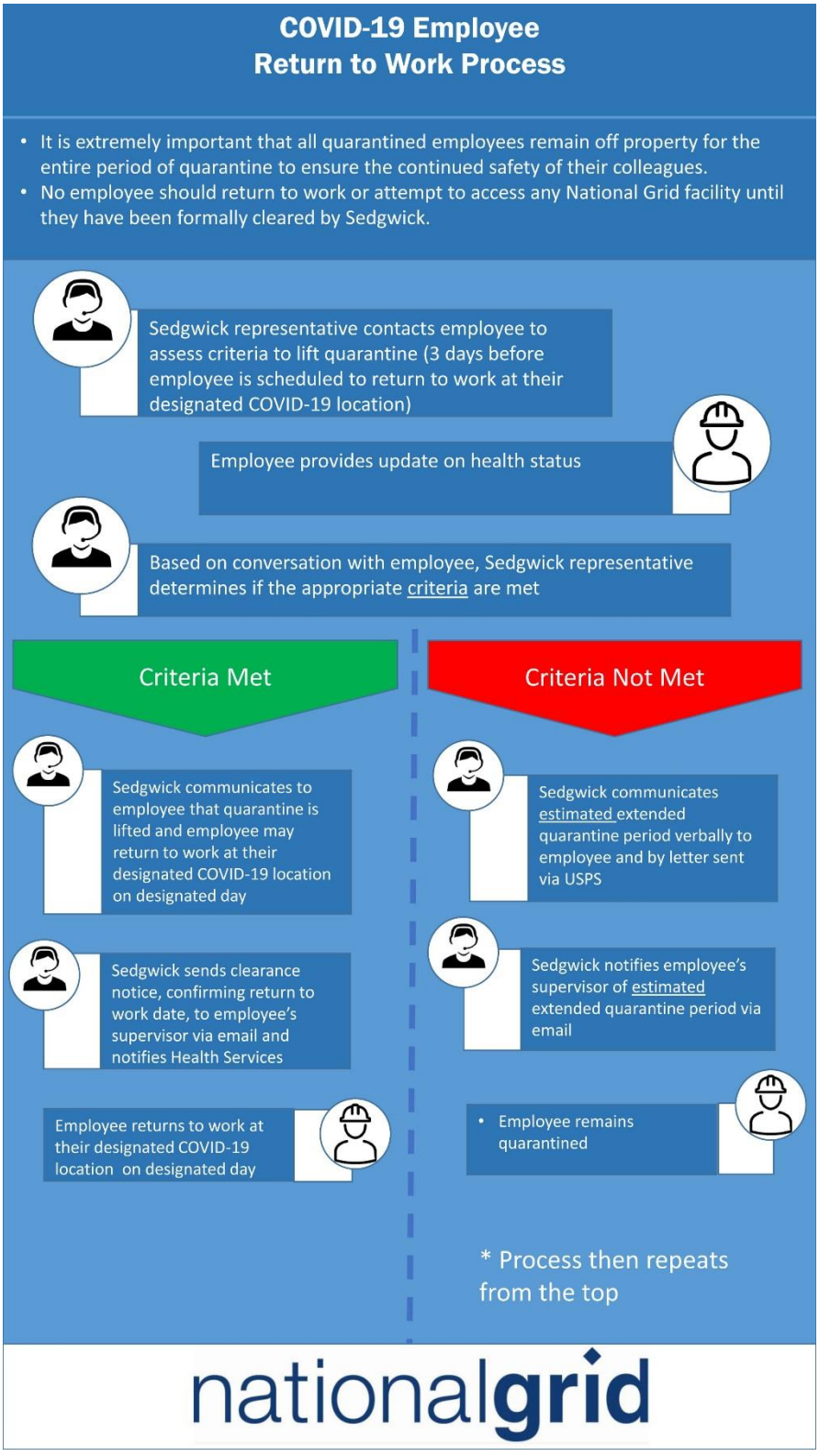
COVID-19 Employee
Return to Work Process
It is extremely important that all quarantined employees remain off property for the entire period of quarantine to ensure the continued safety of their colleagues.
No employee should return to work or attempt to access any National Grid facility until they have been formally cleared by Sedgwick.
Sedgwick representative contacts employee to assess criteria to lift quarantine (3 days before employee is scheduled to return to work at their designated COVID-19 location)
Employee provides update on health status
Based on conversation with employee, Sedgwick representative determines if the appropriate criteria are met
Criteria Met
Criteria Not Met
Sedgwick communicates to employee that quarantine is lifted and employee may return to work at their designated COVID-19 location on designated day
Sedgwick sends clearance notice, confirming return to work date, to employee's supervisor via email and notifies Health Services
Employee returns to work at their designated COVID-19 location on designated day
Sedgwick communicates estimated extended quarantine period verbally to employee and by letter sent via USPS
Sedgwick notifies employee's supervisor of estimated extended quarantine period via email
Employee remains quarantined
* Process then repeats from the top
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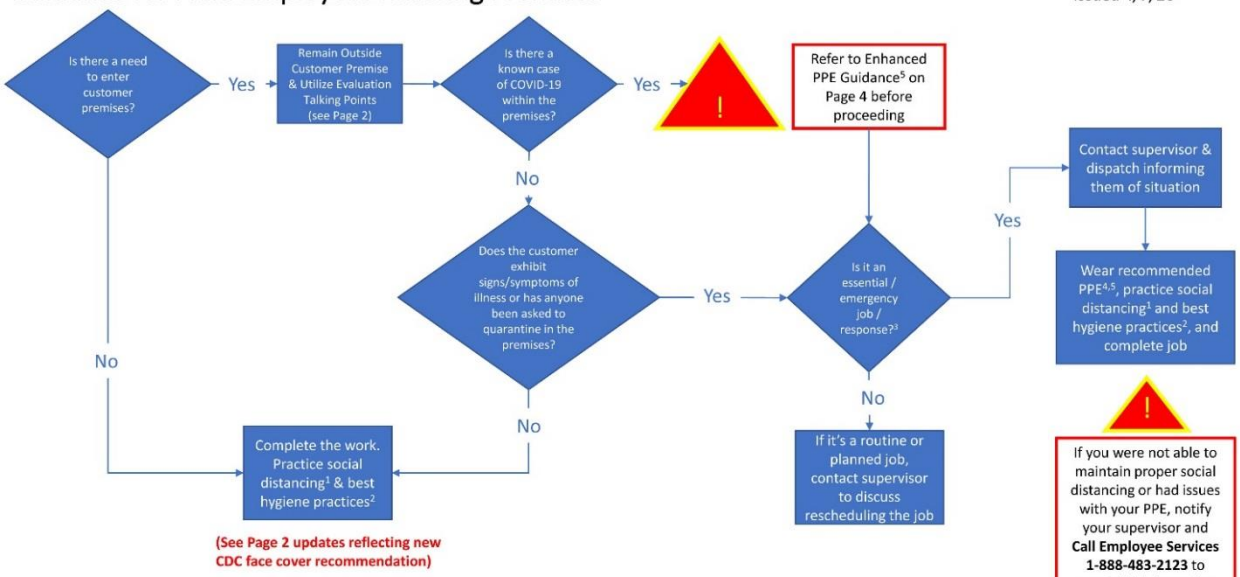
Guidance for Field Employees Entering Premises

Issued 4/7/20



See Page 2 for additional information on Talking Points, CDC Recommendations for (1) Social Distancing and (2) Best Hygiene Practices
See Page 3 for National Grid (3) Emergency Work at a Premises and (4) Standard PPE Guidance
See Page 4 for National Grid (5) Enhanced PPE Guidance

1

Issued 4/8/20

Talking Points - Engage Customer

Prior to entry, engage the customer and advise of social distancing practices. Here are some questions and statements.

- Does someone within the premises have a known case of COVID-19? Has someone within the premises tested positive for the COVID-19 virus?

(IF ANSWER IS 'YES' TO EITHER OF THE ABOVE QUESTIONS, REFER TO ENHANCED PPE GUIDANCE ON PAGE 4)

- Do you mind if I follow the social distancing practice today?
- Is anyone currently sick inside the premises?
- If you are feeling sick, would you mind remaining in another room while I am working This is a best practice policy my company is recommending. Can you tell me where your equipment is located?
- I will do my job, keep you updated and tell you when I am done

(1) Social Distancing

- Maintain at least 6 feet distance between yourself and the customer at all times
- Where social distancing measures cannot be maintained, face cover can be worn to help limit the spread of the virus (see National Grid's Face Cover Guidance for details)

(2) Best Hygiene Practices

- Face covering can be worn in public settings where social distancing measures cannot be maintained (see National Grid's Face Cover Guidance for details)
- Use alcohol-based hand sanitizer (at least 60% alcohol), before and after each home visit; OR wash hands using soap and water for 20 seconds

2

Issued 4/8/20

(3) Emergency Work at a Premises

On arrival, assess the premise/situation in its entirety and consider these questions.

- Is it a multi-unit building?
  - Is the unit where work is required affected?
- What work can be done without interaction/entry?
- Is entry through a side or back door possible to limit exposure?
- Can make safe actions be taken without interaction/entry?
  - Securing Outside Meter/Curb Valve
- Would a hardship be caused by isolating the service?

Note: These questions and considerations are meant to help guide in the decision making process. There may be instances where access to a premise cannot be avoided in order to address immediate public safety concerns. Please reference the Social Distancing and applicable PPE Guidance in all situations.

(4) Standard PPE Guidance for Entering a Premises (No Known COVID-19 cases are present)

- Avoid touching ANYTHING in customer premises other than company equipment and customer equipment related to the job
- Wear disposable latex or nitrile gloves to prevent touching contaminated surfaces
- Latex or nitrile gloves should be donned before entering the home
  - If work gloves are needed to perform the task, remove disposable latex or nitrile gloves and dispose of them. Don work gloves and perform task. Once task is complete remove work gloves and store them. Don a new pair of disposable latex or nitrile gloves to exit the home.
- Remove latex or nitrile gloves and dispose in way that won't create other opportunities for exposure
- Immediately wash / sanitize hands after removing latex or nitrile gloves
- All other PPE normally required for the work being performed should be used

3

Issued 4/8/20

(5) Enhanced PPE Guidance for Entering a Premise (Where a Known COVID-19 Case is Present)

The most effective way to protect the employees from contracting the virus is physical distance; if at all possible, the customer diagnosed with COVID-19 should be asked to move to a separate room before premises entry. When available and practicable, the following PPE items may be used at the premises with a known COVID-19 case present. These PPE items can be used in combination with our Social Distancing and Best Hygiene Practices to limit the spread of the virus.

- N-95 / KN-95 mask (see Page 5 for pictures of typical N-95 / KN-95 masks available)
- Reusable Face Shield
- Disposable Surgical Gloves (nitrile or latex)
- All other PPE required for doing the work (i.e. safety glasses, hard hat, etc.)
- If desired, FR-rated balaclava may be worn to provide additional protection while working

The following steps should be taken while conducting work in the premises:

- Prepare a paper or plastic bag for disposal of used PPE prior to entering the premises.
- Avoid touching ANYTHING in customer premises other than company equipment and customer equipment related to the job.
- Wear disposable latex or nitrile gloves to prevent touching contaminated surfaces.
- Any PPE should be donned before entering the home.
- If a mask is in use, avoid touching your face or adjusting the mask.
- If work gloves are needed to perform the task, remove disposable latex or nitrile gloves and dispose of them. Don work gloves and perform task. Once task is complete remove work gloves and store them. Don a new pair of disposable latex or nitrile gloves to exit the home.

Once work is completed in the home, follow these steps to safely remove the PPE items

- Remove face shield, taking care to avoid touching your face. Clean / disinfect and store properly.
- Remove mask from the back of the head first, taking care to avoid touching your face. Place used mask in a bag and dispose in normal trash.
- If balaclava has been worn, remove covering from back of head, similar to removal of mask.
- Remove latex or nitrile gloves (turn inside out while removing) and place in a bag. Dispose of bag in normal trash.
- Immediately wash / sanitize hands after removing latex or nitrile gloves, following Best Hygiene Practices.

4

Issued 4/8/20

Typical N-95 / KN-95 masks





5

Safeguarding your Vehicle

Now, more than ever, with COVID-19, precautions to safeguard your vehicle when transferring the vehicle to another employee, or when taking your vehicle in for maintenance, is very important.

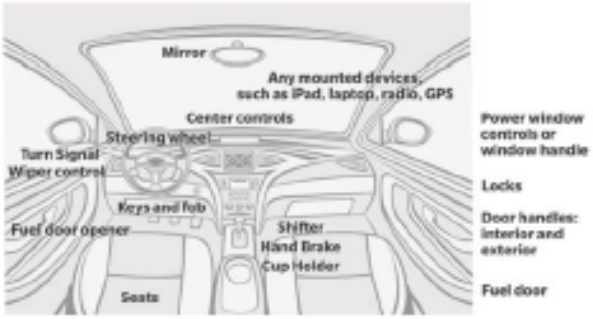
Here are some high-touch areas that should **never** be missed:

• Mirror • Center controls • Keys and fob • Wiper control • Climate control • Audio controls • Hand brake • Seats *(driver/passenger)*/Seatbelts • Fuel door opener • Windows • Headrests • Armrests	• All mounted devices *(any and all electronic devised used - i.e. iPad, laptop, radio, GPS, phone chargers)* • Steering wheel • Headlight switch • All cabin lighting controls • Shifter • Cup holder • Door handle*(inside and out)*/Window control/locks • Air vent • Sun visors

Use disinfectant wipes, diluted bleach solution, or damp soapy water wipes when cleaning all hard surfaces throughout the vehicle.

To guide your efforts when cleaning the vehicle, think about where droplets would fall when you sneeze or cough (*for example: do you turn your head to the side?) and remember to think about your own personal safety:*

- Be sure to wash your hands for **20 seconds** after completing the cleaning process.
- If you take your vehicle home at night, be sure to lock it to prevent it from being compromised.
- Make sure you have a mask and gloves (when/where appropriate).



Before you leave or enter the vehicle – here's a checklist to keep you safe and your team members safe as well:

Activity to Safeguard	✔
Keys / Fob	
Door Handles (interior/exterior)	
Steering Wheel, Shift Lever, Brake Lever, Wiper Stalk, Turn Signal Stalk	
Air Vents, Console, Dashboard, Cup Holder	
Exterior and Interior Fueling Latch, Cover, Cap	
Seats, Seatbelts, Headrests	
Mirrors, Windows, Window Controls	
Interior Lights	
Sun Visors	
Passenger and Driver Door Armrests, Grab Handles, Seat Adjusters	
All Electronic Devices used while in vehicle (iPads, Navigation Systems, Phone Chargers, Laptops, etc.)	

Additional considerations for crew trucks:

Handles on bin doors	
Equipment controls (bucket / digger)	

**** Please consider any other touch point identified by a crew member but not listed***



Contract Employees COVID-19 Reporting Process

Health Services does not typically manage the absences of our contract employees, "contractors". However, to protect our employees, we are screening sick/exposed contractors to determine if they have come into contact with National Grid employees, or if a facilities/vehicle deep cleaning is required. Contract employees are required to call Employee Services (ES) (888) 483-2123 directly. If the contractor does not call Employee Services, the National Grid supervisor may call ES to report the contractor out of work and to initiate contact tracing.

Contractors must be cleared to return to work (RTW) at National Grid by their employer. Per National Grid best practices, we are recommending a 14-day quarantine beginning on the date of notification for all contractors who are sick or believe they have been exposed to COVID-19.

Reporting Process:

1. Contractors call Employee Services **(888) 483-2123** for screening
2. Nurse Practitioner (NP) screens the contractor to determine National Grid close contacts, or if a National Grid facility or vehicle requires deep cleaning. NP obtains employer name and contact email from contractor
3. NP advises contractor to contact their doctor and their employer
4. An email will be sent to National Grid supervisor and the contractor's employer with quarantine start and end date (see email below)
5. Contractor must follow employer's RTW process and complete recommended quarantine (and be symptom free for 3 days)
6. NP will notify any National Grid close contacts to quarantine for 14 days and email National Grid supervisor(s)
7. After 14 days have elapsed, the contractor's employer must send an email to NP confirming that the contractor has returned to work, i.e., all RTW notifications and documentation must be forwarded to Mary Brown, NP Mary.Brown2@nationalgrid.com

Supervisor:

If you are calling Employee Services to report a contractor out of work so that we may initiate contact tracing, or a facilities deep cleaning, please be prepared to answer the following questions when speaking with the NP regarding your contractor:

- Contract employee name

- Contract Employer
- Contract Employer supervisor and email address
- Last date contractor was on National Grid worksite
- National Grid employees the contractor has been in close contact with
- Facilities/vehicle deep cleaning required

email sent to supervisor when contractor is taken out of work for quarantine:

RE: Quarantine Confidential

The contract employee "contractor" listed below has been quarantined and cannot report to a National Grid worksite until they have completed the recommended quarantine. This contractor will follow their employer's process for return to work. After the recommended quarantine has elapsed, and the contractor has been cleared to return to work by their employer, please send email to (Mary.Brown2@nationalgrid.com) to let us know the contractor is back on site.

Contract Employee Name:
Department/Contractor company:
National Grid Supervisor:
Quarantine start date:
End Date:

Saunders, Melissa

From: Saunders, Melissa
Sent: Monday, April 25, 2022 5:31 PM
To: Zeidan, Mousa
Cc: Perry, Patrick; Tan, Paul
Subject: FW: Williamsburg NAPL Permit Extension
Attachments: NYC Parks Permit B529_20190404 (NAPL Recovery - Ngrid).pdf

Hi Mousa,

In the email below, Cory notes NYC Parks has extended the NAPL Recovery access agreement through May 5, 2025.

Please print this email and include it in the HASP folder. The attached access agreement should also be in the HASP folder - please print this out also for inclusion in the event it's missing.

Thanks,
Mel

Melissa Saunders

Associate Vice President, NY/NJ Area Manager - Remediation Practices
melissa.saunders@aecom.com

Click here to connect with me on LinkedIn

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M: 206-502-7914

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From: Saunders, Melissa
Sent: Monday, April 25, 2022 5:23 PM
To: Bierman, Cory <Cory.Bierman@nationalgrid.com>
Cc: Donald Campbell <Donald.Campbell@nationalgrid.com>; Tan, Paul <Paul.Tan@aecom.com>
Subject: RE: Williamsburg NAPL Permit Extension

Thanks for the update Cory.

Melissa Saunders

Associate Vice President, NY/NJ Area Manager - Remediation Practices
melissa.saunders@aecom.com

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From: Bierman, Cory <Cory.Bierman@nationalgrid.com>
Sent: Monday, April 25, 2022 4:51 PM
To: Saunders, Melissa <Melissa.Saunders@aecom.com>
Cc: Donald Campbell <Donald.Campbell@nationalgrid.com>
Subject: [EXTERNAL] Williamsburg NAPL Permit Extension

Hi Melissa,

This morning, NYC Parks granted a permit extension to our current NAPL gauging permit until May 5, 2025. No changes were made so NAPL recovery can proceed as usual.

To follow up on the AECOM Change Notice, Donald just got back from vacation today and needed to look over your response to our comments on the budgeting. He is aiming to get that to you early this week.

Thanks,

Cory Bierman, E.I.T., ENV SP
Contract Employee - Project Manager
Site Investigation & Remediation
nationalgrid
646-931-7931
cory.bierman@nationalgrid.com

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Brooklyn, New York 11217
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You may report the matter by contacting us via our UK Contacts Page or our US Contacts Page (accessed by clicking on the appropriate link)

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For the registered information on the UK operating companies within the National Grid group please use the attached link: https://www.nationalgrid.com/group/about-us/corporate-registrations

City of New York Department of Parks & Recreation
Permit to Perform Work on Park Property

NYC Parks

Mitchell J. Silver, FAICP
Commissioner

The Arsenal
Central Park
New York, NY 10065
www.nyc.gov/parks

Thérèse Braddick
Deputy Commissioner
Capital Projects

Olmsted Center
Flushing Meadows
Corona Park
Flushing, NY 11368

Permit# B529.20190404
Permittee: The Brooklyn Union Gas Company d/b/a National Grid NY
One MetroTech Center Brooklyn, NY 11201

Start Date: 06 May 2019
End Date: 05 May 2022

Parks Interagency Project Manager:
Lindsay Dean

Park Name: **Bushwick Inlet Park**
Boro of **Brooklyn**

Project Title or Purpose: Bushwick Inlet Park – Gauging and Recovery of NAPL
NYSDEC Site No. 224055

This document constitutes a work permit ("Permit") issued by the City of New York City ("City") Department of Parks & Recreation ("Parks") to **The Brooklyn Union Gas Company d/b/a National Grid NY** ("Permittee") to perform certain work known as the Gauging and Recovery of NAPL from 06 May 2019 until 05 May 2022, (the "Term"), at locations adjacent to and nearby Bushwick Inlet Park – 50 Kent Avenue Parcel as more particularly described on the attached map hereinafter referred to as the "Permitted Premises" (N. 11th and N. 12th Streets) and shown on Attachment A, entitled, "NAPL Gauging and Recovery Work Access Requirements" dated April 2019).

1. **Work**

A. This Permit grants Permittee a non-exclusive license to enter the Permitted Premises, subject to the terms and conditions of this Permit, for the limited purposes set forth herein. Permittee has no ownership interest in the Permitted Premises and shall have no rights with respect to the Permitted Premises except as set forth herein. Permittee, its Contractors and Subcontractors shall be in compliance with all terms and conditions of this Permit.

B. This Permit authorizes the Permittee use of the Permitted Premises for the following activities pursuant to and in support of post IRM activities at the Former Williamsburg Works MGP Site (NYSDEC Site No. 224055), as noted below (hereinafter referred to as the "Work"):

i. Permitted Premises (N. 11th and N. 12th Streets)

a) Gauging and collection of Non-Aqueous Phase Liquid (NAPL).

b) Same day load-out of 55 gallon drums containing waste derived from NAPL recovery operations. No drums either empty or containing waste may be stored at the Permitted Premises.

c) Temporary parking of work vehicles permitted solely to perform the Work under this Permit. No overnight parking of any vehicles are permitted.

C. Special Conditions

i. Permittee shall be responsible for any and all fees, fines, violations and/or penalties imposed by any oversite agency due to Permittee's Work.

ii. Permittee shall provide Parks two week's notice and a two week schedule prior to any Work being performed.

iii. Permittee shall not store any materials on the Permitted Premises.

iv. Permittee shall promptly remove any and all drums containing waste from the site.

v. Permittee has appointed Donald Campbell, Project Manager, 718-963-5453 office, 347-452-5973 mobile, Donald.Campbell@nationalgrid.com as the contact person at National Grid for any and all concerns regarding compliance with this permit.

2. General Prohibitions

A. Without separate, express written consent from Parks, Permittee is expressly prohibited from:

i. Occupying, using or in any way affecting Parks premises, systems or resources other than that within the Permitted Premises;

ii. Performing any activities within the Permitted Premises other than those described above;

iii. Performing any Work or other activities pursuant to the Permit not supported by industry standards, best practices or applicable construction or material codes; and

iv. Using or connecting to any of Parks' utilities, including but not limited to water and electric service. Permittee must independently source its own utility service.

B. The express prohibitions of this Paragraph 2 do not limit or modify any other terms and conditions contained in the Permit.

3. Notifications

Permittee shall notify the Administrator for North Brooklyn, at least forty-eight (48) hours before starting the Work. The parties acknowledge that the gauging and collection of NAPL is presently ongoing and shall continue through the notification period.

Contact information for the above contacts can be accessed at:

http://www.nycgovparks.org/about/people

4. Conditions and Terms of Issuance

A. Permittee shall strictly adhere to all City, state and federal laws, rules and regulations, including but not limited to the Rules and Regulations of Parks. Parks does not approve or authorize any work or other activities except as set forth in this Permit or its attachments.

B. Permittee shall, at its sole cost and expense, restore and improve any City property damaged, disrupted or disturbed by the Work, or any other activities by the Permittee, whether or not such property lies within the Permitted Premises. Any such restoration and improvement is subject to the same terms and conditions as are the Work to Parks reasonable satisfaction and approval.

C. Permittee shall be responsible for its contractors, subcontractors, consultants, or any other party used by Permittee in connection with the performance of the Work. Permittee's contractors and subcontractors are bound by the terms and conditions of this Permit and Permittee shall be liable for any damages caused by Permittee's contractors and subcontractors.

D. Any action taken by Permittee that affects any future Parks utility, system or property whatsoever, obligates Permittee to restore such utilities, systems and property to their fully operational and improved condition as reasonable determined by Parks at Permittee's sole expense and within a time period reasonably determined by Parks.

E. Prior to the commencement of the Work, Permittee shall take a complete and thorough set of photographs showing the existing condition of the Permitted Premises and access areas, and shall submit same to Parks' Construction Permit office. Such photographs will be used to determine the scope of restoration requirements. All Work shall be performed exclusively in the areas shown on Attachment A.

5. Expiration, Termination, and Amendment of Permit

This Permit expires automatically on the Expiration Date and is terminable at will at the discretion of the Commissioner of Parks or their designee ("Commissioner") upon thirty (30) days' notice to Permittee. Extension requests must be made in writing thirty (30) days prior to the Expiration Date. Parks reserves the right to amend this Permit at any time to cover new conditions.

6. Coordination

A. Permittee shall coordinate the Work with Parks to ensure that the City's work schedule or other needs related to the Permitted Premises are not impacted.

B. In the event that, during the progress of the Work, Parks authorizes parties other than the Permittee ("Authorized Others") to use the Permitted Premises, Permittee shall coordinate the Work with Authorized Others' activities and shall fully cooperate with and carefully coordinate its own Work with Authorized Others' activities as may be directed by the Commissioner. Permittee shall not commit or permit any act which will interfere with the Authorized Others' activities.

C. If the Commissioner determines that Permittee is failing to coordinate its Work with the activities of Authorized Others as directed by Parks, then the Commissioner shall have the right to terminate the Permit and recover damages, including liquidated damages, from the Permittee until Permittee fully complies with such directions.

D. Permittee shall notify the Commissioner in writing if any Authorized Others fail to coordinate their activities with the Permittee's Work. If the Commissioner finds such charges to be true, the Commissioner shall promptly issue directions to such Authorized Others as the situation may require. The City shall not, however, be liable for any damages suffered by Permittee for any Authorized Others' failure to coordinate their activities with the Work or by reason of the Authorized Others' failure to promptly comply with the directions so issued by the Commissioner, or by reason of any Authorized Others' default in performance, it being understood that the City does not guarantee the responsibility or continued efficiency of any party. Permittee agrees to make no claim against the City for any damages relating to or arising out of any directions issued by the Commissioner pursuant to this Paragraph 6 (including but not limited to the failure of any Authorized Others to comply or promptly comply with such directions), or the failure of the Commissioner to issue any directions, or the failure of any Authorized Others to coordinate their work, or the default in performance of any Authorized Others. Notwithstanding the above, nothing contained in the Permit limits Permittee's right to assert a claim against Authorized Others for any damages relating to or arising out of Authorized Others activities.

7. Other Agencies and Authorities

A. This Permit is issued for gauging and recovery of NAPL on lands under the jurisdiction of Parks. Permittee shall be responsible for securing any and all other permits required to perform any of the Work.

B. Upon the completion of the Work, Permittee shall furnish to Parks and to any other agency or authority involved in the permitting process for the Work plans of such character as may be

directed, showing accurately and distinctly the location, size and type of construction, and complete dimensions of the Work erected or installed in connection with this Permit, as well as the location and dimensions of all substructures encountered during the progress of the Work.

C. The Work shall be open at all times to the reasonable inspection of all agencies and authorities involved in the permitting process for the Work as well as all agencies with applicable oversight authority over any portion of the Work.

8. Access and Use Requirements

A. Permittee shall not commence the Work until all required permits and approvals have been obtained from all appropriate agencies and authorities.

B. For any questions regarding the Permitted Premises, Permittee shall contact the Chief of Operations for the Borough in which the Permitted Premises is located.

C. Prior to any excavation, Permittee shall, contact "One Call Users' Council, Inc." at 1-800-272-4480, to obtain information on underground utilities.

D. Access to the Permitted Premises shall be via Parks' Roads and Paths unless otherwise approved by Parks or any other agency with jurisdiction over adjacent routes.

E. Permittee shall maintain all areas used for access to the Permitted Premises, as well as any staging areas, in a condition acceptable to Parks.

F. Permittee shall not permit construction debris to accumulate anywhere on the Permitted Premises and shall clean up the Permitted Premises on a regular basis during the term of this permit.

G. Permittee shall use refuse receptacles of a capacity which has been determined by Parks to not be detrimental to the access roads and paths leading to the Permitted Premises.

H. Permittee shall not park private vehicles on Parks' property.

I. Emergency vehicles must always have access through the Permitted Premises.

9. Maintenance and Restoration of Site

A. Permittee shall, at its sole cost and expense, completely replace and restore to their pre-Work conditions or better all Parks property and systems, including but not limited to planted areas, trees, shrubs, existing structures or substructures, utility lines, roads, walks and curbs, that are damaged or destroyed by Permittee, whether in or outside the Permitted Premises to Parks reasonable satisfaction and approval.

B. Such replacement or restoration work must comply with all applicable laws, rules, and regulations, be completed within the deadline reasonably established by the Commissioner and be approved by Parks' Construction and Forestry Divisions. All replacement and restoration work shall be performed at the direction and to Parks reasonable satisfaction and approval.

C. Upon the expiration or sooner termination of this Permit, all temporary structures, equipment and material belonging to Permittee shall be removed from the Permitted Premises.

D. Guarantee (Other Than Plantings). All materials used to restore the Permitted Premises, subject to settlement, which remain on the Permitted Premises upon the expiration of this Permit shall be maintained and guaranteed by Permittee for a period of one year after the final inspection and acceptance by the Parks.

E. Supervision. Permittee shall have qualified supervisory personnel present at the Permitted Premises during all phases of the restoration to ensure that Permittee adheres to all Parks' specifications.

F. Final Inspection. Permittee shall notify Parks after the term of this permit when the Permitted Premises is ready for final inspection to certify that Permittee has restored the Permitted Premises in accordance with the terms of this Permit.

G. Weekend or Holiday Work. All Work shall be performed in accordance with Sections 24-222 and 24-223 of the Administrative Code of the City of New York. No Work other than for emergencies or as required by the City or its appropriate agency is to be performed on Parks property on Saturdays, Sundays or Holidays, except by written permission from Parks and in compliance with all City, state and federal laws and the Parks Rules and Regulations.

H. Safety Devices. Barricades, warning devices, signs, flags, lights, shall be provided and maintained as required to insure public safety. Permittee is responsible for the adequacy of the safety devices. Permittee shall, upon direction by Parks, vary and/or increase the safety devices installed on the Permitted Premises. Permittee shall maintain any such devices in good condition throughout the duration of this Permit.

I. Regardless of prior existing conditions at the Permitted Premises, all Work and restoration must be performed at a level consistent with standard construction procedures for new work.

10. Modifications/Choice of Laws/Venue

A. This Permit constitutes the whole of the agreement between the parties hereto, and no other representation made heretofore shall be binding upon the parties hereto. No modification to this Permit shall be valid unless in writing, signed by the parties hereto. Waiver of any breach or default of any provision hereof shall not be deemed a waiver of any subsequent breach of the same or other provision. This Permit shall be deemed to be executed in New York City, State of New York, regardless of the domicile of the Licensee and shall be governed by and construed in accordance with the laws of the State of New York.

B. The parties agree that any and all claims asserted by or against the City arising under or related to this Permit shall solely be heard and determined either in the courts of the United States located in the City or in the courts of the State located in the City and County of New York. The parties shall consent to the dismissal and/or transfer of any claims asserted in any other venue or forum to the proper venue or forum. If Permittee initiates any action in breach of this Permit, Permittee shall be responsible for and shall promptly reimburse the City for any attorneys' fees incurred by the City in removing the action to a proper court consistent with this Permit.

11. Liability

A. To the fullest extent of permitted by law, Permittee shall defend, indemnify and hold the City and its officials and employees harmless against any and all claims, liabilities, settlements, damages, costs and expenses of whatever nature (including, without limitation, attorneys' fees and disbursements) arising out of or related to any of the operations in connection with this Permit, or Permittee's failure to comply with the law or any of the requirements of this Permit. Insofar as the facts or law relating to any of the foregoing would preclude the City or its officials and employees from being completely indemnified by Permittee, the City and its officials and employees shall be partially indemnified by Permittee to the fullest extent permitted by law.

B. Copyrights and Patents: To the fullest extent of the law, Permittee shall indemnify, defend, and hold the City and its officials and employees harmless against any and all claims, liabilities, settlements, damages, costs and expenses of whatever nature (including, without limitation,

attorneys' fees and disbursements), against any of them for infringement or violation of any copyright, patent, trademark, service mark, trade dress, rights of publicity, or other intellectual or proprietary right, or any other property or personal right of any third party, in each case arising out of the use for the purpose of this Permit of any plans, designs, drawings or specifications furnished by Permittee in the performance of this Permit.

C. These indemnification provisions shall survive the termination or expiration of this Permit. These indemnification provisions shall not be limited in any way by any other provision of this Permit.

D. Permittee's construction and restoration activities shall be performed in such manner that the stability of the existing and adjacent areas is not disturbed. Permittee shall be responsible for any damage caused to adjacent Parks areas or appurtenances which result from performance of the Work.

12. Insurance

A. Types of Insurance. From the date Permittee is required to provide Proof of Insurance pursuant to Section 12(C) below through the date of completion of all required Work, Permittee, its Contractors and Subcontractors shall maintain the following types of insurance as indicated herein (with the minimum limits and special conditions specified in Section 12(H)):

i. Commercial General Liability Insurance: Permittee shall maintain a Commercial General Liability ("CGL") insurance policy or policies (including umbrella or excess policies, if any) satisfying the requirements of this Section 12. This insurance shall protect the insureds from claims for property damage and/or bodily injury, including death that may arise from any of the operations under this Permit. Coverage shall be at least as broad as that provided by the most recently issued Insurance Service Office ("ISO") Form CG 0001. Such CGL insurance shall name "City of New York, together with its officials and employees," as an Additional Insured with coverage at least as broad as the most recent edition of ISO Form CG 2026. Such CGL insurance shall be primary and non-contributing to any insurance or self-insurance maintained by the City and must be "occurrence" based rather than "claims-made".

ii. Workers' Compensation, Employers' Liability, and Disability Benefits Insurance: Permittee maintain, and ensure that each Contractor and Subcontractor maintain, Workers Compensation, Employers' Liability, and Disability Benefits Insurance as required by New York law.

iii. Comprehensive Business Automobile Liability Insurance: Permittee shall maintain Comprehensive Business Automobile Liability insurance for liability arising out of any owned, non-owned, leased and hired vehicles to be used in connection with this Permit. Coverage should be at least as broad as the most recent edition of ISO Form CA0001.

iv. Pollution/Environmental Liability Insurance: Permittee and subcontractor shall provide Pollution/Environmental Liability Insurance covering bodily injury and property damage, including loss of use of damaged property or of property that has not been physically injured. Such insurance shall provide coverage for actual, alleged or threatened emission, discharge, dispersal, seepage, release or escape of pollutants, including any loss, cost or expense incurred as a result of any cleanup of pollutants or in the investigation, settlement or defense of any claim, suit, or proceedings against the City arising from Permittee's operations under this Permit. Such insurance shall name and list the City as an Additional Insured. Coverage for the City as Additional Insured shall specifically include the City's officials and employees.

B. General Requirements for Insurance Policies:

i. All required insurance policies shall be maintained with companies that may lawfully issue the required policy and have an A.M. Best rating of at least A- VII or a Standard and Poor's rating of at least A, unless prior written approval is obtained from the Mayor's Office of Operations.

ii. Permittee (or its contractors) shall be solely responsible for the payment of all premiums for all required policies and all deductibles and self-insured retentions to which such policies are subject, whether or not the City is an insured under the policy.

iii. The City's limits of coverage for CGL insurance shall be the greater of

a) the minimum limits set forth in Section 12(H) or

b) the limits provided to Permittee as Named Insured under all primary, excess and umbrella policies of that type of coverage.

C. Proof of Insurance:

i. Before any Work pursuant to this Permit begins, Permittee shall, for each policy required under this Permit, except for Workers Compensation, Employers Liability and Disability Benefits Insurance, file a Certificate of Insurance with the Commissioner pursuant to 12(I).

ii. All Certificate(s) of Insurance shall be in a form reasonably acceptable to the City and shall certify the issuance and effectiveness of the types of insurance specified in Section 12(A) and 12(H) and be accompanied by either a duly executed "Certification by Broker or Agent" in the form contained in Section 12(I) or completed copies of all policies referenced in the Certificate of Insurance. Where completed policies have not yet been issued, binders are acceptable.

iii. Certificates of Insurance confirming renewals of insurance shall be submitted to the Commissioner prior to the expiration date of coverage of policies required under this Permit. Such Certificates of Insurance shall comply with the requirements of this Section 12.

iv. Permittee shall be obligated to provide the City with a copy of any policy required by this Section 12 upon the demand for such policy by the Commissioner or the New York City Law Department.

D. Operations of Permittee:

i. Permittee shall not commence the Work unless and until all required certificates have been submitted to and accepted by the Commissioner. Acceptance by the Commissioner of a certificate hereunder does not excuse Permittee from securing a policy consistent with all provisions of this Section or of any liability arising from its failure to do so.

ii. Permittee shall be responsible for providing continuous insurance coverage in the manner, form, and limits required by this Permit and shall be authorized to perform Work only during the effective period of all required coverage.

iii. In the event that any of the required insurance policies lapse, are revoked, suspended or otherwise terminated, for whatever cause, Permittee shall immediately stop all Work, and shall not recommence the Work until authorized in writing to do so by the Commissioner.

iv. Where notice of occurrence, accident, claim or suit is required under a policy maintained in accordance with this Section 12, Permittee shall notify in writing all insurance carriers that issued potentially responsive policies of any such event relating to any operations under this

Permit (including notice to Commercial General Liability insurance carriers for events relating to Permittee's or its Contractors' employees) no later than 20 days after such event. For any policy where the City is an additional insured, such notice shall expressly specify that "this notice is being given on behalf of the City of New York as Insured as well as the Named Insured." Such notice shall also contain the following information: the number of the insurance policy, the name of the named insured, the date and location of the damage, occurrence, or accident, and the identity of the persons or things injured, damaged or lost. Permittee shall simultaneously send a copy of such notice to the City of New York c/o Insurance Claims Specialist, Affirmative Litigation Division, New York City Law Department, 100 Church Street, New York, New York 10007.

E. Wherever reference is made in this Section 12 to documents to be sent to the Commissioner (e.g., notices, filings, or submissions), such documents shall be sent to the address set forth in Section 15.

F. Materiality/Non-Waiver: Permittee's failure to secure policy(ies) in complete conformity with this Section, or to give the Insurance Company timely notice of any sort required in this Permit on behalf of the City, or to do anything else required by this Section 12 shall constitute a material breach of this Permit. Such breach shall not be waived or otherwise excused by any action or inaction by the City at any time.

G. Other Remedies: Insurance coverage in the minimum amounts provided for herein shall not relieve Permittee of any liability under this Permit, nor shall it preclude the City from exercising any rights or taking such other actions as are available to it under any other provisions of this Permit or as otherwise provided by law.

H. Insurance Schedule

Types of Insurance	Minimum Limits and Special Conditions
Workers' Compensation, Employer's Liability, and Disability Insurance	Per Statutory Limits as required by the laws of the State of New York
Commercial General Liability	$2,000,000 per occurrence, $5,000,000 aggregate. Additional Insureds: 1) City of New York, including its officials and employees, **with coverage at least as broad as ISO Form CG 2026**
Comprehensive Business Auto Coverage	$1,000,000 per accident
Pollution/Environmental Liability	$5,000,000 per occurrence, $10,000,000 aggregate. Additional Insureds: 1) City of New York, including its officials and employees

I. Certificates of Insurance

All certificates of insurance (except certificates of insurance solely evidencing Workers' Compensation Insurance, Employer's Liability Insurance, and/or Disability Benefits Insurance) must be accompanied by one of the following:

(1) the Certification by Insurance Broker or Agent on the following page setting forth the required information and signatures;

-- OR --

(2) copies of all policies as certified by an authorized representative of the issuing insurance carrier that are referenced in such certificate of insurance. If any policy is not available at the time of submission, certified binders may be submitted until such time as the policy is available, at which time a certified copy of the policy shall be submitted.

Form of Certificate appears on the following page.

CITY OF NEW YORK

CERTIFICATION BY INSURANCE BROKER OR AGENT

The undersigned insurance broker or agent represents to the City of New York that the attached Certificate of Insurance is accurate in all material respects.

_____
[Name of broker or agent (typewritten)]

_____
[Address of broker or agent (typewritten)]

_____
[Email address of broker or agent (typewritten)]

_____
[Phone number/Fax number of broker or agent (typewritten)]

_____
[Signature of authorized official, broker, or agent]

_____
[Name and title of authorized official, broker, or agent (typewritten)]

State of .....)
) ss.:
County of .....)

Sworn to before me this _____ day of _____ 20___

_____

NOTARY PUBLIC FOR THE STATE OF _____

13. Independent Contractors, No Assignment

The parties to this Permit shall be independent contractors, and nothing herein shall be deemed to make the parties hereto joint venturers, partners, agent/principal or otherwise. This Permit shall not be assignable without the other party's prior written consent.

14. Investigations

A. The parties to this Permit shall cooperate fully and faithfully with any investigation, audit or inquiry conducted by a State of New York ("State") or City governmental agency or authority that is empowered directly or by designation to compel the attendance and to examine witnesses under oath or conducted by the Inspector General of a governmental agency that is a party in interest to the transaction, submitted bid, submitted proposal, contract, lease, permit, or license that is the subject of the investigation, audit or inquiry.

B.

i. If any person who has been advised that his or her statement and any information from such statement will not be used against him or her in any subsequent criminal proceeding refuses to testify before a grand jury or other governmental agency or authority empowered directly or by designation to compel the attendance of witnesses and to examine witnesses under oath concerning the award of or performance under any transaction, agreement, lease, permit, contract or license entered into with City, State or any political subdivision or public authority thereof, or the Port Authority of New York and New Jersey, or any local development corporation within City, or any public benefit corporation organized under the laws of the State of New York; or

ii. If any person refuses to testify for a reason other than the assertion of his or her privilege against self incrimination in an investigation, audit or inquiry conducted by a City or State governmental agency or authority empowered directly or by designation to compel the attendance of witnesses and to take testimony under oath, or by the Inspector General of the governmental agency that is a party in interest and is seeking testimony concerning the award of or performance under any transaction, agreement, lease, permit, contract or license entered into with City, State or any political subdivision thereof or any local development corporation within the City; then

C.

i. The commissioner or agency head whose agency is a party in interest to the transaction, submitted bid, submitted proposal, contract, lease, permit or license shall convene a hearing, upon not less than five days written notice to the parties involved to determine if any penalties should attach for the failure of a person to testify.

ii. If any non-governmental party to the hearing requests an adjournment, the commissioner or agency head who convened the hearing may, upon granting the adjournment, suspend any contract, lease, permit or license pending the final determination pursuant to paragraph (e) below with City incurring any penalty or damage for delay or otherwise.

D. The penalties which may attach after a final determination by the commissioner or agency head may include, but not exceed:

i. The disqualification for a period not to exceed five years from the date of an adverse determination for any person or entity of which such person was a member at the time the testimony was sought from submitting bids for, transacting business with or entering into or

obtaining any contract, lease, permit or license with or from City; and/or

ii. The cancellation or termination of any and all such existing City contracts, leases, permits or licenses that the refusal to testify concerns and that have not been assigned as permitted under this Permit, nor the proceeds of which pledged, to an unaffiliated and unrelated institutional lender for fair value prior to the issuance of the notice scheduling the hearing, without the City incurring any penalty or damages on account of such cancellation or termination; monies lawfully due for goods delivered, work done, rentals, or fees accrued prior to the cancellation or termination shall be paid by City.

E. The commissioner or agency head shall consider and address in reaching his or her determination and in assessing an appropriate penalty the factors in sub paragraphs (i) and (ii) below. He or she may also consider, if relevant and appropriate, the criteria established in sub-paragraphs (iii) and (iv) below in addition to any other information which may be relevant and appropriate:

i. The party's good faith endeavors or lack thereof to cooperate fully and faithfully with any governmental investigation or audit including, but not limited to, the discipline, discharge or disassociation of any person failing to testify, the production of accurate and complete books and records and the forthcoming testimony of all other members, agents, assignees or fiduciaries whose testimony is sought.

ii. The relationship of the person who refused to testify to any entity that is a party to the hearing, including, but not limited to, whether the person whose testimony is sought has an ownership interest in the entity and/or the degree of authority and responsibility the person has within the entity.

iii. The nexus of the testimony sought to subject entity and its contracts, leases, permits or licenses with City.

iv. The effect a penalty may have on an unaffiliated and unrelated party or entity that has a significant interest in an entity subject to penalties under paragraph (d) above, provided that the party or entity has given actual notice to the commissioner or agency head upon the acquisition of the interest, or at the hearing called for in paragraph (c) (i) above gives notice and proves that such interest was previously acquired. Under either circumstance the party or entity must present evidence at the hearing demonstrating the potential adverse impact a penalty will have on such person or entity.

F.

i. The term "license" or "permit" as used herein shall be defined as a license, permit, franchise or concession not granted as a matter of right.

ii. The term "person" as used herein shall be defined as a natural person doing business alone or associated with another person or entity as a partner, director, officer, principal or employee.

iii. The term "entity" as used herein shall be defined as any firm, partnership, corporation, association or person that receives monies, benefits, licenses, leases or permits from or through City or otherwise transacts business with the City.

iv. The term "member" as used herein shall be defined as any person associated with another person or entity as a partner, director, officer, principal or employee.

G. In addition to and notwithstanding any other provision of this Permit the commissioner or agency head may in his or her sole discretion, terminate this Permit upon not less than three days written notice in the event Permittee fails to promptly report in writing to the Commissioner of

Investigation of the City of New York any solicitation of money, goods, requests for future employment or other benefit or thing of value, by or on behalf of any employee of the City or other person, firm, corporation or entity for any purpose which may be related to the procurement or obtaining of this Permit by the Permitee, or affecting the performance of this Permit.

15. Notices

All notices to Parks shall be sent to the following addresses:

New York City Parks & Recreation
Counsel's Office
The Arsenal
830 Fifth Avenue
New York, New York 10065

AND

Director of Permits
The Olmsted Center
Flushing Meadows-Corona Park
Flushing, New York 11368

AND

Administrator for North Brooklyn
Bushwick Inlet Park
86 Kent Avenue
Brooklyn, NY 11211

All notices to Permittee shall be sent to following address:

The Brooklyn Union Gas Company d/b/a National Grid NY
Attn.: Donald Campbell, Project Manager
287 Maspeth Avenue
Brooklyn, NY 11211

16. Copyright

Permittee warrants that it has obtained or will obtain prior to the commencement of any portion of the Work all required approvals and permissions to use any and all materials that without such permission or approval would infringe or violate the copyright, trademark, service mark, trade dress, rights of publicity, or other intellectual or proprietary right, or any other property or personal right of any third party.

17. Safety Standards

All installed products, materials and equipment installed must meet the reasonable safety standards of their respective industries.

18. Abandoned Project

If at any time during the course of the Work being performed in connection with this Permit it is determined that the Work cannot be completed due to unforeseen field conditions Permittee shall leave the area in the same or better condition the affected area was in prior to commencement of the Work, and at no cost to the City.

19. No Cost

All the Work performed in connection with this Permit shall be at no cost to the City or Parks. In any event, Permittee reserves all rights, and this Permit shall not restrict Permittees ability, to bring any claim against the City or any of its agencies based upon the City's historic ownership, operation or other activities alleged to have led to the incurrence of response costs under the Comprehensive Environmental Response, Compensation, and Liability Act and/or its state law equivalents or the Oil Spill Prevention, Control and Compensation Act of 1977, codified at Navigation Law ss 170 et seq.

20. Assignment

Permittee shall not assign, transfer, convey or otherwise dispose of this Permit or of Permittee's rights, obligations, duties, in whole or in part, in connection with this Permit, unless the prior written consent of Parks shall be obtained, which consent shall not be unreasonably withheld or delayed. Any such assignment, transfer, conveyance or other disposition without such consent shall be void.

21. Merger

This written Permit contains all the terms and conditions agreed upon by the parties hereto, and no other permit, agreement, oral or otherwise, regarding the subject matter of this Permit shall be deemed to exist or to bind any of the parties hereto, or to vary any of the terms contained herein.

22. Modification

No modification, amendment, waiver or release of any provision of this Permit or of any right, obligation, claim or cause of action arising hereunder shall be valid or binding for any purpose unless in writing and duly executed by both parties to this Permit.

23. Protection of Property

Permittee assumes the risk of, and shall be responsible for, any loss or damage to property of the City of New York, involved in the Work performed in connection with this Permit, and caused, either directly or indirectly, by the acts, conduct, omissions or lack of good faith of Permittee, or his or her officers, managerial personnel and employees, or any person, firm, company, agency or others engaged by the Permitee as expert, consultant, specialist or subcontractor hereunder.

The rights and remedies of the City provided herein shall not be exclusive and are in addition to any other rights and remedies provided by law or by this Permit.

24. Progress Schedule

Prior to the commencement of any of the Work to be performed under this Permit, Permittee shall provide the Parks Permit Division, Chief of Operations for the Borough in which the Site is situated, and the Administrator for North Brooklyn with a progress schedule of the Work to be performed. Permittee shall coordinate the Work with Parks to ensure that the City's work schedule or other needs related to the Permitted Premises are not impacted.

25. Liquidated Damages

A. If Permittee fails to vacate the Permitted Premises or leave the Permitted Premises in the condition required by this permit by the Expiration Date, Permittee shall be liable for liquidated damages in the cash amount of $1,000.00 per day for every calendar day or part thereof that such failure continues.

B. Permittee acknowledges that said cash amount is reasonable in proportion to the probable damages likely to be sustained by the City for Permittee's failure to vacate the Permitted Premises by the Termination Date or leave the Permitted Premises in the condition required by the Permit.

C. Permittee acknowledges that the amount of actual damages for the loss of use of property sustained by City in the event of such failure is incapable of precise estimation, that the payment of such cash amount by Permittee would not result in severe economic hardship for Permittee, and that such payment does not constitute a penalty or punitive damages for any purposes.

D. Permittee acknowledges that such liquidated damages compensate the City solely for the lost or impaired use of its property and are separate from and in addition to Permittee's liability to compensate the City for any other damages it may have caused.

E. Such liquidated damage amounts due and unpaid by Permittee shall constitute a lien on any property owned by Permittee.

F. This paragraph survives the Expiration Date or of this Permit or any earlier termination by Parks.

26. Disposal Fees

Permittee shall be solely responsible for any and all disposal fees, fines, penalties and/or violations for the disposal of contaminated and/or hazardous waste at no cost to Parks, including any and all fees assessed by the New York State Department of Environmental Conservation for Work performed pursuant to this Permit, regardless of when assessed. This clause survives the expiration of this Permit. In any event, Permittee reserves all rights, and this Permit shall not restrict Permittees ability, to bring any claim against the City or any of its agencies based upon the City's historic ownership, operation or other activities alleged to have led to the incurrence of response costs under the Comprehensive Environmental Response, Compensation, and Liability Act and/or its state law equivalents or the Oil Spill Prevention, Control and Compensation Act of 1977, codified at Navigation Law ss 170 et seq.

27. Test Results

The results and/or findings of any tests, which include but are not limited to tests for asbestos, lead, contaminated material and/or hazardous material, shall be used solely by Permittee for the purposes of the Work and the construction of the Site. Such results and/or findings may be disclosed only to those persons required by law and/or necessary to perform and complete the work. Permittee shall furnish a copy of the tests results to Parks within five (5) days of Permittee's receipt of same.

28. Publication

Permittee shall not publicize and/or circulate promotional material regarding this Permit, or the Work without the prior written consent from Parks; however, Permittee is required to report its activities to state and federal regulators. Permittee shall provide Parks with copies of all reported activities submitted to any and all state and federal regulators.

CITY OF NEW YORK / PARKS & RECREATION

Signed: _____ 4/26/19

for Daniel Grulich
Director of Interagency Coordination/Construction Permits

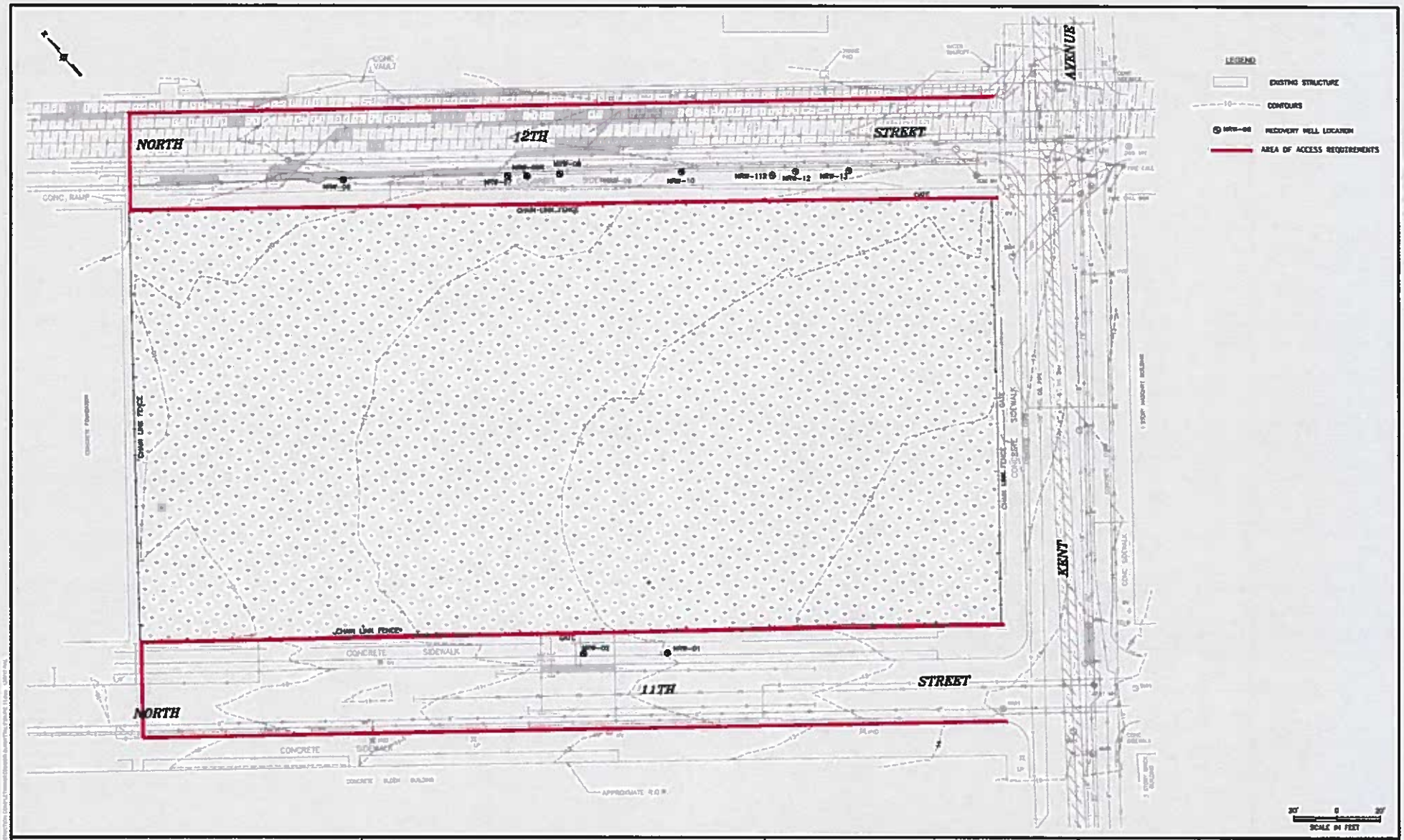
Accepted and agreed:

Signature: _____

Print: Charles F. Willard

Title: Authorized Representative

Date: 4/25/2019



AECOM

NATIONAL GRID
FORMER WILLIAMSBURG MGP SITE
BROOKLYN, KINGS COUNTY, NEW YORK

NAPL GAUGING AND RECOVERY WORK ACCESS REQUIREMENT

DATE: APRIL 2010

AECOM

Attachment I

Project Emergency Response Plan

Attachment I: Project Emergency Response Plan

© AECOM Restricted

National Grid Williamsburg

Location Specific Emergency Response Plan

- All pages of this plan are living documents, to be updated, and signed off as circumstances change and/or reviewed monthly.
- When required to operate under a client's Emergency Response Plan, this plan will be used in conjunction with the client plan. This is to ensure emergency response and notification processes meet the requirements of both the client and AECOM.
- All pages are to be printed off and placed at every building exit and/or designated location(s) on site. They are to be taken by the Floor Marshall/Warden, Emergency Response Coordinator or designate when exiting the building or site so phone numbers, maps and procedures are at hand.

This plan is effective as of

June 24, 2022

and supersedes all other plans relevant to this location in circulation.

Any questions related to this Emergency Response Plan should be directed to:

Name: Melissa Saunders **Phone: 206-502-7914**

Emergency Response is an initial response which may require additional actions as detailed in *SR1-003 WI2 Disruptive Event Response Instruction*.

NATIONAL GRID WILLIAMSBURG

Location Specific Emergency Response Plan

DOCUMENT REVIEW & APPROVAL SIGN-OFF SHEET		YEAR:2022			
REVIEW DATE	**Revision Required?**	**REVIEWED BY**		**APPROVED BY**	
JAN_____	☐ Yes ☐ No		initial		initial
Comments					
FEB_____	☐ Yes ☐ No		initial		initial
Comments					
MAR _____	☐ Yes ☐ No		initial		Initial
Comments					
APR_____	☐ Yes ☐ No		initial		Initial
Comments					
MAY _____	☐ Yes ☐ No		initial		Initial
Comments					
JUN_____	☐ Yes ☐ No		initial		Initial
Comments					
JUL_____	☐ Yes ☐ No		initial		initial
Comments					
AUG _____	☐ Yes ☐ No		initial		initial
Comments					
SEP_____	☐ Yes ☐ No		initial		initial
Comments					
OCT _____	☐ Yes ☐ No		initial		initial
Comments					
NOV _____	☐ Yes ☐ No		initial		initial
Comments					
DEC _____	☐ Yes ☐ No		initial		initial
Comments					

ERP PHONE LIST		
50 Kent Avenue, Brooklyn, NY 11249		
Ambulance		911
Air Medi-Vac		911
Fire FDNY Engine 229 Ladder 146		718-999-2000
Hospital Woodhull Medical Center		718-963-8000
Police NYPD 94th Precinct		718-383-3879
Site Supervisor	Megan Dascoli	908-623-0145
Site Supervisor	Mousa Zeidan	973-820-3257
Site Supervisor	Patrick Perry	315-447-4533
Site Supervisor	Paul Tan	347-536-8660
Project Manager	Melissa Saunders	206-502-7914
Regional SH&E Director	Tony Indorato	757-298-1563
Area/Practice SH&E Manager	Dale “Pete” Wray	302-660-9178
National Grid	Donald Campbell Cory Bierman	DC: 347-452-5973 CB: 646-931-7931
24hr Incident Reporting Line		**1-800-348-5046**

ADDITIONAL PHONE NUMBERS	
Electrical Power – Consolidated Edison	800-752-6633
Natural Gas – National Grid	800-930-5003
Telephone Communications – Verizon	800-225-5499
Environment – NYSDEC	518-402-8044

EMERGENCY COMMUNICATION TREE

Incident Flow Chart



EMERGENCY RESPONSE

Firefighting, medical treatment, rescue, or other emergency response activities should only be performed by properly equipped and trained emergency responders. AECOM recognizes that some of its personnel may have received training in first aid, cardiopulmonary resuscitation (CPR) and AED use, and may choose to perform these duties on injured personnel.

Method(s) of Alarm: **Site does not have any emergency response alarms built in; Vehicle horn will be sounded consecutively three times as a method of alarm.**
Identification Apparel of Floor Marshall/Warden, Emergency Response Coordinator or Designate: **Site Safety Officer will be wearing minimum PPE.**

Evacuation

1. If a situation requires an evacuation or emergency muster/assembly, the pre-determined alarm will be initiated.
2. All personnel (i.e. workers, contractors, visitors) of the area requiring evacuation or muster/assembly will immediately assemble at the designated Muster Point, Assembly Point or Shelter-in-Place as determined by the alarm or communication.
3. The Floor Marshall/Warden, Emergency Response Coordinator or designate will take action to account for all personnel, including visitors (i.e. head count, roll call).
4. The Floor Marshall/Warden, Emergency Response Coordinator or designate shall ensure the appropriate emergency response is activated.
5. Should it be determined that an individual is still within the hazard zone, establish whether a rescue can be safely attempted. Follow the 'Emergency Rescue Procedure' if properly trained and a rescue attempt will not put another individual in jeopardy.
6. Personnel shall await further instruction from the Floor Marshall/Warden, Emergency Response Coordinator or designate (i.e. all clear and re-entry or further evacuation).

Site Specific Additions

7. Primary muster point: corner of Kent Avenue and N 12th Street
8. Secondary muster point: corner of Kent Avenue and N 11th Street
9.

Medical Emergency

1. Stop the work activity.
2. Assess the cause of the injury to avoid injury to yourself (i.e. live wires, gases, hazardous materials).
3. Do not move the casualty unless they remain in danger.
4. First Aid Provider will designate an individual to call for medical assistance (e.g., 911, ambulance, site medic).
5. First Aid Provider will designate an individual to retrieve the first aid kit and blankets.
6. Request assistance from other First Aid Providers as necessary. Administer first aid:
    a. Assess responsiveness: ask permission.
    b. Send for medical help.
    c. Place casualty face up.
    d. Check Airway, Breathing and Circulation ABC's
    e. Control severe bleeding.
7. If CPR is deemed necessary:
    a. Begin chest compressions at a rate of at least 100 compressions per minute.
    b. CPR shall be continued until:
        i. until an AED is applied,
        ii. casualty begins to respond,

iii. another first aider takes over,
iv. medical help takes over, or
v. physically unable to continue.

8. If the casualty begins to breathe on their own, place them in the recovery position, monitor and treat for shock as appropriate.
9. Individual in communication with the designated medical assistance shall attempt to answer any questions, stay on the line until information is verified and follow instruction.
10. Arrange for medical transport as needed. A designated individual should be positioned to direct medical transport to the casualty.
11. Personnel shall await further instruction from the Floor Marshall/Warden, Emergency Response Coordinator or designate (i.e. resume activity).

Site Specific Additions

12. _____

13. _____

14. _____

Fire

1. Alert others in the area of the fire.
2. Sound the alarm or ensure applicable notification system is initiated.
3. All personnel will vacate the building or site and proceed to the Muster Point. DO NOT use elevators.
4. If smoke and heat are strong stay low and close to the floor.
5. Floor Marshall/Warden, Emergency Response Coordinator or designate will proceed through their assigned areas ensuring all personnel have exited.
6. If the fire can be contained, extinguish the fire with the correct type of extinguisher. Remember PASS:
    a. **P** – pull the pin.
    b. **A** – aim the hose at the base of the fire.
    c. **S** – squeeze the handle.
    d. **S** – sweep from side to side until the fire is out or the extinguisher is empty
7. If the fire cannot be contained or there is any concern of an extinguished fire reigniting, call the local fire department, call 911 or notify site fire responders. Give directions to the location; stay on the line until information is verified.
8. The Floor Marshall/Warden, Emergency Response Coordinator or designate will take action to account for all personnel, including visitors (i.e. head count, roll call).
9. A designated individual should be positioned to direct the fire truck to the fire location.
10. Personnel shall await further instruction from the Floor Marshall/Warden, Emergency Response Coordinator or designate (i.e. all clear and re-entry or further evacuation).

Site Specific Additions

11. _____

12. _____

13. _____

Spill / Leak / Release of Hazardous Materials (HAZMAT)

1. Identify the product and assess the risk of injury, fire or explosion.
2. If there is insufficient information on the product or inadequate PPE, move upwind if possible and leave the area immediately (initiate personnel evacuation if required).
3. Isolate the area and deny access to any unauthorized personnel.
4. Only if safe to do so, take measures to stop and control the spill / leak / release
5. Eliminate all ignition sources, if required (no smoking, flares, sparks / flames, engines running).
6. Designate an individual to notify the Floor Marshall/Warden, Emergency Response Coordinator or designate, or Foreman and SH&E representative.
7. Consult the product SDS for accidental release / handling procedures.
8. If it is not possible to stop / control the release, call or appropriate emergency services.

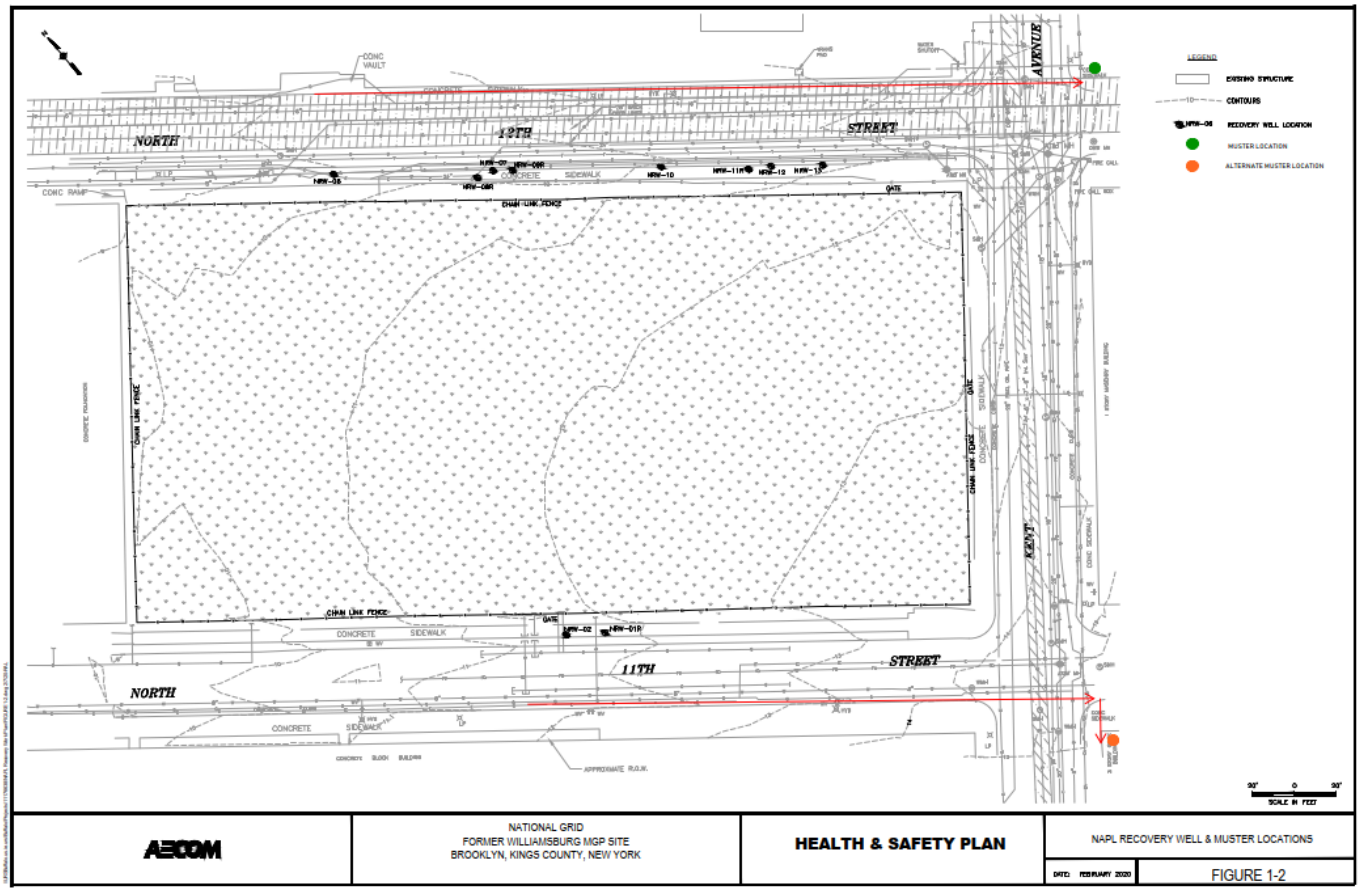
9. Tend to any injured personnel (follow Medical Emergency steps).
10. Personnel shall await further instruction from the Floor Marshall/Warden, Emergency Response Coordinator or designate (i.e. further evacuation or resume activity).

Site Specific Additions

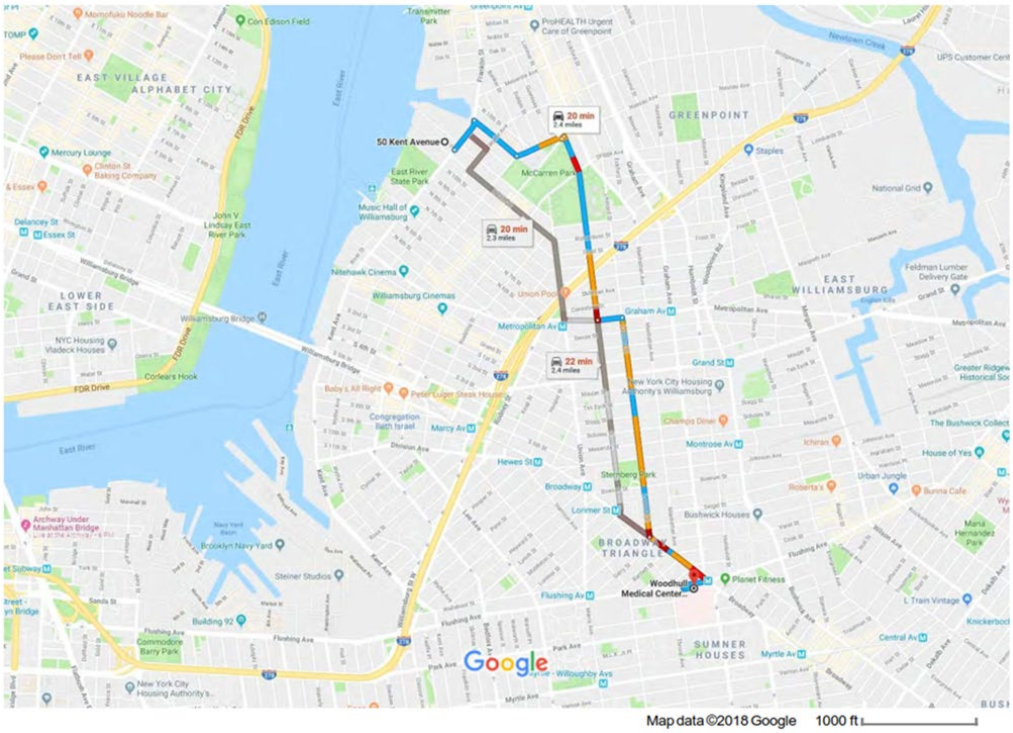
11. Spills that cannot be managed safely by on-site personnel will require support from National Grid's emergency contractor, Miller Environmental. If this is the case, call the National Grid Project Manager and the AECOM Project Manager to organize additional help.
12. All petroleum spills that occur at the site must be reported to National Grid first. National Grid may report the spill to the NYSDEC Spill Hotline. A spill is considered to have not impacted land if it occurs on a paved surface such as asphalt or concrete. A spill in a dirt or gravel parking lot is considered to have impacted land and is reportable
13. A written spill response report shall be prepared at the conclusion of clean-up operations. The spill area is inspected to ensure the area has been satisfactorily cleaned. The use of surface and air sampling is utilized in this determination as necessary. The root cause of the spill shall be examined, and corrective steps taken to ensure the engineering and control measures in place have performed, as required. If alternative precautions or measures are needed, they are made available and implemented. All durable equipment placed into use during clean-up activities is decontaminated for future utilization. All spill response equipment and supplies are re-stocked as required.

Location Map

(include muster points, evacuation routes)



Directions to Medical Facility



Woodhull Medical Center, Ph: 1-718-963-8000

Address:	760 Broadway		
City:	Brooklyn		
State/Province:	NY	**Postal/Zip Code:**	11206
Estimated Travel Time:	20 minutes	**Distance:**	2.4 miles

DRIVING DIRECTIONS

- Head northeast on Kent Ave toward North 12th St
- Take Lorimer St to Metropolitan Ave
- Turn right onto North 14th St
- North 14th St turns left and becomes Nassau Ave
- Turn left onto Bedford Ave
- Turn right onto Lorimer St
- Turn left onto Metropolitan Ave
- Turn right at the first cross street onto Leonard St
- Turn left onto Broadway (pass McDonalds on the right)
- Turn right onto Flushing Ave
- Turn left, arrived at destination

Emergency Response Procedure Action Checklist

DATE: _____

Procedure(s) Followed

Evacuation	☐	Gas Leak	☐
Medical Emergency	☐	Hurricane	☐
Fire	☐	Internal Violence or Intruder	☐
Spill, Leak, Release of Hazardous Material	☐	Lightning	☐
AED Use	☐	Pandemic Management	☐
Bear Charges and Attacks	☐	Power Outage	☐
Civil Disturbance	☐	Severe Winter Storm	☐
Earthquake	☐	Threats of Violence / Bomb Threats	☐
Electrical Live Line Contact	☐	Tornado	☐
Elevator Emergency	☐	Utility Shut-Off Before or During an Emergency	☐
Emergency Rescue	☐	Vehicle Incident	☐
Explosion	☐	Wildfire	☐
Floods/Heavy Rain	☐	Other Procedure: _____	☐

Communication

	Yes	No	N/A		Yes	No	N/A
Alarm initiated	☐	☐	☐	Local law enforcement agency (police) contacted	☐	☐	☐
Floor Marshall/Warden or Emergency Response Coordinator contacted	☐	☐	☐	Client contacted Name: _____	☐	☐	☐
Internal emergency responders contacted (i.e. First aid Provider, onsite medic, rescue crew)	☐	☐	☐	Regulatory Body contacted Name: _____	☐	☐	☐
External emergency services (i.e. fire department, ambulance) contacted	☐	☐	☐	Local Resilience Coordinator (LRC) contacted Name: _____	☐	☐	☐
Supervisor / Foreman contacted	☐	☐	☐	24 Hour Incident Reporting Line called	☐	☐	☐
Concurrent operations contacted	☐	☐	☐	Others contacted _____			

Only take measures that will not put another's safety in jeopardy

Response

	Yes	No	N/A		Yes	No	N/A
Emergency assessed for appropriate response	☐	☐	☐	Appropriate emergency equipment accessed	☐	☐	☐
Evacuation conducted	☐	☐	☐	Individual designated to provide direction to emergency location for emergency services	☐	☐	☐
Roll-Call conducted	☐	☐	☐	Spill/Leak/Release control measures initiated	☐	☐	☐
Emergency assessed for additional hazards	☐	☐	☐	Firefighting equipment utilized	☐	☐	☐
Rescue initiated if safety of others not compromised	☐	☐	☐	All ignition sources controlled	☐	☐	☐
First Aid provided	☐	☐	☐	Further evacuation conducted	☐	☐	☐
Emergency area contained, barricaded or controlled	☐	☐	☐	Utilities shut off	☐	☐	☐
Equipment, machinery or processes shut down if safe to do so	☐	☐	☐	External emergency services provided (i.e. firefighting, air ambulance)	☐	☐	☐

Other response:	Other response:

Completed By: _____ **Signature:** _____

Reviewed By: _____ **Signature:** _____

AECOM

Attachment J

Project Hazardous Materials Communication Plan

Attachment J: Project Hazardous Materials Communication Plan

Materials to be brought or encountered onsite will have a Safety Data Sheet (SDS) maintained in an accessible location for workers to review. Applicable SDSs are presented in **Attachment G**. Materials to be brought or encountered onsite will include:

- Benzene
- N,N-Diethyl-m-toluamide (DEET)
- Diesel Fuel
- Ethylbenzene
- Gasoline with Ethanol and Gasoline – All Grades
- Sulfuric Acid
- Naphthalene
- Toluene
- All-Purpose Cleaning Product (Simple Green®)

As part of the Site Safety Officer (SSO) daily activities, an inventory of hazardous materials will be prepared with the quantities expected to be on site. The inventory will be updated if any additional materials are brought on site and as frequently as necessary to reflect accurate quantities. This chemical inventory list will be readily available for review (usually kept with the SDSs).

Unless each container has appropriate labeling, all chemical containers will be labeled with the following information:

- Product name and identity of the hazardous chemical(s).
- Appropriate hazard warnings.
- Name and address of the chemical manufacturer, importer, or other responsible party.

Labels on incoming containers of hazardous materials will not be removed or defaced. Labels are also required when a hazardous substance is transferred from a primary container to a secondary container. Labels on secondary containers must indicate the product name or the names of the hazardous substances contained therein as well as related physical and health hazards and their associated target organs. Labels may incorporate words, pictures, symbols, or combinations thereof to ensure the appropriate information is provided to the end user.

Examples of acceptable labeling systems include the National Fire Protection Association Diamond, the Hazardous Materials Identification System, the Chemical Hazard Identification and Training system, or similar.

Employee requirements for reviewing SDSs for specific safety and health protection procedures are presented below.

- AHAs will incorporate information contained in the SDSs.
- SDS information will be followed in the use and disposal of material and selection of hazard control and emergency response measures.
- The SSO will obtain an SDS for each chemical before it is used. SDSs will generally be received by the person ordering the product. SDSs for products frequently used should be kept on file because additional copies may not be included in repeat shipments.
- The SSO will review each SDS when it is received to evaluate whether the information is complete and to determine whether existing protective measures are adequate.

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- The SSO will maintain a collection of all applicable and relevant SDSs in an area that is accessible to all employees at all times. An electronic database is an acceptable method of maintaining the SDSs.
- The SSO will replace SDSs when updated sheets are received and will communicate any significant changes to those who work with the chemical.
- SDSs are required for all hazardous materials brought on site by project personnel.

General household products to be used for their specific purpose, food, drugs, and cosmetics brought into the workplace for employee use and consumption are all exempt, as are supplies in the first-aid kit, such as isopropyl alcohol and antibacterial wipes.

Employees bringing hazardous materials on to a site or project must submit SDSs to the SSO. The SSO may restrict the use of certain hazardous materials on a site or project due to occupational health risk, hazardous physical properties of the material, or potential employee sensitivity to odor or irritating properties of the material.

Other personnel working in the same area shall be provided with the following information on chemicals used by or provided to AECOM personnel:

- Names of hazardous chemicals to which they may be exposed while on the jobsite.
- Precautions the employees may take to lessen the possibility of exposure by usage of appropriate protective measures, such as ventilation or isolation of the work. In some cases, as an administrative control measure, a task may be delayed to a time when a minimal number of employees are present in the area.
- Location of SDSs.

As discussed in Section 5.1 of the HASP, employees will be trained initially and periodically when use of hazardous or toxic agents is altered or modified to accommodate changing on-site work procedures. Training shall cover the following topics:

- Requirements and use of the hazard communications program on the project.
- The location of all hazardous or toxic agents at the project.
- Identification and recognition of hazardous or toxic agents on the project.
- Physical and health hazards of the hazardous or toxic agents pertinent to project activities.
- Protective measures employees can implement when working with project-specific hazardous or toxic agents.

Provide training to all employees who have the potential to be exposed to hazardous materials: a) at the time of the initial task assignment, b) whenever new chemicals are introduced into the workplace, and c) more frequently where required by site-specific conditions or client-specific requirements. This training will include the following:

- Applicable regulatory requirements.
- Location of the program, inventory, and SDS.
- Site-specific chemicals used and their hazards (chemical, physical, and health), including the general characteristics of the chemicals and signs and symptoms of exposure.
- How to detect the presence or release of chemicals including the location, types, and usage of any portable and fixed monitoring or detection equipment and their associated alarms, where applicable.
- Safe work practices (S3AM-001-PR1) and methods employees can take to protect themselves from chemical hazards (metals or explosives constituents in soil).
- How to read an SDS.
- Site- or project-specific information on hazard warnings and labels in use at the location, if applicable.
- Site-specific evacuation and rescue procedures in the event of chemical release, including the location of staging areas and personnel accounting procedures.

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The following documentation will be maintained in the project file:

- Chemical inventory list;
- SDSs; and
- Training records.

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Attachment K

AECOM SH&E Policy

Attachment K: AECOM SH&E Policy

Safety, Health & Environment

Purpose

This policy establishes the framework to safeguard AECOM's employees and stakeholders through effective management of risk and commitment to a Culture of Caring.

Commitment

In recognition of the right to a safe and healthy working environment, AECOM is committed to maintaining the physical, psychological, and social well-being, of our employees, stakeholders, and global communities through appropriate risk management strategies.

To advance our Safety, Health & Environment (SH&E) program, we are committed to:

- Our goal of Zero work-related injuries to AECOM employees and stakeholders, incident prevention and protection of the environment while executing our work.
- Providing a highly effective SH&E management system based on our Life-Preserving Principles that empowers employees and drives continuous review and improvement opportunities.
- Effectively managing critical SH&E risk throughout the project lifecycle, through identification and development of suitable actions using the hierarchy of controls.
- Appropriately meeting client requirements and properly incorporating all applicable SH&E legal requirements and local, state, provincial and national regulations.
- Fostering an exceptional safety culture based on communication, collaboration, and consultation, where our people and stakeholders embrace ownership for the well-being of themselves and others.
- Advancing our goals of pollution prevention, resource conservation and environmental sustainability as set out in the Sustainable Legacies strategy.
- Setting aggressive SH&E performance goals and Core Value Metrics; working with employees and business partners to meet targets and promote continuous improvement opportunities.
- Establishing AECOM as the global provider of choice through safe execution of professional services throughout the project lifecycle.

Participation

Individual ownership of our Safety for Life program is required through participation of all parties in our Culture of Caring.

To that end, we expect our leaders, managers, supervisors, employees, and subcontractors to:

- Commit to the well-being of themselves and of all other stakeholders both on and off the job.
- Demonstrate this commitment through compliance with applicable rules and properly identifying, managing and eliminating hazards and reducing risk in the workplace.
- Engage in planning and training to enable competency and the proper and appropriately maintained equipment, materials, and personal protective equipment required to work safely and respond as necessary to emergencies.
- Take action to stop work if the work cannot be executed safely or if conditions or behaviors on the work activity are unsafe or unhealthy.
- Immediately report SH&E incidents, near-misses, unsafe conditions, and at-risk behaviors; participate in investigations and review findings with appropriate stakeholders to enable implementation of corrective and preventative actions.

Accountability

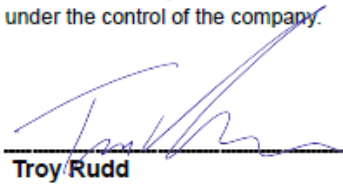
We expect continuous improvement in our journey toward a "zero" incident culture, where everyone participates and is committed to SH&E excellence.

To that end our leaders, managers, supervisors, employees, and subcontractors will be held accountable to their commitment and participation through:

- Recognition and reward of those who positively contribute to excellent SH&E performance.
- Inspections, investigations and reporting to assess SH&E management system application; elevation of high potential findings to senior and executive leadership to enable appropriate action.
- Appropriate action such as coaching or disciplinary measures when expectations are not met.

Review and Communication

This Policy and associated SH&E management system will be reviewed annually and will be made available to all persons under the control of the company.



September 3, 2021

Troy Rudd — **Date**

Chief Executive Officer

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Attachment L

Competent Person Designation

Attachment L: Competent Person Designation

Activity / Area of Competency	Name of Person (Affiliation) Note: Subcontractor may provide this person
☐ **Asbestos**	
☐ **Assured Equipment Grounding Conductor**	
☐ **Blasting & Explosives**	
☐ **Concrete & Masonry Construction**	
☐ **Confined Spaces**	
☐ **Control of Hazardous Energy (Lockout-Tagout)**	
☐ **Crane Assembly / Disassembly**	
☐ **Cranes & Derricks**	
☐ **Demolition**	
☐ **Electrical Wiring Design & Protections**	
☐ **Elevated Work Platforms & Aerial Lifts**	
☐ **Fall Protection**	
☒ **Hearing Protection**	Megan Dascoli, Mousa Zeidan, Paul Tan, Patrick Perry
☒ **Heavy Equipment**	Megan Dascoli
☐ **Ionizing Radiation**	
☐ **Lead**	
☐ **Material Hoists & Personnel Hoists**	
☒ **Respiratory Protection**	Megan Dascoli, Paul Tan
☐ **Rigging Equipment**	
☐ **Scaffolds**	
☐ **Stairways & Ladders**	
☐ **Steel Erection**	
☒ **Trench & Excavations**	Megan Dascoli
☐ **Underground Construction**	
☐ **Welding & Cutting**	

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Americas

Competent Person Designation

S3AM-202-FM1

Company:	AECOM	**AECOM Manager:**	Melissa Saunders
Project Location:	National Grid Williamsburg	**Program/ Project No:**	60601906
Designated Competent Person:	Megan Dascoli	**Employee No:**	

Check the technical activity for which the Designation will apply:

- ☐ Asbestos
- ☐ Assured Equipment Grounding Conductor
- ☐ Blasting & Explosives
- ☐ Concrete & Masonry Construction
- ☐ Confined Space Entry
- ☐ Control of Hazardous Energy (Lockout/Tagout)
- ☐ Crane Assembly / Dissassembly
- ☐ Cranes & Derricks
- ☐ Demolition
- ☐ Electrical Wiring Design & Protections
- ☐ Elevated work platforms & aerial lifts
- ☐ Fall Protection
- ☒ Hearing Protection
- ☒ Heavy Equipment
- ☐ Ionizing Radiation
- ☐ Lead
- ☐ Material Hoists & Personnel Hoists
- ☒ Respiratory Protection
- ☐ Rigging Equipment
- ☐ Scaffolds
- ☐ Silica
- ☐ Stairways & Ladders
- ☐ Steel Erection
- ☒ Trench & Excavations
- ☐ Underground Construction
- ☐ Welding & Cutting

Other (Explain):

The AECOM employee identified has been designated as the Competent Person in the technical area specified by the responsible manager (e.g. Project Manager, Operations Manager, Superintendent) identified. This designation is based on the following:

1. The responsible manager is authorizing the Competent Person to allocate whatever resources that are necessary to perform tasks associated with the area of competency to provide a safe work environment and comply with applicable regulatory and legislative requirements, and AECOM SH&E procedures and policies.
2. The Responsible Manager has confirmed that the individual is competent to perform the required tasks by way of:
   a. Documented training
   b. Practical experience (hands-on)
   c. Documented professional experience
   d. Legislative knowledge

Print name and sign below

Designated by: Melissa Saunders (AECOM Manager) **Date:** 06/29/22

Designated by: Dale "Pete" Wray (AECOM SH&E Manager) **Date:** 06/30/2022

Comments:

Attach any related documentation of training, certifications, insurance coverages, or other related information that supports the designation of the person as Competent.

Americas

Competent Person Designation

S3AM-202-FM1

Company:	AECOM	**AECOM Manager:**	Melissa Saunders
Project Location:	National Grid Williamsburg	**Program/ Project No:**	60601906
Designated Competent Person:	Mousa Zeidan	**Employee No:**	

Check the technical activity for which the Designation will apply:

- ☐ Asbestos
- ☐ Assured Equipment Grounding Conductor
- ☐ Blasting & Explosives
- ☐ Concrete & Masonry Construction
- ☐ Confined Space Entry
- ☐ Control of Hazardous Energy (Lockout/Tagout)
- ☐ Crane Assembly / Dissassembly
- ☐ Cranes & Derricks
- ☐ Demolition
- ☐ Electrical Wiring Design & Protections
- ☐ Elevated work platforms & aerial lifts
- ☐ Fall Protection
- ☒ Hearing Protection
- ☐ Heavy Equipment
- ☐ Ionizing Radiation
- ☐ Lead
- ☐ Material Hoists & Personnel Hoists
- ☐ Respiratory Protection
- ☐ Rigging Equipment
- ☐ Scaffolds
- ☐ Silica
- ☐ Stairways & Ladders
- ☐ Steel Erection
- ☐ Trench & Excavations
- ☐ Underground Construction
- ☐ Welding & Cutting

Other (Explain):

The AECOM employee identified has been designated as the Competent Person in the technical area specified by the responsible manager (e.g. Project Manager, Operations Manager, Superintendent) identified. This designation is based on the following:

1. The responsible manager is authorizing the Competent Person to allocate whatever resources that are necessary to perform tasks associated with the area of competency to provide a safe work environment and comply with applicable regulatory and legislative requirements, and AECOM SH&E procedures and policies.
2. The Responsible Manager has confirmed that the individual is competent to perform the required tasks by way of:
   a. Documented training
   b. Practical experience (hands-on)
   c. Documented professional experience
   d. Legislative knowledge

Print name and sign below

Designated by: Melissa Saunders (AECOM Manager) **Date:** 06/29/22

Designated by: Dale "Pete" Wray (AECOM SH&E Manager) **Date:** 06/30/2022

Comments:

Attach any related documentation of training, certifications, insurance coverages, or other related information that supports the designation of the person as Competent.

Americas

Competent Person Designation

S3AM-202-FM1

Company:	AECOM	**AECOM Manager:**	Melissa Saunders
Project Location:	National Grid Williamsburg	**Program/ Project No:**	60601906
Designated Competent Person:	Patrick Perry	**Employee No:**	

Check the technical activity for which the Designation will apply:

- ☐ Asbestos
- ☐ Assured Equipment Grounding Conductor
- ☐ Blasting & Explosives
- ☐ Concrete & Masonry Construction
- ☐ Confined Space Entry
- ☐ Control of Hazardous Energy (Lockout/Tagout)
- ☐ Crane Assembly / Dissassembly
- ☐ Cranes & Derricks
- ☐ Demolition
- ☐ Electrical Wiring Design & Protections
- ☐ Elevated work platforms & aerial lifts
- ☐ Fall Protection
- ☒ Hearing Protection
- ☐ Heavy Equipment
- ☐ Ionizing Radiation
- ☐ Lead
- ☐ Material Hoists & Personnel Hoists
- ☐ Respiratory Protection
- ☐ Rigging Equipment
- ☐ Scaffolds
- ☐ Silica
- ☐ Stairways & Ladders
- ☐ Steel Erection
- ☐ Trench & Excavations
- ☐ Underground Construction
- ☐ Welding & Cutting

Other (Explain):

The AECOM employee identified has been designated as the Competent Person in the technical area specified by the responsible manager (e.g. Project Manager, Operations Manager, Superintendent) identified. This designation is based on the following:

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2. The Responsible Manager has confirmed that the individual is competent to perform the required tasks by way of:
   a. Documented training
   b. Practical experience (hands-on)
   c. Documented professional experience
   d. Legislative knowledge

Print name and sign below

Designated by: Melissa Saunders (AECOM Manager) **Date:** 06/29/22

Designated by: Dale "Pete" Wray (AECOM SH&E Manager) **Date:** 06/30/2022

Comments:

Attach any related documentation of training, certifications, insurance coverages, or other related information that supports the designation of the person as Competent.

Americas

Competent Person Designation

S3AM-202-FM1

Company:	AECOM	**AECOM Manager:**	Melissa Saunders
Project Location:	National Grid Williamsburg	**Program/ Project No:**	60601906
Designated Competent Person:	Paul Tan	**Employee No:**	

Check the technical activity for which the Designation will apply:

- ☐ Asbestos
- ☐ Assured Equipment Grounding Conductor
- ☐ Blasting & Explosives
- ☐ Concrete & Masonry Construction
- ☐ Confined Space Entry
- ☐ Control of Hazardous Energy (Lockout/Tagout)
- ☐ Crane Assembly / Dissassembly
- ☐ Cranes & Derricks
- ☐ Demolition
- ☐ Electrical Wiring Design & Protections
- ☐ Elevated work platforms & aerial lifts
- ☐ Fall Protection
- ☒ Hearing Protection
- ☐ Heavy Equipment
- ☐ Ionizing Radiation
- ☐ Lead
- ☐ Material Hoists & Personnel Hoists
- ☒ Respiratory Protection
- ☐ Rigging Equipment
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Other (Explain):

The AECOM employee identified has been designated as the Competent Person in the technical area specified by the responsible manager (e.g. Project Manager, Operations Manager, Superintendent) identified. This designation is based on the following:

1. The responsible manager is authorizing the Competent Person to allocate whatever resources that are necessary to perform tasks associated with the area of competency to provide a safe work environment and comply with applicable regulatory and legislative requirements, and AECOM SH&E procedures and policies.
2. The Responsible Manager has confirmed that the individual is competent to perform the required tasks by way of:
   a. Documented training
   b. Practical experience (hands-on)
   c. Documented professional experience
   d. Legislative knowledge

Print name and sign below

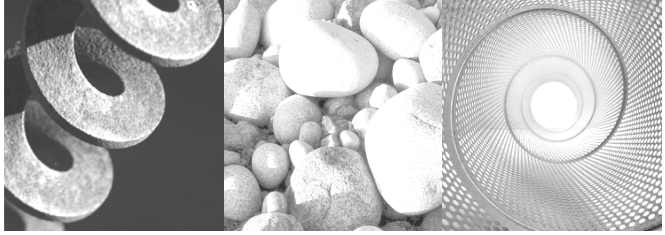
Designated by: Melissa Saunders (AECOM Manager) **Date:** 06/29/22

Designated by: Dale "Pete" Wray (AECOM SH&E Manager) **Date:** 06/30/2022

Comments:

Attach any related documentation of training, certifications, insurance coverages, or other related information that supports the designation of the person as Competent.

APPENDIX G – COMMUNITY AIR MONITORING PLAN



GEI Consultants

Consulting
Engineers and
Scientists

Community Air Monitoring Plan

Williamsburg Works Site

Brooklyn, New York
AOC Index No. TBD
Site No. TBD

Submitted to:
National Grid
One MetroTech Center
Brooklyn, NY 11201

Submitted by:
GEI Consultants, Inc., P.C.
455 Winding Brook Drive, Ste 201
Glastonbury, CT 06033

July 2021
Project 093060

Melissa Felter, P.G.
Project Manager

Jeffrey Parillo
Senior Engineer



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Appendix

A NYSDOH Generic CAMP from DER-10 Appendix 1A

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Abbreviations and Acronyms

AMC	Air Monitoring Consultants
CAMP	Community Air Monitoring Plan
CLP	Contract Laboratory Program
CM	Construction Manager
DER-10	Technical Guidance for Site Investigation and Remediation
ELAP	Environmental Laboratory Approval Program
NEMA	National Electrical Manufacturers Association
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
PM-10	Particulate Matter of 10 micrometers or less in diameter (*i.e.*, Respirable Particulate Matter)
ppm	Parts per million
TVOC	Total Volatile Organic Compounds
USEPA	United States Environmental Protection Agency
$\mu g/m^3$	Micrograms per meter cubed
VOC	Volatile Organic Compound

Executive Summary

This Community Air Monitoring Plan (CAMP) has been developed to provide procedures for measuring, documenting, and responding to potential airborne contaminants during large-scale redevelopment activities below the site-wide building cover associated with the Williamsburg Works site (the Site). The procedures in this CAMP focus on air monitoring techniques and contingency measures designed to mitigate potential airborne contaminants. This CAMP is based on the CAMP guidelines established by the New York State Department of Health (NYSDOH) in the New York State Department of Environmental Conservation (NYSDEC) *DER-10 Technical Guidance for Site Investigation and Remediation* (DER-10) (NYSDEC, 2010).

The CAMP provides Air Monitoring Procedures, Alert Levels, Response Levels, and Action Levels, and it also provides contingency measures if Action Levels are approached. Alert Levels are National Grid established concentration levels for volatile organic compounds, only, and are not established by the NYSDOH or NYSDEC. Alert Levels are set below the levels established by the NYSDOH so that actions can be taken prior to exceeding a NYSDOH threshold. An Alert Level serves as a screening tool to trigger contingent measures, if necessary, to assist in minimizing off-site transport of contaminants during remedial activities. A Response Level is a contaminant concentration level that triggers a temporary work stoppage, continued monitoring, and potential contingent measures. An Action Level is a contaminant concentration that triggers work stoppage and implementation of contingent measures to mitigate potential airborne contaminants prior to resuming work activities. Response Levels and Action Levels are NYSDOH threshold levels established in the November 2009 NYSDOH Generic CAMP presented in Appendix 1A of DER-10 (Appendix A). Exceedances of either Response Levels or Actions Levels will be reported to NYSDEC and NYSDOH.

During times of potential or actual ground intrusive activities below the site-wide building cover, perimeter air monitoring will be conducted using a combination of fixed-station, moveable tripod-mounted, and “walk-around” air monitoring equipment. Monitoring will be performed for total volatile organic compounds (TVOC) and dust along the perimeter of the work area 24 hours a day when fixed stations are used or during working hours when the movable tripod-mounted units are used. The CAMP defines Alert Levels, Response Levels, Action Levels, and specific contingency measures to be implemented. The response actions, potentially including work stoppage and work area controls by various methods, are intended to prevent or significantly reduce the migration of airborne contaminants from the Site.

An air monitoring consultant (AMC) will implement the CAMP and will report any exceedance of Response Levels and Action Levels to the General Contractor, the Construction Manager, National Grid and/or the property owner, NYSDOH, and NYSDEC. As specified in the DER-10, all 15-minute readings will be recorded and be available for State (NYSDEC and NYSDOH) personnel to review. The contractor conducting intrusive activities below the building cover will be responsible for enacting contingency measures to respond to exceedances of Alert Levels, if necessary, and to exceedances of Response and Action Levels, if they occur. The AMC will provide data summary reports to the General Contractor, the Construction Manager (if applicable), National Grid and/or the property owner, and NYSDEC each week during ground intrusive activity below the building cover.

1. Introduction

The New York State Department of Health (NYSDOH) Generic Community Air Monitoring Plan (CAMP), as presented in New York State Department of Environmental Conservation's (NYSDEC) document *DER-10 Technical Guidance for Site Investigation and Remediation*, recommends that real-time monitoring for total volatile organic compounds (TVOC) and particulates (*i.e.* dust) be conducted at the downwind perimeter of each designated work area during ground intrusive activities at contaminated sites. As such, this CAMP describes the proposed air monitoring means and methods that will be implemented during intrusive activities below the site-wide cover at the Williamsburg Works site (the Site). A site location map is shown in Figure 1.

The purpose of the CAMP is to provide early detection in the field of potential short-term emissions and will be conducted in accordance with the generic NYSDOH CAMP.

The objectives of the CAMP are as follows:

- Provide an early warning system to alert the property owner and/or its representative, National Grid and its representative, and the NYSDEC that concentrations of TVOC or dust in ambient air are approaching Action Levels due to site activities.
- Provide potential contingency measures to be enacted by the contractor conducting intrusive activities below the building cover and related contractors that are designed to reduce the off-site migration of contaminants if established Action Levels are approached or exceeded.
- Determine whether construction controls are effective in reducing ambient air concentrations to below Action Levels and make appropriate and necessary adjustments.
- Develop a permanent record that includes a database of perimeter air monitoring results, equipment maintenance, calibration records, and other pertinent information.

1.1 Roles and Responsibilities

The air monitoring consultant (AMC) will implement the monitoring and reporting components of this CAMP under contract with National Grid and/or the property owner. The contractor performing intrusive activities below the building cover is responsible for the selection and implementation of appropriate contingency measures that will mitigate the off-site migration of contaminants in response to Action Levels being approached or

exceeded. The remainder of this section specifies the roles and responsibilities of each entity relative to the CAMP. A communication flowchart is shown in Figure 2 with each entity and lines of communication for the CAMP.

1.1.1 Contractor

The Contractor is the lead contractor responsible for site activities pertaining to the ground intrusive activities below the building cover. The Contractor will be responsible for taking contingent actions in response to Response Level and Action Level exceedances. The Contractor will be responsible for taking contingent actions for Alert Levels, if required by the AMC, Construction Managers (CMs), the property owner, and/or National Grid. The Contractor is responsible for the Health and Safety of its employees.

1.1.2 National Grid

National Grid is ultimately responsible for the remediation of site-related contamination at the Site under an approved work plan with NYSDEC.

1.1.3 New York State Department of Environmental Protection

NYSDEC is responsible for the environmental regulatory enforcement for all activities conducted at the Site including compliance with this CAMP; storm water runoff mitigation (erosion and sediment control); and all environmental and remediation regulations, policies, and guidance applicable to the Site. NYSDEC may provide on-site oversight personnel for the work being conducted.

1.1.4 Construction Managers

CMs are National Grid's and/or the property owner's representatives on site and are responsible for day to day operations on the Site, as applicable[*]. The CM overseeing the ground intrusive activities will be responsible for directing the Contractor to take contingent actions in response to Alert Level (volatile organic compounds [VOCs] only), Response Level, and/or Action Level exceedances. The CMs are responsible for the Health and Safety of their own employees and subcontractors.

1.1.5 The Air Monitoring Consultant

The scope of the AMC activities will be limited to CAMP monitoring and reporting used for the CAMP. The AMC is responsible for the Health and Safety of their employees. The AMC CAMP roles and responsibilities are as follows:

[*] When the construction manager for ground intrusive work is retained by the property owner, National Grid also may retain an environmental construction manager to oversee the AMC and other environmental aspects of the work.

- The AMC will monitor and record TVOC and dust at various locations around the Site as described in the following sections of this CAMP.
- On a daily basis, the AMC will communicate to the following entities whether TVOC or dust exceeded Response Levels or Action Levels specified in Section 2.1. Corrective actions will be required to address the situation. The AMC will convey the CAMP results to the entities listed below and inform them if the Alert or Response Levels have been exceeded. The AMC will direct contractors at the Site to take action if, warranted.

    - **Contractor – TBD**
    - **New York State Department of Environmental Conservation**
      Mr. Gerry Pratt
      Division of Environmental Remediation, NYSDEC
      Office: (518) 402-8246
      625 Broadway, 11th Floor
      Albany, New York 12233-7014
    - **National Grid**
      Donald Campbell, Project Manager
      Office: (718) 963-5453
      287 Maspeth Avenue
      Brooklyn, NY 11211
    - **Construction Manager - TBD (if applicable)**

- The AMC will provide, maintain, and operate the equipment used to implement the CAMP.
- The AMC will provide data summary reports to the Contractor, CMs, National Grid and/or the property owner, and NYSDEC each week during intrusive activity. The reports will identify Response Level and Action Level exceedances and will include data summary reports for all TVOC and dust data collected.

2. Sampling and Analytical Procedures

This section of the CAMP presents a detailed description of the air monitoring sampling and analytical procedures, including data management that will be used during intrusive activities. The intent of the real-time monitoring program is to provide early detection in the field of short-term emissions and off-site migration of site-related TVOC and dust.

Real-time sampling methods will be utilized to determine ambient air concentrations during the project. Monitoring for TVOC and respirable particulate matter (*i.e.*, particulate matter of 10 micrometers or less in diameter, or PM-10) will occur at a minimum of two locations. Wind direction will be monitored under all approaches to community air monitoring that may be employed at the Site. A meteorological station will be established if a centralized data logger system is implemented. Supplemental walk-around perimeter monitoring for TVOC and PM-10, will occur along the perimeter of the project site on an as-needed basis. In the event of an exceedance of a Response Level or Action Level for TVOC or PM-10 at a down-wind monitoring station, the AMC will compare upwind to downwind 15-minute average concentrations. Concentrations within 60 minutes of the exceedance will also be reviewed to determine if activity at the Site is causing the Response Level or Action Level exceedance. The air monitoring procedures and equipment are detailed below.

2.1 Alert Level, Response Level, and Action Levels

Alert Levels are not established by the NYSDOH or NYSDEC and are National Grid-established concentration levels for TVOC only. Alert Levels are set below the levels established by the NYSDOH so that actions can be taken prior to exceeding a NYSDOH threshold. An Alert Level serves as a screening tool to trigger contingent measures, if necessary, to assist in minimizing off-site transport of contaminants during remedial activities.

A Response Level is a contaminant concentration level that triggers a temporary work stoppage, continued monitoring, reporting, and contingent measures. A Response Level serves as a screening tool for both TVOC and PM-10 to trigger contingent measures to assist in minimizing off-site transport of contaminants during remedial ground intrusive activities. Response Levels are NYSDOH thresholds levels established in the May 2010 NYSDOH Generic CAMP presented in Appendix 1A of *Technical Guidance for Site Investigation and Remediation* DER-10 (Appendix A).

An Action Level is a contaminant concentration that triggers work stoppage and implementation of contingent measures to mitigate measured concentrations of potentially airborne contaminants prior to resuming work activities. Action Levels are

NYSDOH threshold levels established in the May 2010 NYSDOH Generic CAMP presented in Appendix 1A of DER-10 (Appendix A). For example, if high concentrations of dust are detected on the Site, contingent measures such as the use of spraying water may be required to reduce the concentrations and keep them below Response Levels.

The following table presents target compounds and corresponding Alert, Response Levels, and Action Levels. The Response Levels and Action Levels are from the NYSDOH Generic CAMP. Alert Levels are National Grid-established concentration levels for TVOC, only.

Target Compounds	**Alert Level**
TVOC (15-minute average concentration)	3.7 ppm greater than background*
Target Compounds	**Response Level**
TVOC (15-minute average concentration)	5.0 ppm greater than background*
Respirable Particulate Matter (PM-10)	100 $\mu g/m^3$ greater than background*
Target Compounds	**Action Level (**)**
TVOC (15-minute average concentration)	25 ppm greater than background*
Respirable Particulate Matter (PM-10)	150 $\mu g/m^3$ greater than background*

ppm - parts per million
$\mu g/m^3$ - micrograms per meter cubed
TVOC – total Volatile Organic Compounds
* Background is defined as the current upwind fifteen-minute average concentration.
** Action Level Exceedance requires work stoppage and mitigation of the condition causing the exceedance.

2.2 Air Monitoring Procedures

During times of intrusive activities below the building cover, perimeter air monitoring will be conducted using a combination of fixed-station, moveable tripod-mounted, and/or "walk-around" air monitoring equipment (as appropriate). Monitoring will be performed for TVOC and dust along the perimeter of the work area 24 hours a day when fixed stations are used or during working hours if the movable tripod-mounted units are used.

Monitoring for TVOC and PM-10 will occur at a minimum of two locations using real-time sampling equipment. Readings will be checked manually on a predetermined, periodic basis if tripod-mounted units are used or transmitted to a centralized data logger system station once per minute. Depending on the units used, monitoring will be conducted during working hours or 24 hours a day, 7 days a week during construction activity along the perimeter of the work area. Supplemental "walk-around" perimeter monitoring for TVOC and PM-10, and odor will occur along the perimeter of the project site on an as-needed basis. Each approach is detailed below.

It is anticipated that tripod-mounted stations will be used for minimally intrusive work such as installation of soil borings or monitoring wells and during shallow intrusive work. It is anticipated that fixed stations will only be used in the event of significant excavation work below the building cover at the Site.

2.2.1 Fixed-Station Monitoring Procedures

Real-time air monitoring for TVOC and suspended particulates will be conducted upwind and downwind of the work area along the perimeter of the Site during significant excavation below the building cover. Instruments will be positioned to monitor at a minimum of two locations adjacent to the work area based on the scale and location of the activities. Real-time monitors will continuously gather data 24 hours a day, 7 days a week. The air monitoring system consists of a minimum of two air monitoring stations, one meteorological tower, and one central computer system. The central computer system will be located in a project trailer or similar work area.

The real-time fixed air monitoring stations will be positioned between the work zone and the largest number of potential off-site receptors or sensitive off-site receptors, such as a school. Therefore, the placement of the fixed air monitoring stations is based on the need to document all potential off-site migration on the perimeter, but also recognizes the potential off-site receptors and the location of the proposed construction activities. Figure 3 displays a typical arrangement of fixed air monitoring stations around the site.

Each real-time air monitoring station will contain the following:

1. Station enclosure,
2. An organic vapor analyzer,
3. A particulate monitor, and
4. A radio telemetry device.

Each monitoring station will be housed in a weather-tight National Electrical Manufacturers Association (NEMA)-4 type enclosure. Each monitoring station will continuously measure and record TVOC and PM-10 at a rate of one sample per minute and record 15-minute time-weighted running averages. Figure 4A shows an example of a typical fixed air monitoring station.

In addition to the air monitoring stations, a Campbell Scientific, Inc. Met Data1 meteorological monitoring system, or equivalent, will be established on site. The meteorological system will continuously monitor temperature, relative humidity, wind speed, and wind direction. Fifteen-minute average values for each meteorological parameter will be stored in the meteorological system and downloaded once per week. Wind direction and wind speed will be displayed on the central computer in real-time to determine upwind and downwind stations for assessing Alert, Response, and Action

Levels. Upwind and downwind stations will be reduced real-time. Wind socks and/or flags will be placed at locations around the site, as necessary, to obtain real-time site-specific wind direction.

All TVOC, PM-10, and meteorological data will be stored in data loggers located within each monitoring/meteorological station. Stored analytical data along with system performance data from each station will be sent in real-time, via radio telemetry, to the central computer system for monitoring and analysis. An automated alarm system will alert AMC personnel of concentrations exceeding the Alert, Response, and Action Levels. The meteorological station will be downloaded at a minimum of once per week. A battery backup will be used, but in the event of severe weather or power loss at the Site, data recording and/or recovery may be affected.

2.2.2 Tripod Mounted Monitoring Procedures

It is anticipated that tripod-mounted stations will be used for minimally intrusive work such as installation of soil borings or monitoring wells and during shallow intrusive work. Instruments will be positioned upwind and downwind of the work area or along the Site perimeter to monitor the air, based on ground intrusive activities, at a minimum of two locations (upwind and downwind). Real-time monitors will continuously gather data during periods of intrusive activity during working hours. The equipment will be manually read on a predetermined periodic cycle during the work activity.

The readings will be collected at a minimum of 15-minute intervals during periods of intrusive activities. Wind direction may be determined by using a wind sock or flagging placed on a pole at the Site.

Each air monitoring station will include the following:

1. Station Tripod and enclosure,
2. An organic vapor analyzer, and
3. A particulate monitor.

Figure 4B shows an example of a typical tripod-mounted air monitoring station.

Each monitoring station will continuously measure and record TVOC and PM-10. All TVOC and PM-10 will be stored in data loggers located within each monitoring station. Data from each piece of equipment will be downloaded daily at the completion of intrusive activities and stored on a central computer system. The location of each station, the work zone, and the wind direction will be noted daily. At each monitoring station location, the 15-minute average value of TVOC and PM-10 will be recorded. The 15-minute average value of TVOC and PM-10 data from the upwind and downwind station will be compared and resultant downwind concentration will be calculated and recorded.

2.2.3 Supplemental Perimeter Walk-around Monitoring

Supplemental walk-around perimeter monitoring for TVOC and PM-10 will occur along the perimeter of the project site on an as-needed basis. Specific site conditions that may trigger walk-around perimeter monitoring include:

- Visible dust;
- Detection of TVOC and/or PM-10 at an air monitoring station at concentrations exceeding an Alert Level, Response Level, and Action Levels; and/or
- Direction by National Grid and/or the property owner, their construction managers, or NYSDEC.

Fifteen-minute average TVOC and PM-10 readings will be collected continuously at a downwind location between the work area and the nearest receptors.

When a triggering condition is observed during ground intrusive activity, the supplemental downwind perimeter monitoring will occur continuously until the conditions that triggered the monitoring have subsided. TVOC concentrations will be monitored and recorded using an organic vapor analyzer. PM-10 will be measured and recorded using a portable aerosol monitor equipped with a PM-10 impactor.

At each monitoring point, the 15-minute average value of TVOC and PM-10, sample time, and sample location will be collected and recorded. Additional temporary monitoring points may be established due to changing site or meteorological conditions.

2.2.4 Equipment Calibration

Equipment calibration will be performed according to manufacturer's instructions. Each organic vapor analyzer will be calibrated once daily using a certified standard isobutylene gas. Particulate monitors for PM-10 will be zeroed daily. Other hand-held portable equipment will be calibrated before each use, or a minimum of once per week when not in use.

2.3 VOC Analytical Sampling

For significant excavation below the building cover when fixed stations are used, verification VOC samples will be collected once per week at two air-monitoring stations. The verification samples are collected to demonstrate that the real-time monitoring stations are effective in measuring the concentration of the VOC target compounds. VOC samples will be collected using 6-liter Summa® canisters (or equivalent vacuum canisters) and analyzed using United States Environmental Protection Agency (USEPA) Method TO-15 modified to include naphthalene. A New York State Environmental Laboratory Approval Program (ELAP)-certified laboratory will perform the analytical testing on the canisters and will provide Category B deliverables as required by the New

York Analytical Services Protocol. The data will be validated in accordance with the USEPA Contract Laboratory Program (CLP) National Functional Guidelines for Organic Data Review, EPA 540/R-99/008 (October 1999) and the USEPA Region II Functional Guidelines for Evaluating Organic Analyses (September 2006), modified as necessary to accommodate the non-CLP methodologies used.

2.4 Pre-Construction Baseline Sampling

For significant excavation below the building cover, pre-construction sampling will be completed to establish baseline ambient air concentrations prior to the start of excavation activities. Baseline conditions will be developed for TVOC and PM-10 in ambient air using real-time fixed station sampling methods. Sample collection and analysis methods will follow those described in subsection 2.2.1. Pre-construction real-time sampling will take place at the fixed air monitoring station locations to determine TVOC and PM-10 baseline conditions. TVOC and PM-10 data will be recorded 24 hours per day for a minimum of three days.

2.5 Data Management Procedures

This section of the Plan discusses the data management procedures that will be used during the remedy. Data may be generated from a variety of sources, including real-time fixed station analytical monitoring, supplemental walk-around monitoring, tripod-mounted monitoring stations, and meteorological monitoring.

These data must be reduced, evaluated, verified, and presented to relevant parties in a timely manner to facilitate decision-making. The data management process for each source of data is discussed below.

The AMC will review all real-time data in a timely manner following collection and transmit the final summary report (see Section 4) to National Grid and/or the property owner.

2.5.1 Fixed Station Monitoring

Analytical data generated at each fixed-station are sent to the central computer system via radio telemetry or will be manually downloaded daily. The monitoring data will also be downloaded to the project database for data evaluation. The following daily charts or tables will be prepared:

- Instantaneous and averaged TVOC concentrations compared to the TVOC Action Level
- Instantaneous and averaged PM-10 concentrations compared to the PM-10 Action Level

- Supplemental Perimeter Walk-Around PM-10 concentrations compared to the Action Level (if any)
- Supplemental Perimeter Walk-Around TVOC concentrations compared to the TVOC Action Level (if any)
- Air monitoring station locations

The following weekly charts or tables will be prepared:

- Meteorological conditions
- Maximum 15-minute average concentrations of TVOC and PM-10
- Upwind and downwind comparison of Response Level and Action Levels reached during the week
- Summary of site activities
- Air monitoring station locations

2.5.2 Tripod Mounted/Supplemental Perimeter Walk-around Monitoring

Analytical data generated at each tripod mounted station and from any supplemental perimeter walk-around monitoring will be manually downloaded daily for data evaluation. The following daily table(s) will be prepared:

- Daily maximum instantaneous and averaged TVOC concentrations compared to the TVOC Action Level
- Daily maximum instantaneous and averaged PM-10 concentrations compared to the PM-10 Action Level
- Supplemental Perimeter Walk-Around PM-10 concentrations compared to the Action Level (if any)
- Supplemental Perimeter Walk-Around TVOC concentrations compared to the TVOC Action Level (if any)
- Air monitoring station locations

The following weekly table(s) will be prepared:

- Maximum 15-minute average concentrations of TVOC and PM-10
- Upwind and downwind comparison of Response Level and Action Levels reached during the week if the daily maximum 15-minute average concentrations of TVOC and PM-10 exceeded a Response Level or Action Levels
- Summary of site activities
- Air monitoring station locations

3. Alert Responses

The purpose of this section is to identify the procedures to be followed in response to elevated levels of target compounds measured during intrusive activities below the building cover. Response actions will be enacted by the Contractor, CMs, and National Grid and/or the property owner. The AMC will report occurrences where a Response Level or Action Level is exceeded, which would require response actions to be enacted. The NYSDEC will be notified of any occurrence where a Response Level and/or Action Level (NYSDOH threshold) is exceeded. If there is a verified exceedance, The AMC will inform the CM (if applicable) and/or Contractor, National Grid and/or the property owner, and NYSDEC within 60 minutes of the exceedance via e-mail at a minimum. In general, a tiered approach to site conditions with corresponding response actions will be implemented during the air monitoring program. The four tiers of site conditions are defined as follows.

- **Site Condition 1.** Normal or ambient air-conditions where all target concentrations are less than the Alert Level for TVOC and the Response Levels for PM-10.
- **Preliminary Site Condition 2.** (TVOC, only.) TVOC concentration is equal to or greater than the Alert Level, but less than the Response Level.
- **Site Condition 2.** Concentration of TVOC and/or PM-10 is less than the Action Level.
- **Site Condition 3.** Concentration of TVOC and/or PM-10 is equal to or greater than the Action Level.

The response plan will rely on real-time data generated from the fixed-station monitoring and/or portable-equipment monitoring and meteorological monitoring. These data sources will be evaluated together in order to make appropriate decisions concerning site conditions and potential control measures.

An explanation of the notification system, specific conditions, and response actions for TVOC and PM-10 is presented below.

3.1 Total Volatile Organic Compounds

TVOC concentrations in air will be measured and recorded by station monitors. Figure 5 presents the TVOC decision diagram that will be used to determine the appropriate site condition based on contaminant concentrations.

Specific TVOC target concentrations for Site Condition 1, Preliminary Site Condition 2, Site Condition 2, and Site Condition 3 are summarized in Table 1.

3.1.1 Site Condition 1

Site Condition 1 will be in effect when the average TVOC concentration, measured over a 15-minute period, is less than the Alert Level (3.7 ppm). Under a Site Condition 1, each organic vapor analyzer located at the monitoring stations (tripod or fixed) will collect and analyze a TVOC sample at a frequency of one sample per minute.

3.1.2 Preliminary Site Condition 2

Preliminary Site Condition 2 will be in effect if the average TVOC concentration, measured over a 15-minute period, is greater than or equal to the Alert Level (3.7 ppm) but less than the Response Level (5.0 ppm). The Contractor, CM, and National Grid and/or the property owner will be notified by the AMC of elevated measurements and a Preliminary Site Condition 2.

At this time, the upwind and downwind concentrations will be compared to determine if the Preliminary Site Condition 2 is due to site activities. If downwind TVOC concentrations are greater than upwind concentrations, then it will be assumed that the Preliminary Site Condition 2 is due to site activities.

If the above condition is true, then a Preliminary Site Condition 2 will be verified. Under a verified Preliminary Site Condition 2, a contingency meeting attended by the AMC, the Contractor, CM, and National Grid and/or the property owner will be held. The Contractor, CM, and National Grid and/or the property owner will determine appropriate response actions. This meeting will be held within 60 minutes of the Preliminary Site Condition 2 verification. Possible Preliminary Site Condition 2 response actions are listed in Table 2. Preliminary Site Condition 2 will remain as long as the TVOC concentration is between 3.7 ppm (Alert Level) and 5.0 ppm (Response Level), based on 15-minute averages.

The site condition will return to Site Condition 1 if the following condition is true.

- The 15-minute average concentrations for TVOC at each of the monitoring stations are less than 3.7 ppm (Alert Level).

3.1.3 Site Condition 2

Site Condition 2 will be in effect if average TVOC concentrations increase to greater than the Response Level of 5.0 ppm. Site Condition 2 will remain in effect if the average TVOC concentration, measured over a 15-minute period, is greater than or equal to 5.0 ppm (Response Level).

Under Site Condition 2, construction activities will be temporarily halted. A meeting attended by the AMC, the Contractor, CM, National Grid and/or the property owner, and NYSDEC (by phone, if not onsite and if available), will be held within 60 minutes of the Site Condition 2. The Contractor, CM, National Grid and/or the property owner, and NYSDEC will determine appropriate response actions. Possible Site Condition 2 corrective measures/actions are listed in Table 2. After appropriate corrective measures/actions are taken, work activities may resume provided that the TVOC concentration at the perimeter of the work area is no more than 5.0 ppm above background for the 15-minute average.

If average TVOC concentrations fall below the Response Level, then the site condition will be returned to Preliminary Site Condition 2, at which time work activities may resume. Preliminary Site Condition 2 will remain in effect as long as the following condition is true.

- The 15-minute average concentration for TVOC is greater than 3.7 ppm (Alert Level) and less than 5.0 ppm (Response Level).

The site condition will return to Site Condition 1 if the following condition is true.

- The 15-minute average concentrations for TVOC at each of the monitoring stations are less than 3.7 ppm (Alert Level).

3.1.4 Site Condition 3

Site Condition 3 will be in effect if average TVOC concentrations increase to greater than the Action Level of 25.0 ppm at the perimeter of the work area. Site Condition 3 will remain in effect if one of the following conditions is true.

- The average TVOC concentration, measured over a 15-minute period, is greater than 25 ppm (Action Level) at the work zone.

Under Site Condition 3, all construction activities will be halted. A meeting attended by the AMC, the Contractor, CM, National Grid and/or the property owner, and NYSDEC (by phone, if not onsite and if available), will be held within 60 minutes of the Response Level notification. The Contractor, CM, National Grid and/or the property owner, and NYSDEC will determine appropriate response actions. Possible Site Condition 3 corrective measures/actions are listed in Table 2.

If average TVOC concentrations fall below the Action Level, then the site condition will be returned to a Site Condition 2. If average TVOC concentrations fall below the Response Level, then the Site Condition will be returned to Preliminary Site Condition 2, at which time work activities may resume. Preliminary Site Condition 2 will remain in effect as long as the following condition is true.

- The 15-minute average concentration for TVOC is greater than 3.7 ppm (Alert Level) and less than 5.0 ppm (Response Level).

The site will return to Site Condition 1 if the following condition is true.

- The 15-minute average concentrations for TVOC at each of the monitoring stations are less than 3.7 ppm (Alert Level).

3.2 Respirable Particulate Matter

PM-10 concentration in air will be measured and recorded by the station monitors and may be temporarily suspended during periods of rain. Figure 6 presents the PM-10 decision diagram.

Specific PM-10 target concentrations for Site Condition 1, Preliminary Site Condition 2, Site Condition 2, and Site Condition 3 are summarized in Table 1.

3.2.1 Site Condition 1

Site Condition 1 will be in effect when the downwind 15-minute average PM-10 concentration is less than 100 $\mu g/m^3$ above the contemporary average upwind conditions (Response Level).

3.2.2 Site Condition 2

Site Condition 2 will be in effect if the difference between the downwind and background average 15-minute PM-10 concentration is greater than 100 $\mu g/m^3$ above the contemporary upwind concentration (Response Level), less than 150 $\mu g/m^3$ (Action Level), and related to ground intrusive activities or if visible dust is observed leaving the work area. The Contractor, CM, National Grid and/or the property owner, and NYSDEC will be notified by the AMC of elevated measurements and a possible Site Condition 2. The upwind and downwind PM-10 concentrations will be compared to determine if the elevated PM-10 concentrations are due to site activities. If downwind PM-10 concentrations are 100 $\mu g/m^3$ greater than upwind concentrations (Response Level), then it will be assumed that the Site Condition 2 is due to site activities.

The Site Condition 2 will remain in effect as long as the average PM-10 concentration is greater than or equal to 100 $\mu g/m^3$ above upwind conditions (Response Level), and less

than or equal to 150 μg/m^3(Action Level) provided that no visible dust is observed leaving the work area. Under a verified Site Condition 2, dust suppression techniques must be implemented by the Contractor. At this point, routine monitoring continues and 15-minute averages continue to be evaluated. Work may continue with dust suppression techniques provided that downwind PM-10 levels do not exceed 150 μg/m^3 above the upwind level (Action Level) and provided that no visible dust is migrating offsite from the work area.

A contingency meeting attended by the AMC, the Contractor, CM, National Grid and/or the property owner, and NYSDEC will be held within 60 minutes of the verified Site Condition 2 if the condition is not mitigated by dust suppression techniques. Possible response actions for dust control are listed in Table 2.

3.2.3 Site Condition 3

Site Condition 3 will be in effect if the average 15-minute PM-10 concentration exceeds 150 μg/m^3 above the contemporary average upwind concentration (Action Level) or if visible dust is migrating from the work area and the difference between the average and background concentrations is greater than or equal to 100 μg/m^3. Under Site Condition 3, work must be stopped and a meeting attended by the AMC, the Contractor, CM, National Grid and/or the property owner, and NYSDEC (by phone, if not onsite and if available) will be held within 60 minutes of the Action Level notification. The Contractor, CM, National Grid and/or the property owner, and NYSDEC will determine appropriate response actions. Possible Site Condition 3 response actions for PM-10 are listed in Table 2. Work may resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 concentration to within 150 μg/m^3 of the upwind level and in preventing visible dust migration and provided that no visible dust is migrating from the work area.

4. Reporting

The AMC will prepare and submit weekly reports to the Contractor, CM, National Grid and/or the property owner, and NYSDEC summarizing the CAMP monitoring data. Each weekly report will be letter-style and will include charts/tables summarizing the following:

- Maximum 15-minute average concentrations of TVOC, and PM-10
- Upwind and downwind comparison of Response Levels and Action Level reached during the weekly period
- Summary of site activities
- Air monitoring station locations
- Meteorological conditions (for fixed stations only)

Following the completion of all work, a final summary report of the Community Air Monitoring activities and data will be prepared and submitted to NYSDEC.

References

New York State Department of Environmental Conservation. 2010. DER-10/Technical Guidance for Site Investigation and Remediation. Division of Environmental Remediation. May 3, 2010. Appendix 1A. pp. 204-206.

Tables

Table 1. Target Concentrations for Site Conditions
Community Air Monitoring Plan
Williamsburg Works Site
Brooklyn, New York

	Alert Level[1]	NYSDOH generic CAMP[2]		Site Condition 1	Preliminary Site Condition 2	Site Condition 2	Site Condition 3
		Response Level	Action Level				
TVOC	3.7 ppm	5.0 ppm	25 ppm	< 3.7 ppm	≥ 3.7 ppm	≥ 3.7 ppm, < 5.0 ppm	≥ 5.0 ppm
PM-10	NA	100 ug/m^3	150 ug/m^3	< 100 ug/m^3	NA	≥ 100 ug/m^3, < 150 ug/m^3	≥ 150 ug/m^3

Notes:

[1] Alert Levels are not established by the NYSDOH or NYSDEC and are internally established concentration levels for total volatile organic compounds. Alert Levels are set below the levels established by the NYSDOH so that actions can be taken prior to exceeding a NYSDOH threshold. An Alert Level serves as a screening tool to trigger contingent measures, if necessary, to assist in minimizing off-site transport of contaminants during remedial activities.

[2] Response Levels and Action Levels are defined in Appendix 1A of the New York State Department of Environmental Conservation *DER-10/Technical Guidance for Site Investigation and Remediation* (NYSDEC, 2010)

ug/m^3 - micrograms per cubic meter

ppmv - parts per million by volume

TVOC - total volatile organic compounds

PM-10 - particulate matter (i.e. dust) less than 10 microns in diameter

NA - not applicable

Table 2. Site Conditions and Response Actions
Community Air Monitoring Plan
Williamsburg Works Site
Brooklyn, New York

Site Condition	Control Measure
Site Condition 1	Normal site activities - No control measures required
Preliminary Site Condition 2	Hold a contingency meeting attended by the AMC, the Contractor, CM, and National Grid and/or the property owner Temporarily relocate work to an area with potentially lower emission levels Cover all or part of the excavation area Apply VOC emission suppressant foam over open excavation areas Slow the pace of construction activities Change construction process or equipment that minimize air emissions Install a perimeter barrier fence Haul materials in properly tarped or watertight containers* Cover excavated areas and material after excavation ceases* Reduce the excavation size and/or number of excavations*
Site Condition 2	Establish trend of data and determine if evaluation/wait period is warranted Temporarily stop work Temporarily relocate work to an area with potentially lower emission levels Apply water to area of activity or haul roads to minimize dust levels Reschedule work activities Cover all or part of the excavation area Apply VOC emission suppressant foam over open excavation areas Slow the pace of construction activities Change construction process or equipment that minimize air emissions Install a perimeter barrier fence Apply water on haul roads* Wet equipment and excavation faces* Spray water on buckets during excavation and dumping* Haul materials in properly tarped or watertight containers* Restrict vehicle speeds to 10 mph* Cover excavated areas and material after excavation ceases* Reduce the excavation size and/or number of excavations*

Table 2. Site Conditions and Response Actions
Community Air Monitoring Plan
Williamsburg Works Site
Brooklyn, New York

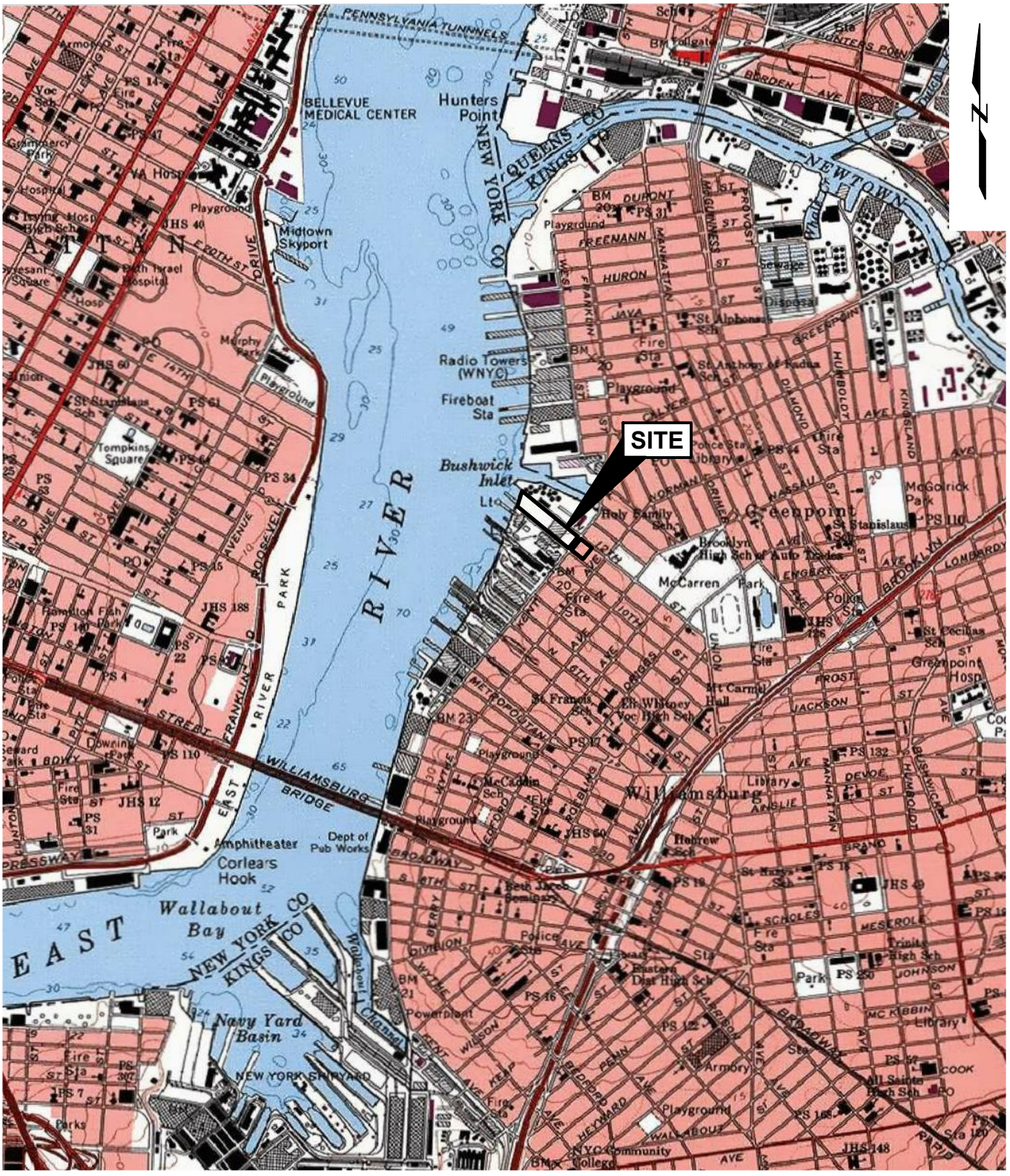
Site Condition	Control Measure
Site Condition 3	Halt work Encapsulate construction area and treat air exhaust Perform work during cold weather Cease construction activities Re-evaluate air monitoring work plan

Notes:

The control measures specified under each site condition can be implemented in any order that is most appropriate under the existing site conditions.

* Control measures suggested in the New York State Department of Environmental Conservation *DER-10/Technical Guidance for Site Investigation and Remediation* (NYSDEC, 2010)

Figures



SOURCE:

Map created with TOPO! ® ©2001 National Geographic (www.nationalgeographic.com/topo)

0 2000' 4000'

SCALE: 1" = 2000'

Community Air Monitoring Plan
Williamsburg Works Site
Borough Of Brooklyn, New York

nationalgrid

GEI Consultants

SITE LOCATION MAP

Project 093060 | July 2021 | Fig. 1

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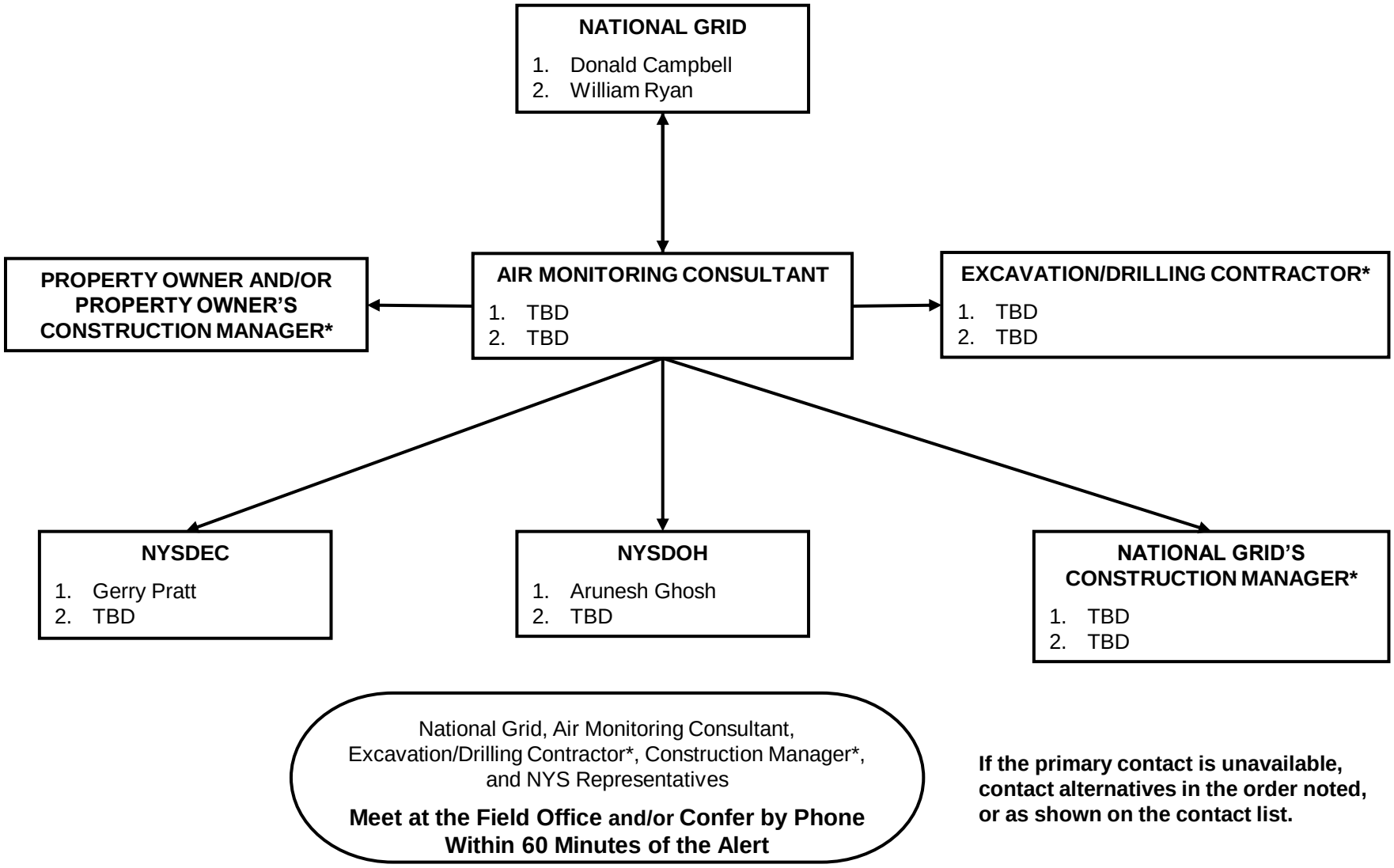

NOTE:

TBD To Be Determined

* May not be applicable to all work completed at the site

Community Air Monitoring Plan
Williamsburg Works Site
Borough Of Brooklyn, New York

nationalgrid

GEI Consultants

COMMUNICATION FLOWCHART

Project 093060 | July 2021 | Fig. 2

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SOURCE:
AERIAL PHOTOGRAPH FROM BING MAPS
ACCESSED VIA ARCGISONLINE.COM ON 1/5/2018.

0 80' 160'
SCALE: 1" = 80'

Community Air Monitoring Plan
Williamsburg Works Site
Borough Of Brooklyn, New York

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TYPICAL AIR MONITORING STATION LOCATION PLAN

Project 093060 | July 2021 | Fig. 3

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1. Solar Panel
2. DustTrak™ sample tubing with in-line condenser
3. DustTrak™ sample inlet with PM-10 impactor
4. Station enclosure
5. DustTrak™ Aerosol Monitor
6. PhotoVac™ 20/20 PID
7. PhotoVac™ 20/20 PID sample inlet
8. PhotoVac™ 20/20 PID sample inlet tubing
9. Data communications device

NOTE:
Figure depicts an AirLogics™, LLC Light air monitoring station as an example and may not be representative of the actual system or components that will be employed at the site

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EXAMPLE FIXED STATION
INTERNAL COMPONENTS

Project 093060 | July 2021 | Fig. 4A

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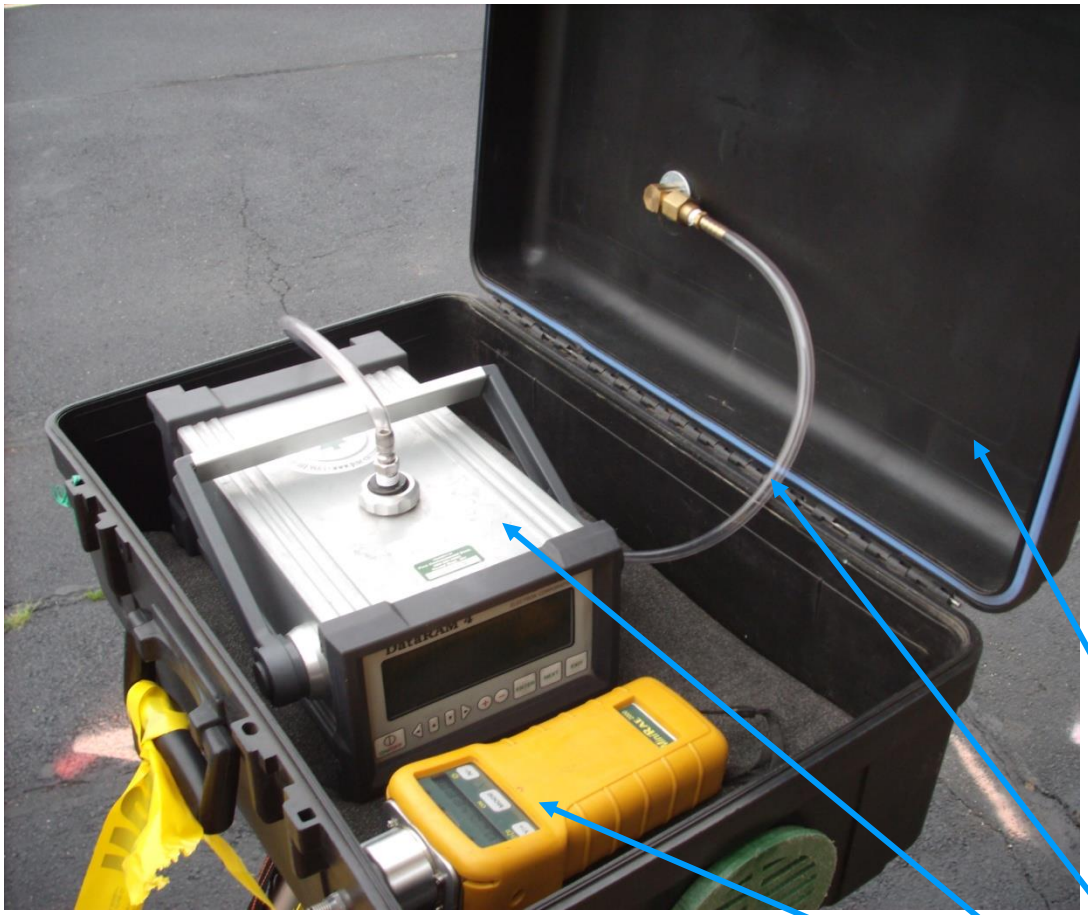

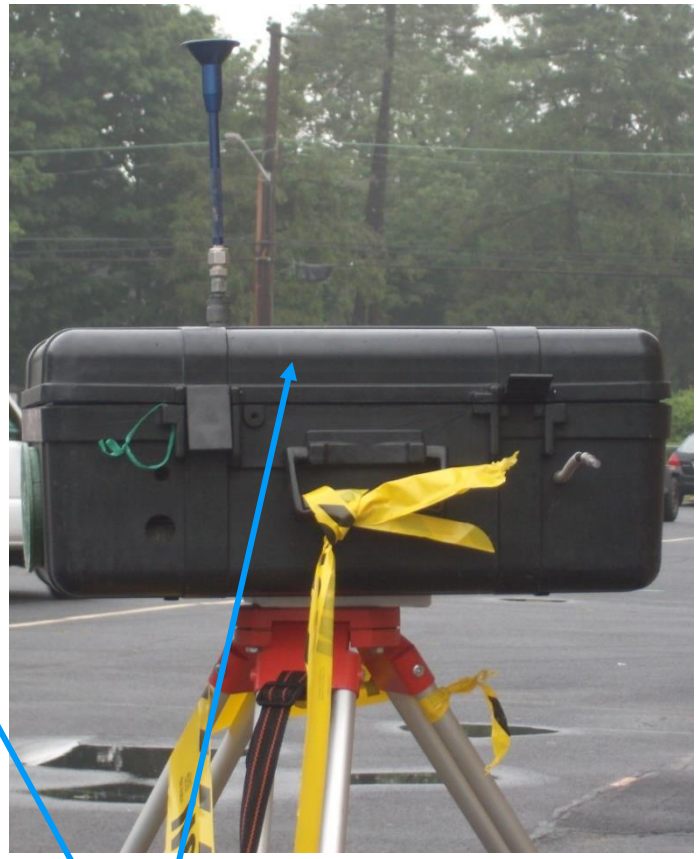

(1) (2) (3) (4)

1. MiniRAE 2000 PID Organic Vapor Anayzer (OVM)
2. DataRAM Particulate Monitor
3. DataRAM sample tubing
4. Station enclosure

NOTE:
Figure depicts a Pine Environmental air monitoring station as an example and may not be representative of the actual system or components that will be employed at the site

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EXAMPLE TRIPOD MOUNTED STATION
INTERNAL COMPONENTS

Project 093060 | July 2021 | Fig. 4B

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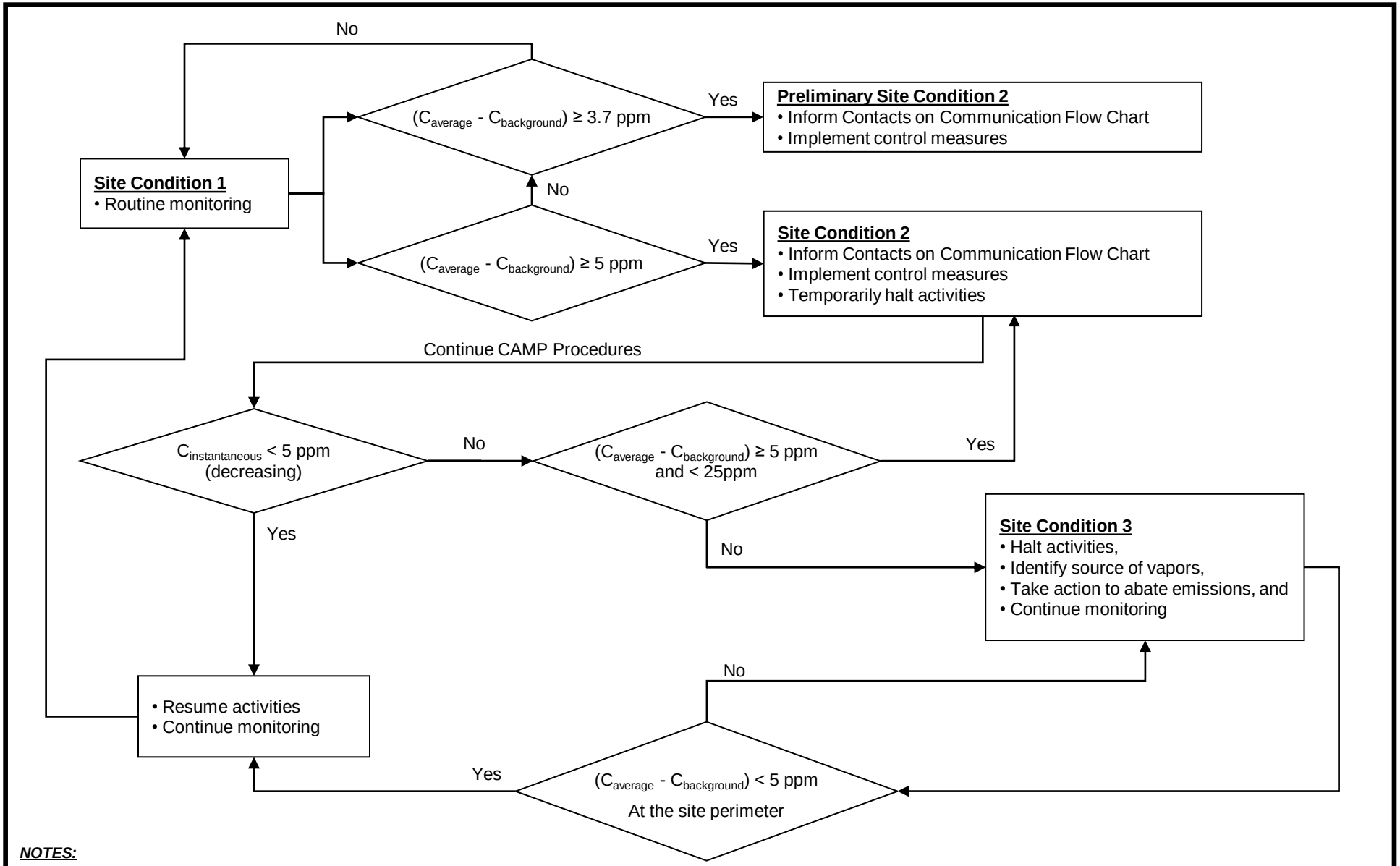

NOTES:

1. TVOC – Total Volatile Organic Compound
2. ppm – parts per million
3. $C_{average}$ = 15-minutes average concentration
4. $C_{background}$ = 15-minutes average concentration upwind
5. $C_{instantaneous}$ = 1-minute measured concentration

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TVOC
DECISION DIAGRAM

Project 093060 | July 2021 | Fig. 5

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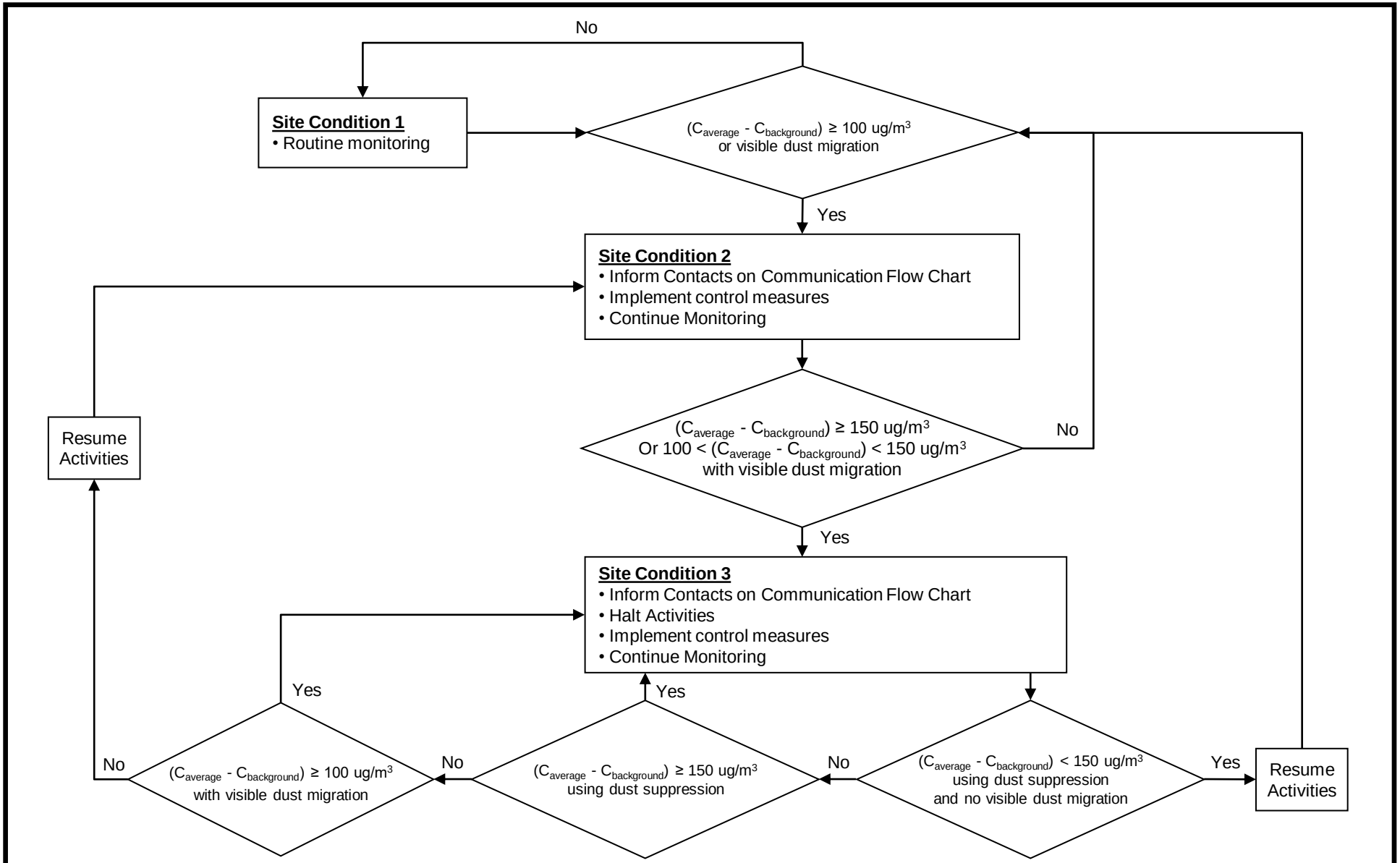

NOTES:

1. µg/m^3 – micrograms per cubic meter
2. $C_{average}$ = 15-minutes average concentration
3. $C_{background}$ = 15-minutes average concentration upwind

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Williamsburg Works Site
Borough Of Brooklyn, New York

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PARTICULATE MATTER
DECISION DIAGRAM

Project 093060 | April 2021 | Fig. 6

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Appendix A

NYSDOH Generic CAMP from DER-10 Appendix 1A

Appendix 1A
New York State Department of Health
Generic Community Air Monitoring Plan

Overview

A Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area when certain activities are in progress at contaminated sites. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air.

The generic CAMP presented below will be sufficient to cover many, if not most, sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical- specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

Community Air Monitoring Plan

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for VOCs and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate DEC/NYSDOH staff.

Continuous monitoring will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. “Periodic” monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or

overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. The monitoring work should be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

1. If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

2. If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

3. If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.

4. All 15-minute readings must be recorded and be available for State (DEC and NYSDOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations should be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment must be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

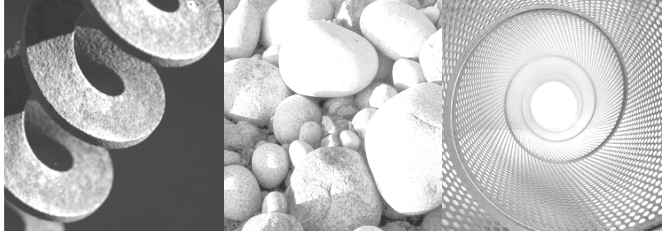
1. If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration.

3. All readings must be recorded and be available for State (DEC and NYSDOH) and County Health personnel to review.

December 2009

APPENDIX H – QUALITY ASSURANCE PROJECT PLAN



GEI Consultants

Consulting
Engineers and
Scientists

Quality Assurance Project Plan

Williamsburg Works Site

Brooklyn, New York
AOC Index No. A2-0552-0606
Site #: TBD

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July 2021
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Appendices

A Laboratory Quality Manual

MF/ah H:\WPROC\Project\NationalGrid\Williamsburg\ISMP\2021 July – Site-Wide\Appendices\Appendix H - QAPP\Appendix H - WilliamsburgQAPP.DOC

Abbreviations and Acronyms

ASP	Analytical Service Protocols
ASTM	American Society for Testing and Materials
CAS	Chemical Abstract Service
CMS	Chip Measurement System
CLP	Contract Laboratory Protocol
COC	Chain Of Custody
DQO	Data Quality Objective
DO	Dissolved Oxygen
DUSR	Data Usability Summary Report
ELAP	Environmental Laboratory Approval Program
EPA	United States Environmental Protection Agency
FSP	Field Sampling Plan
GC/MS	Gas Chromatography/Mass Spectroscopy
GEI	GEI Consultants, Inc., P.C.
LCS	Labortory Control Sample
LEL	Lower Explosive Limit
MDL	Method Detection Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyls
PID	Photoionization Detector
PM	Project Manager
PQL	Practical Quantification Limit
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation Recovery Act
RL	Reporting Limit
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SD	Standard Deviation
SOP	Standard Operating Procedures
SVOC	Semivolatile Organic Compound
TAL	Target Analyte List
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TIC	Tentatively Identified Compounds
TOX	Total Organic Halides
TPH	Total Petroleum Hydrocarbons
USDOT	United States Department of Transportation
VOC	Volatile Organic Compound

Quality Assurance Glossary

"Analytical Services Protocol" or "ASP" means the New York State Department of Environmental Conservation (NYSDEC's) compendium of approved EPA and NYSDEC laboratory methods for sample preparation and analysis and data handling procedures.

"Confirmatory Sample" means a sample taken after remedial action is expected to be complete to verify that the cleanup requirements have been met. This term has the same meaning as "post remediation sample."

"Contract laboratory program" or "CLP" means a program of chemical analytical services developed by the United States Environmental Protection Agency (EPA) to support CERCLA.

"Data Usability Summary Report, (DUSR)" is a document that provides a thorough evaluation of the analytical data to determine whether or not the data, as presented, meets the site/project specific criteria for data quality and use.

"Effective solubility" means the theoretical aqueous solubility of an organic constituent in groundwater that is in chemical equilibrium with a separate phase mixed product (product containing several organic chemicals). The effective solubility of a particular organic chemical can be estimated by multiplying its mole fraction in the product mixture by its pure phase solubility.

"Environmental Laboratory Accreditation Program" or "ELAP" means a program conducted by the New York State Department of Health (NYSDOH), which certifies environmental laboratories through on-site inspections and evaluation of principles of credentials and proficiency testing.

"Intermediate Sample" means a sample taken during the investigation process that will be followed by another sampling event to confirm that remediation was successful or to confirm that the extent of contamination has been defined to below a level of concern.

"Method detection limit" or "MDL" means the minimum concentration of a substance that can be measured and reported with a 99 percent confidence that the analyte concentration is greater than zero and is determined from the analysis of a sample in a given matrix containing the analyte.

"Non-targeted compound" means a compound detected in a sample using a specific analytical method that is not a targeted compound, a surrogate compound, a system monitoring compound or an internal standard compound.

"Practical quantitation level" or "PQL" means the lowest quantitation level of a given analyte that can be reliably achieved among laboratories within the specified limits of precision and accuracy of a given analytical method during routine laboratory operating conditions.

"PAH" means polycyclic aromatic hydrocarbon as defined by United States Environmental Protection Agency (USEPA) Method 8270.

"Quality assurance" or "QA" means the total integrated program for assuring the reliability of monitoring and measurement data, which includes a system for integrating the quality planning, quality assessment and quality improvement efforts to meet data end-use requirements.

"Quality assurance project plan" or "QAPP" means a document, which presents in specific terms the policies, organization, objectives, functional activities, and specific quality assurance/quality control activities designed to achieve the data quality goals or objectives of a specific project or operation.

"Quality control" or "QC" means the routine application of procedures for attaining prescribed standards of performance in the monitoring and measurement process.

"Semi volatile organic compound" or "SVOC" means compounds amenable to analysis by extraction of the sample with an organic solvent. For the purposes of this section, semi volatiles are those target compound list compounds identified in the statement of work in the current version of the EPA Contract Laboratory Program.

"Target analyte list" or "TAL" means the list of inorganic compounds/elements designated for analysis as contained in the version of the EPA Contract Laboratory Program Statement of Work for Inorganics Analysis, Multi-Media, and Multi-Concentration in effect as of the date on which the laboratory is performing the analysis. For the purpose of this chapter, a Target Analyte List scan means the analysis of a sample for Target Analyte List compounds/elements.

"Targeted compound," means a hazardous substance, hazardous waste, or pollutant for which a specific analytical method is designed to detect that potential contaminant both qualitatively and quantitatively.

"Target compound list plus 30" or "TCL+30" means the list of organic compounds designated for analysis (TCL) as contained in the version of the EPA "Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration" in effect as of the date on which the laboratory is performing the analysis, and up to 30 non-targeted organic compounds (plus 30) as detected by gas chromatography/mass spectroscopy (GC/MS) analysis. For the purposes of this chapter, a Target Compound List+30 scan means the analysis of a sample for Target Compound List compounds and up to 10 non-targeted volatile organic compounds and up to 20 non-targeted semi volatile organic compounds using GC/MS analytical methods. Non-targeted compound criteria should be pursuant to the version of the EPA "Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, and Multi-Concentration" in effect as of the date on which the laboratory is performing the analysis.

"Tentatively identified compound" or "TIC" means a non-targeted compound detected in a sample using a GC/MS analytical method, which has been tentatively, identified using a mass spectral library search. An estimated concentration of the TIC is also determined.

"Unknown compound" means a non-targeted compound, which cannot be tentatively identified. Based on the analytical method used, the estimated concentration of the unknown compound may or may not be determined.

"Volatile organics" means organic compounds amenable to analysis by the purge and trap technique. For the purposes of this chapter, analysis of volatile organics means the analysis of a sample for either those priority pollutants listed as amenable for analysis using EPA method 624 or those target compounds identified as volatiles in the version of the EPA "Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration" in effect as of the date on which the laboratory is performing the analysis.

"**Waste oil"** means used and/or reprocessed engine lubricating oil and/or any other used oil, including but not limited to: fuel oil, engine oil, gear oil, cutting oil, transmission fluid, oil storage tank residue, animal oil and vegetable oil, which has not subsequently been refined.

1. Purpose

GEI Consultants, Inc., P.C. (GEI) has prepared this Quality Assurance Project Plan (QAPP) for the Williamsburg Works site located in Brooklyn, New York (the Site). The QAPP is a companion document to the draft *Interim Site Management Plan* (ISMP) and Field Sampling Plan (FSP) dated April 2021. The project location is shown on Figure 1 of the ISMP. The QAPP presents the project scope and goals, organization, objectives, sample handling procedures and specific QA/QC procedures for samples collected under the ISMP.

Furthermore, this QAPP identifies project responsibilities, prescribes guidance and specifications to make certain that:

- Samples are identified and controlled through sample tracking systems and chain-of-custody (COC) protocols
- Field and laboratory analytical results are valid and usable by adherence to established protocols and procedures
- Laboratory data are validated so they can be applied to developing a conceptual understanding of the nature and extent of contamination of soils and ground waters at the Williamsburg Works site
- All aspects of the investigation, from field to laboratory are documented to provide data that are technically sound and legally defensible

The requirements of this QAPP apply to all contractor activities as appropriate for their respective tasks.

This QAPP was prepared based upon guidance provided by the NYSDEC:

- *DER-10, Technical Guidance for Site Investigation and Remediation.* New York State Department of Environmental Conservation. May 2010.

2. Project Goals and Objectives

On behalf of National Grid, GEI prepared an ISMP to manage remaining impacts at the Williamsburg Works site in the Williamsburg neighborhood of Brooklyn, New York (Site) until the Environmental Easement is extinguished in accordance with ECL Article 71, Title 36. This QAPP was prepared to provide quality assurance guidelines for any additional sampling that may be required at the Site. The Site was used to manufacture gas from 1850 until prior to 1941.

3. Project Organization and Responsibility

Qualified Environmental Professional (QEP) is responsible for the implementation of the scope of work, including the supervision of contractors, field activities, and the evaluation and interpretation of data. The Consultant will direct the sampling activities and coordinate submittal of samples to testing laboratories. The project organization and key personnel for the Consultant are listed below:

Program Manager: Jim Ash
Project Manager (PM): Melissa Felter
Field Team Leader: TBD
Quality Assurance Officer: Lorie MacKinnon
Corporate Health & Safety Officer: Steve Hawkins
Data Validator: Lorie MacKinnon
Data Manager: Jaimie Wargo

The primary responsibilities of each of these personnel are described in the following table.

Key Project Personnel and Responsibilities		
Position	**Consultant Personnel**	**Areas of Responsibilities**
Program Manager	Jim Ash	▪ Overall program oversight ▪ Project management ▪ Project schedule ▪ Client contact regarding project related issues ▪ Personnel and resource management ▪ Review of project submittals ▪ Budgeting
Project Manager (PM)	Melissa Felter	▪ Client contact regarding project related issues ▪ Coordination of contractors ▪ Technical development and implementation of Work Plan and Field Sampling Plan ▪ Personnel and resource management ▪ Preparation and review of project submittals ▪ Preparation of project submittals ▪ Budgeting
Field Team Leader	TBD	▪ Client contact regarding project related issues on day to day basis as part of field operations ▪ Coordination of contractors ▪ Implementation of Work Plan and Field Sampling Plan ▪ Personnel and resource management ▪ Preparation of project submittals
Quality Assurance	Lorie MacKinnon	▪ QA/QC for sampling and laboratory

Key Project Personnel and Responsibilities		
Position	**Consultant Personnel**	**Areas of Responsibilities**
Officer		performance
Data Validator	Lorie MacKinnon	▪ Perform data validation activities ▪ Prepare data usability summary reports ▪ Evaluate data with regards to quality objectives
Data Managers	Jaimie Wargo Julie Dicostanzo	▪ Manage raw data from the laboratory

A New York State Department of Health (NYSDOH) Environmental Laboratory approval Program (ELAP) approved laboratory will be utilized to perform standard analytical chemistry parameters for surface soils, subsurface soil, and groundwater samples including:

- Volatile Organic Compounds (VOCs) according to EPA Method 8260B
- Semi volatile Organic Compounds (SVOCs) according to EPA Method 8270C
- Target Analyte List (TAL) Metals according to EPA Method 6000/7000 series
- Polychlorinated Biphenyls (PCBs) by EPA Method 8082
- Pesticides by EPA Method 8081
- Herbicides by EPA Method 8151A
- Total Cyanide by EPA Method 9012 (groundwater only)
- Free Cyanide [Extraction by EPA Method 9013A/ Analysis by Microdiffusion American Society for Testing and Materials (ASTM) Method D4282-95] (soils only)
- Disposal Parameters (total metals, Toxicity Characteristic Leaching Procedure (TCLP) by EPA 1311, Resource Conservation Recovery Act (RCRA) 8 metals by EPA 6000/ 7000 series, TCLP pesticides EPA 8081A, TCLP herbicides by 8151A, TCLP VOC by EPA 8260B, TCLP SVOC by EPA 8270C, paint filter test, ignitability by EPA 1030 (soils)/EPA 1010 (water), corrosivity by EPA 9040 (water)/ 9045 (soils) , reactivity [cyanide by EPA 7.3.3.2 and sulfide by EPA 7.3.4.2] by , total petroleum hydrocarbons (TPH) by EPA 8015B/ 418.1, total PCBs by EPA 8082, flashpoint, total organic halides (TOX) EPA 450.1, and % solids)

The NYSDOH ELAP's relevant certifications are summarized in the following table.

Table 1 provides a summary of surface soil and subsurface soil analyses, Table 2 provides a summary of groundwater analyses, and Table 3 provides a summary of soil vapor and indoor and outdoor air analyses. Table 4 provides a summary of quality assurance samples, holding times and analysis for each media.

Drilling and test pit excavation contractors will be identified once the work plan is approved.

4. Quality Assurance Objectives

This section establishes the QA objectives for measurements that are critical to the project. The QA objectives are developed for relevant data quality indicators. These indicators include the method detection limit, reporting limit, precision, accuracy, completeness, representativeness, and comparability. The data quality objectives (DQOs) are based on project requirements and ensure: (1) that the data generated during the project are of known quality and (2) that the quality is acceptable to achieve the project's technical objectives provided in the Work Plan. All analytical data will be provided by the laboratory using the New York State ASP Category B deliverable format.

Quantitation Limits are laboratory-specific and reflect those values achievable by the laboratory performing the analyses. However, in order to ensure that the analytical methodologies are capable of achieving the DQOs, measurement performance criteria have been set for the analytical measurements in terms of accuracy, precision, and completeness. The analytical methods to be used at this site will provide a level of data quality and can be used to evaluate potential impacts to soil and groundwater from the former Site operations, compared to NYSDEC Part 375 soil cleanup objectives and New York State Ambient Groundwater Standards, Criteria and Guidance values, and for purposes of risk assessment.

The overall QA objective is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting which will provide results that are scientifically valid, and the levels of which are sufficient to meet DQOs. Specific procedures for sampling, chain of custody, laboratory instruments calibration, laboratory analysis, reporting of data, internal quality control, and corrective action are described in other sections of the QAPP.

The data quality indicators are presented in subsections 4.1 through 4.6. Procedures to assess the data quality indicators are given below in Section 13. Laboratory MDLs and PQLs for soils, groundwater, soil vapor and ambient air are located on Tables 5 through 7, respectively. Soil clean-up objectives and groundwater standards and guidance values are located on Tables 8 and 9.

4.1 Required Quantification Limit

The required quantification limit is the quantitative analytical level for individual analytes needed to make decisions relative to the objectives of the project. Quantitative limits may be expressed as the MDL or some quantitative level defined in terms relative to the program. It

should be noted that there is some ambiguity in the definitions and use of terms that define quantification limits. The MDL presented herein is a well-defined and accepted entity, although attainable only under ideal laboratory conditions.

Method Detection Limit: The MDL is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. MDL is determined from analysis of a sample in a given matrix type containing the analyte.

Practical Quantitation Limit: The PQL [also referred to as the reporting limit (RL)] is the concentration in the sample that corresponds to the lowest concentration standard of the calibration curve.

Laboratory MDLs and PQLs for soils, groundwater, soil vapor and ambient air are located on Tables 5 through 7, respectively.

4.2 Accuracy

Accuracy is the closeness of agreement between an observed value and an accepted reference value. The difference between the observed value and the reference value includes components of both systematic error (bias) and random error.

Accuracy in the field is assessed through the adherence to all field instrument calibration procedures, sample handling, preservation, and holding time requirements, and through the collection of equipment blanks prior to the collection of samples for each type of equipment being used (e.g., sample liners, drilling shoe, or stainless–steel sampling implements).

The laboratory will assess the overall accuracy of their instruments and analytical methods (independent of sample or matrix effects) through the measurement of "standards," materials of accepted reference value. Accuracy will vary from analysis to analysis because of individual sample and matrix effects. In an individual analysis, accuracy will be measured in terms of blank results, the percent recovery (%R) of surrogate compounds in organic analyses, or %R of spiked compounds in matrix spikes (MSs), matrix spike duplicates (MSDs) and/or laboratory control samples (LCSs). This gives an indication of expected recovery for analytes tending to behave chemically like the spiked or surrogate compounds. The laboratory accuracy will be evaluated in accordance with laboratory quality assurance plan and standard operating procedures located in Appendix A.

4.3 Precision

Precision is the agreement among a set of replicate measurements without consideration of the "true" or accurate value: i.e., variability between measurements of the same material for the same analyte. In environmental sampling, precision is the result of field sampling and analytical factors. Precision in the laboratory is easier to measure and control than precision in the field. Replicate laboratory analyses of the same sample provide information on analytical precision; replicate field samples provide data on overall measurement precision. The difference between the overall measurement precision and the analytical precision is attributed to sampling precision. Precision is measured in a variety of ways including statistically, such as calculating variance or standard deviation. The difference between the overall measurement precision and the analytical precision is attributed to sampling precision.

Precision in the field is assessed through the collection and measurement of field duplicates. Field duplicates will be collected at a frequency of one per twenty investigative samples per matrix per analytical parameter, with the exception of the waste characterization parameters. Precision will be measured through the calculation of relative percent differences (RPDs) as described below in subsection 13.2. The resulting information will be used to assess sampling and analytical variability. Field duplicate RPDs must be less than 50% for soil samples and less than 30% for aqueous samples. These criteria apply only if the sample and/or duplicate results are >5x the quantitation limit; if both results are <5x the quantitation limit, the criterion will be doubled. Duplicate samples are described in below in subsection 5.1.5. Table 4 summarizes the number of duplicates per media sampled.

Precision in the laboratory is assessed through the calculation of RPD for duplicate samples. For organic analyses, laboratory precision will be assessed through the analysis of MS/MSD samples and field duplicates. For the inorganic analyses, laboratory precision will be assessed through the analysis of matrix duplicate pairs and field duplicate pairs. MS/MSD samples or matrix duplicate pairs will be performed at a frequency of one per twenty primary samples per matrix. Duplicate samples are described in below in subsection 5.1.5. Table 4 summarizes the number of duplicates per media sampled.

4.4 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. "Normal conditions" are defined as the conditions expected if the sampling plan was implemented as planned. The objective for completeness is a sufficient amount of valid data to achieve a predetermined statistical level of confidence. Critical samples must be identified, and plans must be formulated to secure requisite valid data for these samples.

Field completeness is a measure of the amount of (1) valid measurements obtained from all the measurements taken in the project and (2) valid samples collected. The field completeness objective is greater than 90 percent.

Laboratory completeness is a measure of the amount of valid measurements obtained from all valid samples submitted to the laboratory. The laboratory completeness objective is greater than 95 percent.

To ensure that these percentages are met, materials for crucial parameters will be retained if re-sampling is required and strict adherence to holding times will be required.

4.5 Representativeness

Representativeness is a qualitative parameter that expresses the degree to which data accurately and precisely represents either a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition within a defined spatial and/or temporal boundary. To ensure representativeness, the sampling locations have been selected to provide coverage over a wide area and to highlight potential trends in the data.

Representativeness is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the ISMP and FSP are followed and that proper sampling, sample handling, and sample preservation techniques are used.

Representativeness in the laboratory is ensured by using the proper analytical procedures, appropriate methods, and meeting sample-holding times. These are provided in Table 4 and within Appendix A.

4.6 Comparability

Comparability is a qualitative parameter that expresses the confidence with which one data set can be compared to another. Comparability is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the ISMP and FSP are followed and that proper sampling techniques are used. Maximization of comparability with previous data sets is expected because the sampling design and field protocols are consistent with those previously used.

Comparability is dependent on the use of recognized EPA or equivalent analytical methods and the reporting of data in standardized units. To facilitate data comparison, the data-reporting format as presented below will be used:

- Conventions (units reported as): for solids (weight/unit weight [i.e., mg/kg]); for liquids (weight/unit volume [i.e., mg/L]); for air (weight/unit volume [i.e., mg/m3]).
- Use common chemical name with corresponding chemical abstract system (CAS) code.
- Report all data for soils on a dry-weight basis.

5. Sampling Plan

Environmental sampling may include subsurface soil, surface soil, soil vapor, ambient air, groundwater and waste characterization sampling. Subsurface soil borings and monitoring wells will be installed utilizing drilling methods presented in the FSP. Groundwater samples will be collected utilizing low-flow sampling methods, peristaltic pumps, bailers, whale pumps, or bladder pumps. Performing grab or composite sampling by appropriate hand-held sampling equipment will be the preferred method for waste characterization sampling. Analytical samples and analysis methods are described in the ISMP Sampling methods and procedures are described in the FSP.

5.1 Sample Type, Location, and Frequency

Samples required by the ISMP will vary depending on the location and nature of work being performed. Not all sample types described in this section will be required under the ISMP for each event.

5.1.1 Subsurface Borings Soil Sampling

If soil borings are required, locations will be sampled utilizing drilling methods listed in the FSP. Soil borings may be completed as permanent monitoring wells. The actual number of subsurface soil samples and their location may be modified based upon subsurface utilities and property access. The number and location of samples will vary based upon access and subsurface obstructions. Soils will be evaluated through visual, olfactory, and field screening observations in accordance with the FSP. Soil samples will be collected and submitted for laboratory analysis in general accordance with the Work Plan and the FSP. Monitoring wells will be installed in accordance with the Work Plan and FSP. A summary of subsurface soil samples and analysis are located on Table 1.

5.1.2 Test Pit Sampling

If test pits are required, they will be excavated using a backhoe or other excavation equipment. Soils will be evaluated through visual, olfactory, and field screening observations in accordance with the FSP. Soil samples will be collected and submitted for laboratory analysis in general accordance with the ISMP and the FSP. A summary of subsurface soil samples and analysis are located on Table 1.

5.1.3 Surface Soil Sampling

If surface samples are required, locations will be sampled using hand tools. The samples will be collected from 0 to 2 inches below vegetative cover. The actual number of surface soil samples and their location may be modified based upon field conditions. Soils will be evaluated through visual, olfactory, and field screening observations in accordance with the FSP. Soil samples will be collected and submitted for laboratory analysis in general accordance with the ISMP and the FSP. A summary of surface soil samples and analysis are located on Table 1.

5.1.4 Groundwater Sampling

If groundwater samples are required, monitoring wells will be gauged and sampled. Groundwater samples will be collected from monitoring wells screened across the water table or targeted intervals at the proposed sample locations. Groundwater samples will be collected and submitted for laboratory analysis in general accordance with the FSP and ISMP. Water quality parameters including temperature, pH, turbidity, salinity, dissolved oxygen (DO), oxidation reduction potential (ORP), and specific conductance, will be collected prior to laboratory analysis in general accordance with the ISMP and the FSP. A summary of groundwater samples and analysis are located on Table 2.

5.1.5 Soil Vapor Sampling

If soil vapor samples are required, soil vapor points will be installed, and samples will be collected in general accordance with the *New York State Department of Health's "Guidance for Evaluating Soil Vapor Intrusion in the State of New York".* Within buildings, sub-slab soil vapor points will be installed to evaluate the soil vapor conditions. For exterior soil vapor locations, the soil vapor samples will be collected from temporary soil vapor probes, which will be installed, to a depth of approximately five feet below grade. Soil vapor samples will be collected in certified clean SUMMA canisters and submitted for laboratory analysis in general accordance with the FSP and ISMP. A summary of soil vapor samples and analysis are located on Table 3.

5.1.6 Ambient Air Samples

If ambient air samples are required, they will be collected from the approximate breathing height (approximately 3 to 5 feet aboveground). The samples will be collected utilizing an individually certified 6-Liter SUMMA® canister with a laboratory-supplied flow controller that is calibrated to not exceed 0.2 liters per minute. Each SUMMA® canister will be shipped to an approved-NYSDOH ELAP registered laboratory for analysis. The samples will be analyzed for VOCs and naphthalene by the modified EPA Method TO-15.

5.1.7 Investigation-Derived Waste Sample Collection

Waste classification sampling will be conducted for soil and liquid wastes. The purpose of characterizing a waste is for its proper off-site disposal. Composite samples will be collected from the on-site waste storage vessels (drums or roll-off) for parameters required by the approved disposal facility. Soil samples will be collected utilizing stainless steel sampling tools, shovel, or auger that had been decontaminated. Liquid samples will be collected utilizing disposable bailer, peristaltic pump, a pump with tubing, or other similar methods. These samples will be handled in general accordance with sample handling procedures presented in the FSP. Investigation derived waste samples will be analyzed for parameters listed in Section 3 or other analyses that are required by the National Grid-approved facility.

5.1.8 Field QC Sample Collection

Field QC samples are used to monitor the reproducibility and representativeness of field sampling activities. The field QC samples are handled transported and analyzed in the same manner as the associated field samples. Field QC samples will include equipment blanks, trip blanks, field duplicates and MS/MSDs. The quantity, field QC sample type and analysis is detailed on Table 4.

Equipment Blank Samples are used to monitor the adequacy of decontamination procedures and possible sources of contamination such as potential laboratory methodologies. Equipment blanks will consist of laboratory-supplied, distilled or de-ionized water and will be used to check for potential contamination of the equipment, which may cause sample contamination. Equipment blanks will be collected by routing the distilled water through decontaminated piece of sampling equipment or disposable sampling equipment into laboratory supplied bottles. Non-dedicated field equipment will be decontaminated as specified below in subsection 4.3. Equipment blanks will be submitted to the laboratory at a frequency of one per 20 samples per matrix per type of equipment being used per parameter. Equipment blanks will not be completed for waste characterization sampling activities.

Trip Blank Samples will consist of analyte free water and will be prepared by the laboratory. (Trip blanks are used to assess the potential for VOC contamination of samples due to contaminant migration during sample shipment and storage. Trip blanks will be transported to the project location unopened, stored with the site characterization samples, and kept closed until analyzed by the laboratory. Trip blanks will be submitted to the laboratory at a frequency of one per cooler, which contains samples submitted for VOC analysis.

Field Duplicate Samples, also referred to as blind duplicate samples, are two samples that are submitted form the same interval using the same sample procedures. Field duplicates will be used to assess the sampling and analytical reproducibility. Both samples are collected

utilizing the same methods and are submitted for the same laboratory analysis however different sample identification numbers are used. Field duplicates will be submitted at a frequency of one per 20 samples for all matrices and all parameters. Field duplicates will not be completed for waste characterization sampling activities.

MS/MSD Samples are two additional aliquots of the same sample submitted for the same parameters as the original sample. However, the additional aliquots are spiked with the compounds of concern. Matrix spikes provide information about the effect of the sample matrix on the measurement methodology. MS/MSDs will be submitted at a frequency of one per 20 investigative samples per matrix for organic and inorganic parameters. MS/MSDs will not be completed for waste characterization sampling activities.

Refer to Table 4 for a summary of QC sample preservation and container requirements.

5.2 Sample Preservation and Containerization

The analytical laboratory will supply the sample containers for the chemical samples. These containers will be cleaned by the manufacturer to meet or exceed all analyte specifications established in the latest United States EPA's Specifications and Guidance for Contaminant-Free Sample Containers. Certificates of analysis are provided with each bottle lot and maintained on file to document conformance to United States EPA specifications. The containers will be pre-preserved, where appropriate (Table 4).

5.3 Equipment Decontamination

All non-dedicated sampling equipment shall be cleaned between each use in the following manner:

- Wash/scrub with a biodegradable degreaser ("Simple Green") if there is oily residue on equipment surface
- Tap water rinse
- Wash and scrub with Alconox (or non-phosphate soap) and water mixture
- Tap water rinse
- All equipment used to collect samples for VOCs and SVOC analysis will then receive a methanol rinse followed by a de-ionized water rinse.
- All equipment used to collect samples for metals analysis will then receive a 10% nitric acid solution rinse followed by a de-ionized water rinse.
- Equipment will be wrapped in polyethylene plastic or aluminum foil for storage or transportation from the designated decontamination area to the sampling location, where appropriate.

The drilling and excavation equipment will be decontaminated in general accordance with methods described in the FSP.

Groundwater sampling pumps will be cleaned by washing and scrubbing with an Alconox/water solution, rinsing with tap water and irrigating with de-ionized water.

Decontamination fluids will be containerized into United States Department of Transportation (USDOT)/UN-approved 55-gallon drums or containment vessels and will be characterized and disposed of by National Grid at an approved disposal facility.

6. Documentation and COC

6.1 Sample Collection Documentation

6.1.1 Field Notes

Field notes documenting field activities will be maintained in a field notebook in general accordance with subsection 2.2 of the FSP. Field logbooks will provide the means of recording the chronology of data collection activities performed during the investigation. The logbook will be a bound notebook with water-resistant pages. Logbook entries will be dated, legible, and contain accurate and inclusive documentation of the activity. Each page of the logbook will be signed in permanent ink and dated. No erasures or obliterations of field notes will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark, which is signed and dated by the sampler. The correction shall be written adjacent to the error.

Field logbooks will be reviewed at regular intervals by the field team leader, site manager and PM for completeness and representativeness. Logbooks will be supported by daily activity reports as described in subsection 2.3 of the FSP.

6.1.2 COC Records

Sample custody is discussed in detail below in subsection 6.2. COC records are initiated by the samplers in the field. The field portion of the custody documentation should include:

- The project name
- Signature(s) of sampler (s) responsible for sample custody
- Sample ID number
- Date and time of collection
- Whether the sample is grab or composite
- Names of individuals involved in sampling
- Air bill or other shipping number (if applicable)

On a regular basis (daily or on such a basis that all holding times will be met), samples will be transferred to the custody of the respective laboratories, via third-party commercial carriers or via laboratory courier service. Sample packaging and shipping procedures, and field COC procedures are described below in subsection 6.2.1 of this Plan. Sample receipt and log-in procedures at the laboratory are described below in subsection 6.2.2 of this Plan.

6.1.3 Sample Labeling

Each sample will be labeled with a pre-printed adhesive label using indelible ink. The label should include the date and time of collection, sampler's initials, tests to be performed, preservative (if applicable), and a unique identification. The following identification scheme will be used:

PRIMARY SAMPLES TYPES	QA/QC SAMPLE TYPES
SOIL SAMPLES	**FIELD BLANKS**
Surface Soil-ID (SAMPLE DEPTH-FEET)	SAMPLE-ID – [DATE]
WW-SS-01 (0-0.2)	WW-SS-FB-033107
Boring -ID (SAMPLE DEPTH-FEET)	WW-SB-FB-033107
WW -SB-01 (10-15)	WW-MW-FB-033107
GROUNDWATER SAMPLES	**MATRIX SPIKE/DUP**
Monitoring Well-ID	SAMPLE [ID] [DEPTH] [EITHER MS OR MSD]
WW-MW-01	WW-SS-01 (0-0.2) MS/MSD
SOIL VAPOR SAMPLES	WW-SB-01 (10-15) MS/MSD
Soil Vapor Point-ID	WW-MW-01 (10-15) MS/MSD
WW-SV-01	**TRIP BLANKS**
AMBIENT AIR SAMPLES	SAMPLE- ID [DATE]
Outdoor Air	WW-TB-063007
WW-OA-01	**BLIND DUPLICATES**
	SAMPLE -ID[XX][DATE]
	WW-SS-XX-063007
	WW-SB-XX-063007
	WW-MW-XX-063007
	WW-OA-01-063007

This sample label contains the authoritative information for the sample. Inconsistencies with other documents will be settled in favor of the vial or container label unless otherwise corrected in writing from the field personnel collecting samples or the Data Manager and/or the Project QA Officer.

6.1.4 Sample Handling

Samples will be handled in general accordance with Section 12 of the FSP.

6.2 Sample Custody

The COC provides a record of the custody of any environmental field sample from the time of collection to the delivery to the laboratory. Custody is one of several factors that are necessary for the admissibility of environmental data as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility: relevance and authenticity. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final evidence files.

A sample is considered to be under a person's custody if:

- The item is in the actual possession of a person
- The item is in the view of the person after being in actual possession of the person
- The item was in the actual physical possession of the person but is locked up to prevent tampering
- The item is in a designated and identified secure area

6.2.1 Field Custody Procedures

Samples will be collected following the sampling procedures indicated in the Work Plan and the FSP. A summary of samples and collection methods are provided above in Section 5 of this QAPP. Documentation of sample collection is described above in subsection 6.1. Sample COC and packaging procedures are summarized below. These procedures will ensure that the samples will arrive at the laboratory with the COC intact.

- The field sampler is personally responsible for the care and custody of the samples until they are transferred or dispatched properly. Field procedures have been designed such that as few people as possible will handle the samples.
- All bottles will be identified by the use of sample labels with sample numbers, sampling locations, date/time of collection, and type of analysis. The sample numbering system is presented above in subsection 6.1.3.
- Sample labels will be completed for each sample using waterproof ink unless prohibited by weather conditions.
- Samples will be accompanied by a completed COC form. The sample numbers and locations will be listed on the COC form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents the transfer of custody of samples from the sampler to another person, to a mobile laboratory, and to the laboratory facility.
- All shipments will be accompanied by the COC record identifying the contents. The original record will accompany the shipment, and copies will be retained by the sampler and placed in the project files.
- Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed custody record enclosed in and secured to the inside top of each sample box or cooler. Shipping containers will be secured with strapping tape and custody seals for shipment to the laboratory. The custody seals will be attached to the cooler and covered with clear plastic tape after being signed by field personnel.
- If the samples are sent by common carrier, the air bill will be used. Air bills will be retained as part of the permanent documentation. Commercial carriers are not required to sign off on the custody forms since the custody forms will be sealed inside the sample cooler and the custody seals will remain intact.
- Samples remain in the custody of the sampler until transfer of custody is completed. This consists of delivery of samples to the laboratory sample custodian, and signature

of the laboratory sample custodian on COC document as receiving the samples and signature of sampler as relinquishing samples.

6.2.2 Laboratory Custody Procedures

After accepting custody of the shipping containers, the laboratory will document the receipt of the shipping containers by signing the COC record. The laboratory will:

- Examine the shipping containers to verify that the custody tape is intact
- Examine all sample containers for damage
- Determine if the temperature required for the requested testing program has been maintained during shipment and document the temperature on the COC records
- Compare samples received against those listed on the COC
- Verify that sample holding times have not been exceeded
- Examine all shipping records for accuracy and completeness
- Determine sample pH (if applicable) and record on COC forms
- Sign and date the COC immediately (if shipment is accepted) and attach the air bill
- Note any problems associated with the coolers and/or samples on the cooler receipt form and notify the laboratory project manager, who will be responsible for contacting the data manager
- Attach laboratory sample container labels with unique laboratory identification and test
- Place the samples in the proper laboratory storage.

Following receipt, samples will be logged in according to the following procedure:

- The samples will be entered into the laboratory tracking system. At a minimum, the following information will be entered: project name or identification, unique sample numbers (both client and internal laboratory), type of sample, required tests, date and time of laboratory receipt of samples, and field ID provided by field personnel.
- The completed COC, air bills, and any additional documentation will be placed in the final evidence file.

7. Calibration Procedure

7.1 Field Instruments

Field instruments will be calibrated according to the manufacturer's specifications. Air monitoring instruments will be calibrated to a known reference gas standard and ambient air outside the work zone. Calibration will be completed daily. If concentrations of VOCs are encountered above the reference gas standard, the soil screening photoionization detector (PIDs) may be calibrated or re-checked against the reference gas standard. Water quality meters will be calibrated with known reference solutions. All calibration procedures performed will be documented in the field logbook and will include the date/time of calibration, name of person performing the calibration, reference standard used, and the readings. The following equipment has been identified for use to implement sampling required by the ISMP.

Subsurface Soil Sampling Activities:

- RAE Systems MultiRAE Plus equipped with VOC (10.6 eV lamp), lower explosive limit (LEL), percent oxygen, hydrogen sulfide and hydrogen cyanide
- RAE Systems MiniRAE 2000 (PID) with 10.6 eV lamp
- Drager Chip Measurement System (CMS) and compound specific chips (including benzene, hydrogen sulfide, hydrogen cyanide, etc.)
- MIE pDR 1200 with cyclone and pump [particulate monitor]
- MSA LC Pump or SKC 224-PCXR4 [air pump for dust monitoring]
- BIOS Dry Cal DC Lite Primary Flow Meter Model ML [air pump calibration]

Groundwater Sampling Activities

- In-Situ Multi-Parameter Troll 9000
- YSI 6280 XLM water quality meter

Similar field equipment can be substituted that perform the same functions can be substituted if selected equipment is not available from equipment supplier.

7.2 Laboratory Instruments

Calibration procedures for a specific laboratory instrument will consist of initial calibrations, initial calibration verifications, and/or continuing calibration verification. Detailed descriptions of the calibration procedures for a specific laboratory instrument are included in the laboratory's quality assurance plan, which describe the calibration procedures, their

frequency, acceptance criteria, and the conditions that will require recalibration. These procedures are as required in the respective analytical methodologies summarized in Tables 1 through 3 of this QAPP.

8. Sample Preparation and Analytical Procedures

Analytical samples will be collected in general accordance with the FSP and as specified in the ISMP. Tables 1 through 3 provide a sample collection matrix that is separated by media. Analytical samples will be collected into laboratory-preserved sample containers and will be preserved as indicated in Table 4.

9. Data Reduction, Validation, and Reporting

Appropriate QC measures will be used to ensure the generation of reliable data from sampling and analysis activities. Proper collection and organization of accurate information followed by clear and concise reporting of the data is a primary goal in this project. Complete data packages suitable for data validation to support the generation of a DUSR according to NYSDEC requirements will be provided by the analytical laboratory.

9.1 Field Data Evaluation

Measurements and sample collection information will be transcribed directly into the field logbook or onto standardized forms. If errors are made, results will be legibly crossed out, initialed and dated by the person recording the data, and corrected in a space adjacent to the original (erroneous) entry. Reviews of the field records by the field team leader, site manager, and PM will ensure that:

- Logbooks and standardized forms have been filled out completely and that the information recorded accurately reflects the activities that were performed.
- Records are legible and in accordance with good record keeping procedures, i.e., entries are signed and dated, data are not obliterated, changes are initialed, dated, and explained.
- Sample collection, handling, preservation, and storage procedures were conducted in accordance with the protocols described in the FSP and Work Plan, and that any deviations were documented and approved by the appropriate personnel.

9.2 Analytical Data Validation

The consultant will be responsible for performing an independent validation of the analytical data. Project-specific procedures will be used to validate analytical laboratory data. The basis for the validation will be the USEPA CLP National Functional Guidelines for Organic Data Review (February 2005) and the USEPA CLP National Functional Guidelines for Inorganic Data Review (October 2004), modified to accommodate the criteria in the analytical methods used in this program, and Region II Standard Operating Procedures (SOPs) for CLP Organic Data review (Revision 11, June 1996) and Evaluation of Metals for the CLP Program (Revision 11, February 1992). Critical functions for determining the validity of generated data are: (1) strict adherence to the analytical methods, (2) assurance that the instrumentation employed was operated in accordance with defined operating procedures, (3) assurance that quality parameters built into the analytical procedures have been adhered to, and (4) confirmation that the DQOs have been met.

Table 4 highlights the QC criteria and holding time requirements for all analyses conducted under this program. These criteria will be used to evaluate and qualify the data during validation.

The consultant or qualified contracted personnel will validate analytical samples collected under the ISMP. Samples collected for waste classification will not be validated. Validation will include all technical holding times, as well as QC sample results (blanks, surrogate spikes, laboratory duplicates, MS/MSDs, and LCSs), tunes, internal standards, calibrations, target compound identification, and results calculations.

For all analyses, the laboratory will report results, which are below the laboratory's reporting limit; these results will be qualified as estimated (J) by the laboratory. The laboratory may be required to report TICs for the VOC and SVOC analyses; this will be requested by the consultant on an as-needed basis

The overall completeness of the data package will also be evaluated by the data validator. Completeness checks will be administered on all data to determine whether full data deliverables were provided. The reviewer will determine whether all required items are present and request copies of missing deliverables.

Upon completion of the validation, a report will be prepared. This report will summarize the samples reviewed, elements reviewed, any nonconformance with the established criteria, and validation actions. Data qualifiers will be consistent with EPA National Functional Guidelines. This report will be in a format consistent with NYSDEC's DUSR.

9.3 Analytical Data Validation

Laboratory deliverables will consist of an original hard copy data package that is in general accordance with NYSDEC ASP Category B data deliverable requirements.

10. Internal Quality Control

Laboratory and field quality internal control checks will be used to ensure the data quality objectives. At a minimum, this will include:

- Matrix spike and/or matrix spike duplicate samples
- Matrix duplicate analyses
- Laboratory control spike samples
- Instrument calibrations
- Instrument tunes for VOC 8260B and SVOC 8270C analyses
- Method and/or instrument blanks
- Surrogate spikes for organic analyses
- Internal standard spikes for VOC 8260B and SVOC 8270C analyses
- Detection limit determination and confirmation by analysis of low-level calibration standard

The laboratory quality plan for the selected ELAP is located in Appendix A.

Field quality control samples will include:

- Equipment blanks as outlined in Table 4
- Field duplicate samples as outlined in Table 4
- Trip blanks as outlined in Table 4
- MS/MSDs as outlined in Table 4

11. Performance and System Audits

Audits are an independent means of: 1) evaluating the operation or capability of a measurement system, and 2) documenting the use of QC procedures designed to generate data of know and acceptable quality.

Field audits may be completed to assess sample collection protocols, determine the integrity of COC procedures, and evaluate sample documentation and data handling procedures. Field audits may be scheduled by the QA officer, PM, site manager or in-house consultant, at their discretion. Written records of audits and any recommendations for corrective action will be submitted to the PM.

The QA officer is the interface between management and project activities in matters of project quality. The QA officer will review the implementation of the QAPP. Reviews will be conducted at the completion of field activities and will include the results of any audits and an evaluation of the data quality.

12. Preventative Maintenance

Preventative maintenance will be performed on field equipment in accordance with the manufacturer's recommendations. Preventative maintenance to field will be provided by the equipment vendor. The following equipment has been identified for use to implement the ISMP.

Subsurface Soil Sampling Activities:

- RAE Systems MultiRAE Plus equipped with VOC (10.6 eV lamp), LEL, percent oxygen, hydrogen sulfide and hydrogen cyanide
- RAE Systems MiniRAE 2000 PID with 10.6 eV lamp.
- RAE Systems VRAE Surveying Monitor with LEL, hydrogen cyanide, hydrogen sulfide, carbon monoxide, and percent oxygen.
- Drager CMS and compound specific chips.
- MIE pDR 1200 with cyclone and pump
- MSA LC Pump
- BIOS DCL-5k pump calibrator

Groundwater Sampling Activities

- In-Situ Troll 9000
- YSI 600 XLM

Similar equipment will be substituted that perform the same functions can be substituted if selected equipment is not available from equipment supplier.

Laboratory equipment calibration and maintenance procedures are specified in the ELAP laboratory quality manual located in Appendix A.

13. Specific Procedures to Assess Data Quality Indicators

QC analyses conducted as a part of the testing program will provide a quantitative quality assessment of the data generated and their adherence to the data quality indicators. The data quality indicators ensure that the quality assurance objectives for the project are met.

13.1 Detection Limits

13.1.1 Method Detection Limit

The MDL is defined as follows for all measurements:

$$MDL = (t[n-1,1-a=0.99]) \times (s)$$

where: s = standard deviation of the replicate analysis,
t(n-1, 1-a=0.99) = student's t-value for a one-sided, 99 percent confidence level and a standard deviation estimate with n-1 degrees of freedom

The MDLs calculated by the laboratory are determined under ideal conditions. MDLs for environmental samples are dependent on the sample aliquot, the matrix, the concentration of analyte, and interference present in the matrix, the percent of moisture, dilution factor, etc. The MDL for each sample analysis will be adjusted accordingly.

13.1.2 *Reporting Limit*

The RL is the concentration of an analyte in the sample that corresponds to the lowest concentration standard of the calibration curve. As with the MDLs, the RLs are dependent on the sample aliquot, the final sample volume, the percent of moisture, dilution factor, etc.

The RL is determined as follows:

$$RL = \frac{Lowest\ conc.\ std\ (ng)}{Volume\ injected\ (uL)}\ x\ \frac{Sample\ aliquot\ (mL\ or\ g)}{Final\ volume\ (mL)}\ x\ DF\ x\ \frac{100}{(100 - \%M)}$$

where: DF = dilution factor, including all dilutions or lost samples not accounted for in a sample aliquot/final volume ratio
%M = percent moisture for solid samples.

13.2 Precision

Variability will be expressed in terms of the RPD when only two data points exist. The RPD is calculated as:

$$RPD = \frac{(Larger\ Value - Smaller\ Value)}{[(Larger\ Value + Smaller\ Value)/2]}\ x\ 100\%$$

For data sets greater than two points, the percent relative standard deviation (percent RSD) is used as the precision measurement. It is defined by the equation:

$$Percent\ RSD = \frac{Standard\ Deviation}{Mean}\ x\ 100\%$$

Standard deviation (SD) is calculated as follows:

$$SD = \sqrt{\sum_{i=1}^{n} \frac{(y_i - y)^2}{n - 1}}$$

where: SD = standard deviation
yi = measured value of the ith replicate
y = mean of replicate measurements
n = number of replicates

For measurements such as pH, where the absolute variation is more appropriate, precision is usually reported as the absolute range (D) of duplicate measurements:

D = | first measurement - second measurement |

or as the absolute standard deviation previously given. RPD, %RSD, and D are independent of the error of the analyses and reflect only the degree to which the measurements agree with each other, not the degree to which they agree with the true value for the parameter measured.

13.3 Accuracy

Accuracy is related to the bias in a measurement system. Accuracy describes the degree of agreement of a measurement with a true value. Accuracy will be expressed as percent recovery for each matrix spike analyte by using the following equation:

$$\%\ Recovery = \frac{Css - Cus}{Csa}\ X\ 100\%$$

where: Css = measured concentration in spiked sample
Cus = measured concentration in unspiked sample
Csa = known concentration added to the sample

Accuracy for a measurement such as pH is expressed as bias in the analysis of a standard reference sample according to the equation:

$$Bias = pH_m - pH_t$$

where: pH_m = measured pH
pH_t = the true pH of the standard reference sample

13.4 Completeness

Data completeness is a measure of the amount of usable data resulting from a measurement effort. For this program, completeness will be defined as the percentage of valid data obtained compared to the total number of measurements necessary to achieve our required statistical level of confidence for each test. The confidence level is based on the total number of samples proposed in the Work Plan.

Data completeness is calculated as:

$$Completeness = \frac{Number\ of\ valid\ data\ points}{Number\ of\ data\ points\ necessary\ for\ confidence\ level}\ x\ 100\%$$

The completeness goal is to generate a sufficient amount of valid data. It is anticipated that 95 percent of the data will be complete. Data validation criteria discussed in the work plan and Section 10 of this QAPP will be used to determine data completeness. Any data deficiencies and their effect on project goals will be evaluated in the DUSR.

13.5 Representativeness

Representativeness is a qualitative statement that expresses the extent to which the sample accurately and precisely represents the characteristics of interest of the study. Representativeness is primarily concerned with the proper design of the sampling program and is best ensured by proper selection of sampling locations and the taking of a sufficient number of samples. It is addressed by describing the sampling techniques, the matrices sampled, and the rationale for the selection of sampling locations, which are discussed in the field sampling plan and Work Plan

13.6 Comparability

Comparability is a qualitative parameter expressing the confidence that one set of data can be compared to another. Comparability is possible only when standardized sampling and analytical procedures are used.

14. Corrective Action

If unacceptable conditions are identified as a result of audits or are observed during field sampling and analysis, the PM, Field Team Leader, and QA officer will document the condition and initiate corrective procedures. The specific condition or problem will be identified, its cause will be determined, and appropriate action will be implemented.

The entire sampling program will be under the direction of the PM and QA officer. The emphasis in this program is on preventing problems by identifying potential errors, discrepancies, and gaps in the data collection, laboratory analysis, and interpretation process. Any problems identified will be promptly resolved. Likewise, follow-up corrective action is always an option in the event that preventative corrective actions are not effective.

The acceptance limits for the sampling and analyses to be conducted in this program will be those stated in the method or defined by other means in the ISMP and FSP. Corrective actions are likely to be immediate in nature and most often will be implemented by the contracted laboratory analyst or the PM. The corrective action will usually involve recalculation, reanalysis, or repeating a sample run.

14.1 Immediate Corrective Action

Corrective action in the field may be needed when the sample requirements are changed (i.e., more/less samples, sampling locations), or when sampling procedures and/or field analytical procedures require modification, etc. due to unexpected conditions. The field team may identify the need for corrective action. The Field Team Leader, Site Manager, and PM will approve the corrective action and notify the QA officer. The PM and QA officer will approve the corrective measure. The Field Team Leader and Site Manager will ensure that the corrective measure is implemented by the field team.

Corrective actions will be implemented and documented in the field record book. Documentation will include:

- A description of the circumstances that initiated the corrective action
- The action taken in response
- The final resolution
- Any necessary approvals

No staff member will initiate corrective action without prior communication of findings through the proper channels.

Corrective action in the laboratory will be completed in accordance with the quality assurance procedures located in the Appendix A. Any corrective actions completed by the laboratory will be documented in both the laboratory's corrective action files, and the narrative data report sent from the laboratory to the PM. If the corrective action does not rectify the situation, the laboratory will contact the PM, who will determine the action to be taken and inform the appropriate personnel.

If potential problems are not solved as an immediate corrective action, the contractor will apply formalized long-term corrective action if necessary.

Tables

Table 1. Soil Field Sampling Matrix
Quality Assurance Project Plan
Williamsburg Works Site
Brooklyn, New York

SAMPLE SELECTION PROTOCOL:
1. Shallow soils within observed impacts (0 to 5' bgs);
2. Subsurface soils within heaviest observed impacts below 5 feet (if present);
3. Subsurface soils below deepest observed visual impacts.

IF NO IMPACTS ARE OBSERVED:
1. Shallow soils (0 to 5' bgs);
2. Water table interface;
3. Completion depth of boring.

Sample I.D.	Sample Location	Sample Number			Sample Zone Depths					Analysis (Method[1])								
		Number Samples Proposed	Number Samples Collected	Date Collected	0 to 5' bgs	Heaviest Impacted Zone below 5 feet (if Present)	Water Table Interface	Subsurface soils below deepest observed visual impacts	Completion depth of boring	VOCs (8260B)	SVOCs (8270C)	TAL Metals (6000/7000)	Free Cyanide (EPA 9013A/ Micro-diffusion ASTM D4282-02)	Herbicides (8151A)	PCBs (8082)	Pesticides (8081A)	Alkylated PAHs (8270 SIM)	TPH (3550)
Surface Soils																		
Subsurface Soils																		

Notes:
VOCs - volatile organic compounds
SVOCs - semivolatile organic compounds
TAL - target analyte list
PCBs - polychlorinated biphenyls
PAH - polycyclic aromatic hydrocarbons
TPH - total petroleum hydrocarbons
ASTM - American Society for Testing and Materials
1. Chemical analysis test methods specified are from U.S. EPA SW-846 test methods.

Table 2. Groundwater Field Sampling Matrix
Quality Assurance Project Plan
Williamsburg Works Site
Brooklyn, New York

Sample I.D.	Sample Location	SAMPLE SELECTION PROTOCOL: Collect one groundwater sample at the water table or installed monitoring well depth.				Water Quality Measurements						Analysis (Method[1])						
		Sample Number			Sample Zone													
		Number Samples Proposed	Number Samples Collected	Date Collected	Water Table	pH	Specific Conductance	Temperature	Oxidation Reduction Potential (ORP)	Turbidity	Dissolved Oxygen	VOCs (8260B)	SVOCs (8270C)	TAL Metals (6000/7000)	Total Cyanide (9012)	Herbicides (8151A)	PCBs (8082)	Pesticides (8081A)

Notes:
VOCs - volatile organic compounds
SVOCs - semivolatile organic compounds
TAL - target analyte list
PCBs - polychlorinated biphenyls
1. Chemical analysis test methods specified are from U.S. EPA SW-846 test methods.

Table 3. Soil Vapor and Ambient Air Field Sampling Matrix
Quality Assurance Project Plan
Williamsburg Works Site
Brooklyn, New York

Sample I.D.	Sample Location	**SAMPLE SELECTION PROTOCOL:** **1. Collect one soil vapor sample at the installed soil vapor point depth.** **2. Collect indoor air and outdoor air samples from the height of the breathing zone, approximately 3-5 feet above the ground surface.**			Analysis (Method)
		Sample Number			VOCs (expanded) (modified TO-15)
		Number Samples Proposed	Number Samples Collected	Date Collected	

Notes:
VOCs - volatile organic compounds

Table 4. Analytical Methods/Quality Assurance Summary
Quality Assurance Project Plan
Williamsburg Works Site
Brooklyn, New York

Media	Number of Primary Samples	QA/QC Samples				Total Number of Samples	Analytical Parameters	Method	Preservative	Holding Time	Container
		TB	FB[2]	DUP	MS/MSD						
Surface Soil							VOCs	8260B	Cool to 4°C	14 days to analysis	Wide mouth 2-oz. VOA, clear glass jar
							SVOCs	8270C	Cool to 4°C	14 days to extraction; 40 days from extraction to analysis	Wide mouth 8-oz. and 4oz. clear glass jars[1]
							TAL Metals	6000/7000	Cool to 4°C	28 days to analysis for mercury; 6 months to analysis for other metals	Wide mouth 8-oz. and 4oz. clear glass jars[1]
							Free Cyanide	9013A/ ASTM Method D4282-02	Cool to 4° C	14 days	Wide-mouth amber 8-oz.
							Herbicides	8151A	Cool to 4°C	14 days to extraction; 40 days from extraction to analysis	Wide mouth 8-oz. and 4oz. clear glass jars[1]
							PCBs	8082	Cool to 4°C	7 days to extraction; 40 days from extraction to analysis	Wide mouth 8-oz. and 4oz. clear glass jars[1]
							Pesticides	8081A	Cool to 4°C	7 days to extraction; 40 days from extraction to analysis	Wide mouth 8-oz. and 4oz. clear glass jars[1]
Subsurface Soil							VOCs	8260B	Cool to 4°C	14 days to analysis	Wide mouth 2-oz. VOA, clear glass jar
							SVOCs	8270C	Cool to 4°C	14 days to extraction; 40 days from extraction to analysis	Wide mouth 8-oz. and 4oz. clear glass jars[1]
							TAL Metals	6000/7000	Cool to 4°C	28 days to analysis for mercury; 6 months to analysis for other metals	Wide mouth 8-oz. and 4oz. clear glass jars1
							Free Cyanide	9013A/ ASTM Method D4282-02	Cool to 4° C	14 days	Wide-mouth amber 8-oz.
							Herbicides	8151A	Cool to 4°C	14 days to extraction; 40 days from extraction to analysis	Wide mouth 8-oz. and 4oz. clear glass jars[1]
							PCBs	8082	Cool to 4°C	7 days to extraction; 40 days from extraction to analysis	Wide mouth 8-oz. and 4oz. clear glass jars[1]
							Pesticides	8081A	Cool to 4°C	7 days to extraction; 40 days from extraction to analysis	Wide mouth 8-oz. and 4oz. clear glass jars[1]
							Alkylated PAHs	8270 SIM	Cool to 4°C	14 days to extraction; 40 days from extraction to analysis	Wide mouth 8-oz. and 4oz. clear glass jars[1]
							TPH	3550	Cool to 4°C	14 days to extraction; 40 days from extraction to analysis	Wide mouth 8-oz. and 4oz. clear glass jars[1]

Table 4. Analytical Methods/Quality Assurance Summary
Quality Assurance Project Plan
Williamsburg Works Site
Brooklyn, New York

Media	Number of Primary Samples	QA/QC Samples				Total Number of Samples	Analytical Parameters	Method	Preservative	Holding Time	Container
		TB	FB[2]	DUP	MS/MSD						
Soil Vapor							VOCs (including naphthalene)	TO-15	None	14 Days to analysis	2.7-Liter Summa Canister
Indoor Air							VOCs (including naphthalene)	TO-15	None	14 Days to analysis	6-Liter Summa Canister
Outdoor Air							VOCs (including naphthalene)	TO-15	None	14 Days to analysis	6-Liter Summa Canister

Table 4. Analytical Methods/Quality Assurance Summary
Quality Assurance Project Plan
Williamsburg Works Site
Brooklyn, New York

Media	Number of Primary Samples	QA/QC Samples				Total Number of Samples	Analytical Parameters	Method	Preservative	Holding Time	Container
		TB	FB[2]	DUP	MS/MSD						
Groundwater							VOCs	8260B	pH<2 with HCl, Cool to 4°C	14 days to analysis	(2) 40 mL VOA vials
							SVOCs	8270C	Cool to 4°C	7 days to extraction; 40 days from extraction to analysis	(2) 1 L amber glass jar
							TAL Metals	6000/7000	pH<2 with HNO_3; Cool to 4°C	28 days to analysis for mercury; 6 months to analysis for other metals	(1) 500 mL polyethylene container
							Total Cyanide	9012	NaOH to pH>12/Cool to 4°C	14 days to analysis	(1) 500 mL polyethylene container
							Herbicides	8151A	Cool to 4°C	7 days to extraction; 40 days from extraction to analysis	(1)-1 L amber glass jar
							PCBs	8082	Cool to 4°C	7 days to extraction; 40 days from extraction to analysis	(1)-1 L amber glass jar
							Pesticides	8081A	Cool to 4°C	7 days to extraction; 40 days from extraction to analysis	1)-1 L amber glass jar

[1]: SVOC, TAL metals, herbicides, pesticides and PCBs will be collected from the (1)- 8 oz jar and the (1)- 4 oz jar
[2]: Soil field blanks will include bottles listed in groundwater section of the table.
VOCs - volatile organic compounds
SVOCs - semivolatile organic compounds
TAL - target analyte list
PCBs - polychlorinated biphenyls
PAH - polycyclic aromatic hydrocarbons
TPH - total petroleum hydrocarbons
ASTM - American Society for Testing and Materials
°C- Degrees Celsius
L - Liter
oz. - ounce
mL - Milliliter
HNO3 - Nitric acid
HCl - Hydrochloric Acid
NAOH-Sodium Hydroxide

Table 5. Quantification Limits for Soils
Quality Assurance Project Plan
Williamsburg Works Site
Brooklyn, New York

	Reporting Detection Limit	Method Detection Limit	Units
Metals by EPA Method 6000/7000 series			
Aluminum	258	20	mg/Kg
Antimony	11.7	1.14	mg/Kg
Arsenic	8	1.22	mg/Kg
Barium	2	0.18	mg/Kg
Beryllium	2	0.5	mg/Kg
Cadmium	3	1	mg/Kg
Calcium	85	11.6	mg/Kg
Chromium	3	0.34	mg/Kg
Cobalt	2	0.42	mg/Kg
Copper	5	0.8	mg/Kg
Iron	145	10.2	mg/Kg
Lead	9	0.76	mg/Kg
Magnesium	35	9.2	mg/Kg
Manganese	2.5	0.64	mg/Kg
Mercury	0.05	0.02	mg/Kg
Nickel	6.25	0.44	mg/Kg
Potassium	200	40	mg/Kg
Selenium	16	1.6	mg/Kg
Silver	3	0.32	mg/Kg
Sodium	94	20	mg/Kg
Thallium	20	4.17	mg/Kg
Vanadium	4	0.36	mg/Kg
Zinc	20	3.8	mg/Kg
Semivolatile Organic Compounds (SVOCs) by EPA Method 8270C			
1,2,4-Trichlorobenzene	333	55.96	ug/Kg
1,2-Dichlorobenzene	333	56.43	ug/Kg
1,2-Diphenylhydrazine	333	32.86	ug/Kg
1,3-Dichlorobenzene	333	50.49	ug/Kg
1,4-Dichlorobenzene	333	52.75	ug/Kg
2,2-oxybis (1-chloropropane)	333	47.18	ug/Kg
2,4,5-Trichlorophenol	1667	120.96	ug/Kg
2,4,6-Trichlorophenol	333	85.18	ug/Kg
2,4-Dichlorophenol	333	108.95	ug/Kg
2,4-Dimethylphenol	333	172.3	ug/Kg
2,4-Dinitrophenol	1667	114.87	ug/Kg
2,4-Dinitrotoluene	333	60.09	ug/Kg
2,6-Dinitrotoluene	333	60.57	ug/Kg
2-Chloronaphthalene	333	48.46	ug/Kg
2-Chlorophenol	333	86.27	ug/Kg
2-Methylnaphthalene	333	52.92	ug/Kg
2-Methylphenol	333	89.03	ug/Kg
2-Nitroaniline	1667	42.32	ug/Kg
2-Nitrophenol	333	115.71	ug/Kg
3,3-Dichlorobenzidine	667	88.96	ug/Kg
3-Nitroaniline	1667	68.54	ug/Kg
4,6-Dinitro-2-methylphenol	1667	239.28	ug/Kg
4-Bromophenyl phenyl ether	333	51.16	ug/Kg
4-Chloro-3-methylphenol	333	112.76	ug/Kg

Table 5. Quantification Limits for Soils
Quality Assurance Project Plan
Williamsburg Works Site
Brooklyn, New York

	Reporting Detection Limit	Method Detection Limit	Units
Semivolatile Organic Compounds (SVOCs) by EPA Method 8270C (Continued)			
4-Chloroaniline	333	107.34	ug/Kg
4-Chlorophenyl phenyl ether	333	45.74	ug/Kg
4-Methylphenol	333	179.39	ug/Kg
4-Nitroaniline	667	48.17	ug/Kg
4-Nitrophenol	1667	141.69	ug/Kg
Acenaphthene	333	55.32	ug/Kg
Acenaphthylene	333	40.59	ug/Kg
Aniline	333	73.83	ug/Kg
Anthracene	333	54.55	ug/Kg
Benzidine	3333	1134.9	ug/Kg
Benzo(a)anthracene	333	45.31	ug/Kg
Benzo(a)pyrene	333	41.16	ug/Kg
Benzo(b)fluoranthene	333	93.11	ug/Kg
Benzo(ghi)perylene	333	36.99	ug/Kg
Benzo(k)fluoranthene	333	37.12	ug/Kg
Benzoic acid	1667	90.33	ug/Kg
Benzyl alcohol	333	62.93	ug/Kg
Bis(2-chloroethoxy)methane	333	57.03	ug/Kg
Bis(2-chloroethyl)ether	333	44.86	ug/Kg
Bis(2-ethylhexyl)phthalate	333	44.37	ug/Kg
Butyl benzyl phthalate	333	43.04	ug/Kg
Carbazole	333	48.63	ug/Kg
Chrysene	333	41.6	ug/Kg
Dibenzo(a,h)anthracene	333	36.71	ug/Kg
Dibenzofuran	333	52.67	ug/Kg
Diethyl phthalate	333	48.88	ug/Kg
Dimethyl phthalate	333	51.27	ug/Kg
Di-n-butyl phthalate	333	43.98	ug/Kg
Di-n-octyl phthalate	333	34.97	ug/Kg
Fluoranthene	333	41.87	ug/Kg
Fluorene	333	43.39	ug/Kg
Hexachlorobenzene	333	48.52	ug/Kg
Hexachlorobutadiene	333	67.85	ug/Kg
Hexachlorocyclopentadiene	333	247.96	ug/Kg
Hexachloroethane	333	59.22	ug/Kg
Indeno(1,2,3-cd)pyrene	333	33.74	ug/Kg
Isophorone	333	60.02	ug/Kg
Naphthalene	333	56.66	ug/Kg
Nitrobenzene	333	40.4	ug/Kg
n-Nitrosodimethylamine	333	48.87	ug/Kg
n-Nitroso-di-n-propylamine	333	44.63	ug/Kg
n-Nitrosodiphenylamine	333	49.76	ug/Kg
Pentachlorophenol	1667	287.85	ug/Kg
Phenanthrene	333	38.58	ug/Kg
Phenol	333	96.98	ug/Kg
Pyrene	333	45.56	ug/Kg
Pyridine	667	39.9	ug/Kg

Table 5. Quantification Limits for Soils
Quality Assurance Project Plan
Williamsburg Works Site
Brooklyn, New York

	Reporting Detection Limit	Method Detection Limit	Units
Volatile Organic Compounds (VOCs) by EPA Method 8260B			
1,1,1-Trichloroethane	5	0.84	ug/Kg
1,1,2,2-Tetrachloroethane	5	1.21	ug/Kg
1,1,2-Trichloroethane	5	1.04	ug/Kg
1,1-Dichloroethane	5	0.81	ug/Kg
1,1-Dichloroethene	5	1.09	ug/Kg
1,2,3-Trichloropropane	5	1.62	ug/Kg
1,2,4-Trichlorobenzene	5	0.61	ug/Kg
1,2-Dichloroethane	5	0.99	ug/Kg
1,2-Dichloropropane	5	1.06	ug/Kg
2-Butanone (MEK)	10	1.78	ug/Kg
2-Chloroethylvinylether	5	1.37	ug/Kg
2-Hexanone	10	2.53	ug/Kg
4-Methyl-2-pentanone (MIBK)	5	1.18	ug/Kg
Acetone	20	3.15	ug/Kg
Acrolein	20	3.1	ug/Kg
Acrylonitrile	5	1.19	ug/Kg
Benzene	5	0.86	ug/Kg
Bromodichloromethane	5	0.84	ug/Kg
Bromoform	5	0.99	ug/Kg
Bromomethane	5	0.82	ug/Kg
Carbon disulfide	5	0.61	ug/Kg
Carbon tetrachloride	5	0.78	ug/Kg
Chlorobenzene	5	0.79	ug/Kg
Chloroethane	5	1.89	ug/Kg
Chloroform	5	0.53	ug/Kg
Chloromethane	5	0.9	ug/Kg
cis-1,2-Dichloroethene	5	1.04	ug/Kg
cis-1,3-Dichloropropene	5	0.78	ug/Kg
Dibromochloromethane	5	0.41	ug/Kg
Dichlorodifluoromethane	5	1.25	ug/Kg
Ethylbenzene	5	0.79	ug/Kg
Isopropyl ether	5	0.44	ug/Kg
Methylene chloride	20	2.21	ug/Kg
Methyl-tert-butyl-ether (MTBE)	5	0.93	ug/Kg
Styrene	5	1.06	ug/Kg
tert-Butyl alcohol	20	4.69	ug/Kg
Tetrachloroethene	5	0.7	ug/Kg
Toluene	5	0.84	ug/Kg
trans-1,2-Dichloroethene	5	0.58	ug/Kg
trans-1,3-Dichloropropene	5	0.92	ug/Kg
Trichloroethene	5	0.68	ug/Kg
Trichlorofluoromethane	5	0.6	ug/Kg
Trichlorotrifluoroethane	5	0.63	ug/Kg
Vinyl acetate	10	2.7	ug/Kg
Vinyl chloride	5	0.87	ug/Kg
Xylenes (total)	5	1.96	ug/Kg

Table 5. Quantification Limits for Soils
Quality Assurance Project Plan
Williamsburg Works Site
Brooklyn, New York

	Reporting Detection Limit	Method Detection Limit	Units
Free Cyanide by EPA Method 9013/ ASTM D4282-02			
Cyanide	TBD	TBD	ug/Kg

Notes:
mg/kg - milligrams per kilogram
ug/Kg - micrograms per kilogram
TBD - To Be Determined
EPA - Environmental Protection Agency
ASTM - American Standard for Testing and Materials

Table 6. Quantification Limits for Groundwater
Quality Assurance Project Plan
Williamsburg Works Site
Brooklyn, New York

	Reporting Detection Limit	Method Detection Limit	Units
Cyanide by EPA Method 9012			
Cyanide, Total	10	1	ug/L
Metals by EPA Method 6000/7000 series			
Aluminum	500	92	ug/L
Antimony	20	5.4	ug/L
Arsenic	40	3.9	ug/L
Barium	5	0.74	ug/L
Beryllium	5	0.54	ug/L
Cadmium	10	1.1	ug/L
Calcium	300	56	ug/L
Chromium	10	1.3	ug/L
Cobalt	10	1.8	ug/L
Copper	10	4.3	ug/L
Iron	100	54	ug/L
Lead	10	3	ug/L
Magnesium	100	26	ug/L
Manganese	15	6.9	ug/L
Mercury	0.4	0.07	ug/L
Nickel	10	1.9	ug/L
Potassium	400	191	ug/L
Selenium	30	5	ug/L
Silver	6	1.1	ug/L
Sodium	400	98	ug/L
Thallium	40	10	ug/L
Vanadium	6	1.5	ug/L
Zinc	50	11	ug/L
Semivolatile Organic Compounds (SVOCs) by EPA Method 8270C			
1,2,4-Trichlorobenzene	10	0.68	ug/L
1,2-Dichlorobenzene	10	0.74	ug/L
1,2-Diphenylhydrazine	10	0.84	ug/L
1,3-Dichlorobenzene	10	0.68	ug/L
1,4-Dichlorobenzene	10	0.46	ug/L
2,2-oxybis (1-chloropropane)	10	0.62	ug/L
2,4,5-Trichlorophenol	50	0.78	ug/L
2,4,6-Trichlorophenol	10	0.79	ug/L
2,4-Dichlorophenol	10	0.84	ug/L
2,4-Dimethylphenol	10	0.73	ug/L
2,4-Dinitrophenol	50	5.13	ug/L
2,4-Dinitrotoluene	10	0.8	ug/L
2,6-Dinitrotoluene	10	0.59	ug/L
2-Chloronaphthalene	10	0.73	ug/L
2-Chlorophenol	10	0.6	ug/L
2-Methylnaphthalene	10	0.64	ug/L
2-Methylphenol	10	0.59	ug/L
2-Nitroaniline	50	1.12	ug/L
2-Nitrophenol	10	0.75	ug/L
3,3-Dichlorobenzidine	10	0.98	ug/L

Table 6. Quantification Limits for Groundwater
Quality Assurance Project Plan
Williamsburg Works Site
Brooklyn, New York

	Reporting Detection Limit	Method Detection Limit	Units
Semivolatile Organic Compounds (SVOCs) by EPA Method 8270C (Continued)			
3-Nitroaniline	50	0.67	ug/L
4,6-Dinitro-2-methylphenol	50	4.24	ug/L
4-Bromophenyl phenyl ether	10	0.91	ug/L
4-Chloro-3-methylphenol	10	0.51	ug/L
4-Chloroaniline	10	0.43	ug/L
4-Chlorophenyl phenyl ether	10	0.82	ug/L
4-Methylphenol	10	0.33	ug/L
4-Nitroaniline	20	1.05	ug/L
4-Nitrophenol	50	1.85	ug/L
Acenaphthene	10	0.8	ug/L
Acenaphthylene	10	0.75	ug/L
Aniline	10	0.63	ug/L
Anthracene	10	0.99	ug/L
Benzidine	100	2.15	ug/L
Benzo(a)anthracene	10	1.19	ug/L
Benzo(a)pyrene	10	1.08	ug/L
Benzo(b)fluoranthene	10	1.54	ug/L
Benzo(ghi)perylene	10	1.04	ug/L
Benzo(k)fluoranthene	10	0.91	ug/L
Benzoic acid	50	5.88	ug/L
Benzyl alcohol	10	0.99	ug/L
Bis(2-chloroethoxy)methane	10	0.87	ug/L
Bis(2-chloroethyl)ether	10	0.87	ug/L
Bis(2-ethylhexyl)phthalate	10	1.31	ug/L
Butyl benzyl phthalate	10	0.96	ug/L
Carbazole	10	1.11	ug/L
Chrysene	10	0.97	ug/L
Dibenzo(a,h)anthracene	10	1.34	ug/L
Dibenzofuran	10	0.82	ug/L
Diethyl phthalate	10	0.82	ug/L
Dimethyl phthalate	10	0.63	ug/L
Di-n-butyl phthalate	10	1.14	ug/L
Di-n-octyl phthalate	10	1.3	ug/L
Fluoranthene	10	1.08	ug/L
Fluorene	10	0.77	ug/L
Hexachlorobenzene	10	1.07	ug/L
Hexachlorobutadiene	10	0.84	ug/L
Hexachlorocyclopentadiene	10	2.21	ug/L
Hexachloroethane	10	1.06	ug/L
Indeno(1,2,3-cd)pyrene	10	1.17	ug/L
Isophorone	10	0.66	ug/L
Naphthalene	10	0.66	ug/L
Nitrobenzene	10	0.79	ug/L
n-Nitroso-di-n-propylamine	10	0.7	ug/L
n-Nitrosodiphenylamine	10	1.08	ug/L
n-Nitrosomethylethylamine	10	0.5	ug/L
Pentachlorophenol	50	5.04	ug/L
Phenanthrene	10	0.66	ug/L
Phenol	10	0.35	ug/L
Pyrene	10	1.01	ug/L
Pyridine	20	2.31	ug/L

Table 6. Quantification Limits for Groundwater
Quality Assurance Project Plan
Williamsburg Works Site
Brooklyn, New York

	Reporting Detection Limit	Method Detection Limit	Units
Volatile Organic Compounds (VOCs) by EPA Method 8260B			
1,1,1-Trichloroethane	5	0.4	ug/L
1,1,2,2-Tetrachloroethane	5	0.4	ug/L
1,1,2-Trichloroethane	5	0.6	ug/L
1,1-Dichloroethane	5	0.6	ug/L
1,1-Dichloroethene	5	0.7	ug/L
1,2,3-Trichloropropane	5	1.1	ug/L
1,2,4-Trichlorobenzene	5	0.9	ug/L
1,2-Dichloroethane	5	0.6	ug/L
1,2-Dichloropropane	5	0.9	ug/L
1,3-Dichloropropane	5	0.4	ug/L
2-Butanone (MEK)	5	1.2	ug/L
2-Chloroethylvinylether	5	0.6	ug/L
2-Hexanone	5	0.8	ug/L
4-Methyl-2-pentanone (MIBK)	5	0.7	ug/L
Acetone	5	1.4	ug/L
Acrolein	10	7.8	ug/L
Acrylonitrile	5	1.6	ug/L
Benzene	5	0.4	ug/L
Bromodichloromethane	5	0.4	ug/L
Bromoform	5	0.8	ug/L
Bromomethane	5	1.2	ug/L
Carbon disulfide	5	0.9	ug/L
Carbon tetrachloride	5	1	ug/L
Chlorobenzene	5	0.4	ug/L
Chloroethane	5	0.8	ug/L
Chloroform	5	0.7	ug/L
Chloromethane	5	0.5	ug/L
cis-1,2-Dichloroethene	5	0.6	ug/L
cis-1,3-Dichloropropene	5	0.5	ug/L
Dibromochloromethane	5	0.5	ug/L
Dichlorodifluoromethane	5	0.6	ug/L
Ethylbenzene	5	1	ug/L
Isopropyl ether	5	N/A	ug/L
Methylene chloride	5	0.4	ug/L
Methyl-tert-butyl-ether (MTBE)	5	0.3	ug/L
Styrene	5	0.5	ug/L
Tetrachloroethene	5	0.5	ug/L
Toluene	5	0.3	ug/L
trans-1,2-Dichloroethene	5	0.5	ug/L
trans-1,3-Dichloropropene	5	0.3	ug/L
Trichloroethene	5	0.7	ug/L
Trichlorofluoromethane	5	0.6	ug/L
Trichlorotrifluoroethane	5	0.5	ug/L
Vinyl acetate	5	0.2	ug/L
Vinyl chloride	5	0.8	ug/L
Xylenes (total)	5	1	ug/L

Notes:
ug/L - micrograms per liter
EPA - Environmental Protection Agency

Table 7. Quantification Limits for Soil Vapor and Ambient Air
Quality Assurance Project Plan
Williamsburg Works Site
Brooklyn, New York

Analyte	CAS Number	Molecular Weight	Reporting Limit (ppbv)	Reporting Limit ($\mu g/m^3$)
NYSDEC DER TO-15 TCL				
Benzene	71-43-2	78.11	0.20	0.64
Benzyl chloride	100-44-7	140.57	0.40	2.3
Bromodichloromethane	75-27-4	163.83	0.20	1.3
Bromoform	75-25-2	252.75	0.20	2.1
Bromomethane (Methyl bromide)	74-83-9	94.95	0.20	0.78
2-Butanone (Methyl ethyl ketone)	78-93-3	72.11	1.0	2.9
Carbon Tetrachloride	56-23-5	153.84	0.20	1.3
Chlorobenzene	108-90-7	112.56	0.20	0.92
Chloroethane	75-00-3	64.52	0.20	0.53
Chloroform	67-66-3	119.39	0.20	0.98
Chloromethane (Methyl chloride)	74-87-3	50.49	0.50	1
Cyclohexane	110-82-7	84.16	0.50	1.7
Dibromochloromethane	124-48-1	208.29	0.20	1.7
1,2-Dibromoethane	106-93-4	187.88	0.20	1.5
1,2-Dichlorobenzene	95-50-1	147.01	0.20	1.2
1,3-Dichlorobenzene	541-73-1	147.01	0.20	1.2
1,4-Dichlorobenzene	106-46-7	147.01	0.20	1.2
Dichlorodifluoromethane (Freon 12)	75-71-8	120.92	0.20	0.99
1,1-Dichloroethane	75-34-3	98.97	0.20	0.81
1,2-Dichloroethane	107-06-2	98.96	0.20	0.81
1,1-Dichloroethene	75-35-4	96.95	0.20	0.79
1,2-Dichloroethene (cis)	156-59-2	96.95	0.20	0.79
1,2-Dichloroethene (trans)	156-60-5	96.95	0.20	0.79
1,2-Dichloropropane	78-87-5	112.99	0.20	0.92
cis-1,3-Dichloropropene	10061-01-5	110.98	0.20	0.91
trans-1,3-Dichloropropene	10061-02-6	110.98	0.20	0.91
1,2-Dichlorotetrafluoroethane (Freon 114)	76-14-2	170.93	0.20	1.4
1,4-Dioxane	123-91-1	88.11	0.50	1.8
Ethanol *	64-17-5	46.07	0.20	0.38
Ethylbenzene	100-41-4	106.16	0.20	0.87
Hexachlorobutadiene	87-68-3	260.76	1.0	10.7
n-Hexane	110-54-3	86.18	0.50	1.8
Methylene Chloride	75-09-2	84.94	0.50	1.7
4-Methyl-2-pentanone (MIBK)	108-10-1	100.16	0.50	2
MTBE (Methyl tert-butyl ether)	1634-04-4	88.15	1.0	3.6
Styrene	100-42-5	104.14	0.20	0.85

Table 7. Quantification Limits for Soil Vapor and Ambient Air
Quality Assurance Project Plan
Williamsburg Works Site
Brooklyn, New York

Analyte	CAS Number	Molecular Weight	Reporting Limit (ppbv)	Reporting Limit (µg/m3)
Tertiary Butyl Alcohol (TBA)	76-65-0	74.12	2.00	6.1
1,1,2,2-Tetrachloroethane	79-34-5	167.86	0.20	1.4
Tetrachloroethene (PCE)	127-18-4	165.85	0.20	1.4
Toluene	108-88-3	92.13	0.20	0.75
1,2,4-Trichlorobenzene	120-82-1	181.46	1.0	7.4
1,1,1-Trichloroethane	71-55-6	133.42	0.20	1.1
1,1,2-Trichloroethane	79-00-5	133.42	0.20	1.1
1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113)	76-13-1	187.38	0.20	1.5
Trichloroethene (TCE)	79-01-6	131.4	0.20	1.1
Trichlorofluoromethane (Freon 11)	75-69-4	137.38	0.20	1.1
1,2,4-Trimethylbenzene	95-63-6	120.19	0.20	0.98
1,3,5-Trimethylbenzene	108-67-8	120.19	0.20	0.98
2,2,4-Trimethylpentane	540-84-1	114.23	0.50	2.3
Vinyl Chloride	75-01-4	62.5	0.20	0.51

Notes:
a. Actual reporting limits of field samples may be higher due to sample dilution by the laboratory to quantify compounds at elevated concentrations. (see note b)
b. The laboratory must notify KeySpan prior to sample dilution.
c. ppbv = part per billion by volume
d. ug/m 3 = microgram per cubic meter

Table 8. Soil Clean-Up Objectives
Quality Assurance Project Plan
Williamsburg Works Site
Brooklyn, New York

Analytes	Unrestricted Use (ppm)	Residential Use (ppm)	Restricted-Residential Use (ppm)	Restricted-Commercial Use (ppm)	Restricted-Industrial Use (ppm)	Protection of Groundwater (ppm)	Protection of Ecological Resources (ppm)
Volatile Organic Compounds							
Acetone	0.05	100	100	500	1,000	0.05	2.2
Benzene	0.06	2.9	4.8	44	89	0.06	70
Butanone, 2-	0.12	100	100	500	1,000	0.12	100
Butylbenzene, n-	12	100	100	500	1,000	12	NE
Butylbenzene, tert-	5.9	100	100	500	1,000	5.9	NE
Butylbenzene,sec-	11	100	100	500	1,000	11	NE
Carbon tetrachloride	0.76	1.4	2.4	22	44	0.76	NE
Chlorobenzene	1.1	100	100	500	1,000	1.1	40
Chloroform	0.37	10	49	350	700	0.37	12
Dichlorobenzene,1,2-	1.1	100	100	500	1,000	1.1	NE
Dichlorobenzene,1,3-	2.4	17	49	280	560	2.4	NE
Dichlorobenzene,1,4-	1.8	9.8	13	130	250	1.8	20
Dichloroethane,1,1-	0.27	19	26	240	480	0.27	NE
Dichloroethane,1,2-	0.02	2.3	3.1	30	60	0.02	10
Dichloroethene, cis-1,2-	0.25	59	100	500	1,000	0.25	NE
Dichloroethene,1,1-	0.33	100	100	500	1,000	0.33	NE
Dioxane,1,4-	0.1	9.8	13	130	250	0.1	0.1
Ethylbenzene	1	30	41	390	780	1	NE
Methyl tert-butyl ether	0.93	62	100	500	1,000	0.93	NE
Methylene chloride	0.05	51	100	500	1,000	0.05	12
Naphthalene	12	100	100	500	1,000	12	NE
Propylbenzene, n-	3.9	100	100	500	1,000	3.9	NE
Tetrachloroethene	1.3	5.5	19	150	300	1.3	2
Toluene	0.7	100	100	500	1,000	0.7	36
Trans-1,2-dichloroethene	0.19	100	100	500	1,000	0.19	NE
Trichloroethane, 1,1,1-	0.68	100	100	500	1,000	0.68	NE
Trichloroethene	0.47	10	21	200	400	0.47	2
Trimethylbenzene, 1,2,4-	3.6	47	52	190	380	3.6	NE
Trimethylbenzene, 1,3,5-	8.4	47	52	190	380	8.4	NE
Vinyl chloride	0.02	0.21	0.9	13	27	0.02	NE
Xylene, total	0.26	100	100	500	1,000	1.6	0.26
Semivolatile Organic Compounds							
Acenaphthene	20	100	100	500	1,000	98	20
Acenaphthylene	100	100	100	500	1,000	107	NE
Anthracene	100	100	100	500	1,000	1,000	NE
Benz[a]anthracene	1	1	1	5.6	11	1	NE
Benzo[a]pyrene	1	1	1	1	1.1	22	2.6
Benzo[b]fluoranthene	1	1	1	5.6	11	1.7	NE
Benzo[g,h,i]perylene	100	100	100	500	1,000	1,000	NE
Benzo[k]fluoranthene	0.8	1	3.9	56	110	1.7	NE
Chrysene	1	1	3.9	56	110	1	NE
Dibenz[a,h]anthracene	0.33	0.33	0.33	0.56	1.1	1,000	NE
Dibenzofuran	7	14	59	350	1,000	210	NE
Fluoranthene	100	100	100	500	1,000	1,000	NE
Fluorene	30	100	100	500	1,000	386	30
Hexachlorobenzene	0.33	0.33	1.2	6	12	3.2	NE
Indeno[1,2,3-cd]pyrene	0.5	0.5	0.5	5.6	11	8.2	NE
Methylphenol, 4-	0.33	34	100	500	1,000	0.33	NE
Cresol, m (methylphenol, 3-)	0.33	100	100	500	1,000	0.33	NE
Methylphenol,2-	0.33	100	100	500	1,000	0.33	NE
Pentachlorophenol	0.8	2.4	6.7	6.7	55	0.8	0.8
Phenanthrene	100	100	100	500	1,000	1,000	NE
Phenol	0.33	100	100	500	1,000	0.33	30
Pyrene	100	100	100	500	1,000	1,000	NE

Table 8. Soil Clean-Up Objectives
Quality Assurance Project Plan
Williamsburg Works Site
Brooklyn, New York

Analytes	Unrestricted Use (ppm)	Residential Use (ppm)	Restricted-Residential Use (ppm)	Restricted-Commercial Use (ppm)	Restricted-Industrial Use (ppm)	Protection of Groundwater (ppm)	Protection of Ecological Resources (ppm)
Pesticides							
Aldrin	0.005	0.019	0.097	0.68	1.4	0.19	0.14
Alpha-bhc	0.02	0.097	0.48	3.4	6.8	0.02	0.04
Alpha-chlordane	0.094	0.91	4.2	24	47	2.9	1.3
Beta-BHC	0.036	0.072	0.36	3	14	0.09	0.6
DDD,4,4-	0.0033	2.6	13	92	180	14	0.0033
DDE,4,4-	0.0033	1.8	8.9	62	120	17	0.0033
DDT,4,4-	0.0033	1.7	7.9	47	94	136	0.0033
Delta-BHC	0.04	100	100	500	1,000	0.25	0.04
Dieldrin	0.005	0.039	0.2	1.4	2.8	0.1	0.006
Endosulfan I	2.4	4.8	24	200	920	102	NE
Endosulfan II	2.4	4.8	24	200	920	102	NE
Endosulfan sulfate	2.4	4.8	24	200	920	1,000	NE
Endrin	0.014	2.2	11	89	410	0.06	0.014
Gamma-BHC	0.1	0.28	1.3	9.2	23	0.1	6
Heptachlor	0.042	0.42	2.1	15	29	0.38	0.14
Silvex	3.8	58	100	500	1,000	3.8	NE
Polychlorinated Biphenyls (PCBs)							
Total PCBs	0.1	1	1	1	25	3.2	1
Metals							
Arsenic	13	16	16	16	16	16	13
Barium	350	350	400	400	10,000	820	433
Beryllium	7.2	14	72	590	2700	47	10
Cadmium	2.5	2.5	4.3	9.3	60	7.5	4
Chromium (VI)	1	22	110	400	800	19	1
Chromium (III)	30	36	180	1500	6800		41
Copper	50	270	270	270	10,000	1720	50
Lead	63	400	400	1000	3900	450	63
Manganese	1600	2000	2,000	10,000	10,000	2,000	1600
Mercury	0.18	0.81	0.81	2.8	5.7	0.73	0.18
Nickel	30	140	310	310	10,000	130	30
Selenium	3.9	36	180	1500	6800	4	3.9
Silver	2	36	180	1500	6800	8.3	2
Zinc	109	2200	10,000	10,000	10,000	2480	109
Cyanide							
Cyanide, Total	27	27	27	27	10,000	40	NE

Notes:
ppm - parts per million

Table 9. Groundwater Standards, Criteria and Guidelines
Quality Assurance Project Plan
Williamsburg Works Site
Brooklyn, New York

Parameter	DQL[1]
Volatile Organic Compounds	
Acetone	50
Benzene	1
2-Butanone	50
Carbon Disulfide	NE
Carbon Tetrachloride	5
Chlorobenzene	5
Chloroethane	5
Chloroform	7
Dibromochloromethane	50
1,2-Dichlorobenzene	3
1,3-Dichlorobenzene	3
1,4-Dichlorobenzene	3
1,1-Dichloroethane	5
1,2-Dichloroethane	**0.6**
1,1-Dichloroethene	5
trans-1,2-Dichloroethene	5
1,3-Dichloropropane	5
Ethylbenzene	5
Freon 113	5
Methylene chloride	5
4-Methyl-2-pentanone	503
Tetrachloroethene	5
1,1,1-Trichloroethane	5
1,1,2,2-Tetrachloroethane	5
1,2,3-Trichloropropane	**0.04**
1,2,4-Trichlorobenzene	5
Toluene	5
Trichloroethene	5
Vinyl chloride	2
Xylenes	5
Isopropylbenzene	5
n-Propylbenzene	5
p-Isopropyltoluene	5
1,2,4-Trimethylbenzene	5
1,3,5-Trimethylbenzene	5
n-Butylbenzene	5
sec-Butylbenzene	5
t-Butylbenzene	5
MTBE	10

Table 9. Groundwater Standards, Criteria and Guidelines
Quality Assurance Project Plan
Williamsburg Works Site
Brooklyn, New York

Parameter	DQL[1]
Pesticides	
Aldrin	ND
alpha-BHC	**0.01**
beta-BHC	0.04
delta-BHC	0.04
Chlordane	**0.05**
4,4'-DDD	0.3
4,4'-DDE	0.2
4,4'-DDT	0.2
Dieldrin	**0.004**
Endosulfan I	NE
Endosulfan II	NE
Endosulfan sulfate	NE
Endrin	ND
Endrin ketone	5
gamma-BHC (Lindane)	0.05
gamma-Chlordane	NE
Heptachlor	0.04
Heptachlor epoxide	0.03
Methoxychlor	35
2,4'-DDD	NE
Aniline	5
Semivolatile Organic Compounds	
Acenaphthene	20
Acenaphthylene	NS
Anthracene	50
Benzo(a)anthracene	**0.002**
Benzo(a)pyrene	ND
Benzo(b)fluoranthene	**0.002**
Benzo(g,h,i)perylene	NE
Benzo(k)fluoranthene	**0.002**
Bis(2-ethylhexyl)phthalate	5
Butylbenzylphthalate	50
Chrysene	**0.002**
4-Chloroaniline	5
4-Chloro-3-methylphenol	**1**
2-Chlorophenol	**1**
Dibenzofuran	NE

Table 9. Groundwater Standards, Criteria and Guidelines
Quality Assurance Project Plan
Williamsburg Works Site
Brooklyn, New York

Parameter	DQL[1]
Dibenz(a,h)anthracene	NE
3,3'-Dichlorobenzidine	5
2,4-Dichlorophenol	5
2,4-Dinitrophenol	**10**
2,6-Dinitrotoluene	5
Diethylphthalate	50
Dimethylphthalate	50
Di-n-butylphthalate	50
Di-n-octylphthalate	50
Fluoranthene	50
Fluorene	50
Hexachlorobenzene	**0.04**
Indeno(1,2,3-cd)pyrene	**0.002**
Isophorone	50
2-Methylnaphthalene	NE
2-Methylphenol	**1**
4-Methylphenol	**1**
Naphthalene	10
Nitrobenzene	**0.4**
2-Nitroaniline	5
2-Nitrophenol	**1**
4-Nitrophenol	**1**
3-Nitroaniline	5
Pentachlorophenol	**1**
Phenanthrene	50
Phenol	**1**
Pyrene	50
2,4,5-Trichlorophenol	**1**
Total Metals	
Aluminum	NE
Antimony	**3**
Arsenic	25
Barium	1000
Beryllium	3
Cadmium	5
Calcium	NE
Chromium	50
Cobalt	NE
Copper	200

Table 9. Groundwater Standards, Criteria and Guidelines
Quality Assurance Project Plan
Williamsburg Works Site
Brooklyn, New York

Parameter	DQL[1]
Iron	300
Lead	25
Magnesium	35,000
Manganese	300
Mercury	0.7
Nickel	100
Potassium	NE
Selenium	10
Silver	50
Sodium	20,000
Thallium	**0.5**
Vanadium	NE
Zinc	2000
Polychlorinated Biphenyls (PCBs)	
Aroclor 1016	**0.09**
Aroclor 1221	**0.09**
Aroclor 1232	**0.09**
Aroclor 1242	**0.09**
Aroclor 1248	**0.09**
Aroclor 1254	**0.09**
Aroclor 1260	**0.09**
Cyanide	
Cyanide	200

[1] DQL based on TOGS Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations (June, 1998)
[2] DQL listed is for total PCBs
DQL = Data Quality Level
NE = None established
ND = Not detected when analyzed by method listed in Table 7
Compounds which will not achieve the DQL are highlighted

Appendix A

Laboratory Quality Manual (electronic only)

Quality Assurance Manual Cover Page

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Title Page:

Quality Assurance Manual
Approval Signatures

Laboratory Director – Mark Acierno	12/19/2017 Date
Quality Manager - Carl Armbruster	12/19/2017 Date
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Technical Manager, Inorganics – Donald Evans	12/19/2017 Date

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REFERENCED CORPORATE SOPs AND POLICIES

SOP / Policy Reference	Title
CA-I-P-002	Electronic Reporting and Signature Policy
CA-L-P-002	Contract Compliance Policy
CW-L-S-004	Subcontracting
CA-Q-M-002	Corporate Quality Management Plan
CA-Q-S-001	Solvent and Acid Lot Testing and Approval
CA-Q-S-002	Acceptable Manual Integration Practices
CA-Q-S-006	Detection Limits
CA-Q-S-009	Root Cause Analysis
CA-T-P-001	Qualified Products List
CW-E-M-001	Corporate Environmental Health & Safety Manual
CW-F-P-002	Company-Wide Authorization Matrix
CW-F-P-004	Procurement and Contracts Policy
CW-F-S-007	Capital Expenditure, Controlled Purchase Requests and Fixed Asset Capitalization
CW-L-P-004	Ethics Policy
CW-L-S-002	Internal Investigation
CW-Q-S-001	Corporate Document Control and Archiving
CW-Q-S-002	Writing a Standard Operating Procedure (SOPs)
CW-Q-S-003	Internal Auditing
CW-Q-S-004	Management Systems Review
CW-Q-S-005	Data Recall Process
CA-C-S-001	Work Sharing Process

REFERENCED LABORATORY SOPs

SOP Reference	Title
ED-GEN-002	Document Control
ED-GEN-026	Evaluation of Analytical Accuracy and Precision Through The Use of Control Charts
ED-GEN-010	Calibration of Analytical Balances
ED-GEN-003	Control of Non-Conformances and Corrective Action
ED-GEN-024	Record Storage and Retention
ED-GEN-022	Training
ED-GEN-001	Data Management and Handling Procedures
ED-GEN-021	Data Review
ED-SPM-001	Login
ED-RP-001	Reports Production
ED-GEN-014	Thermometer Calibration

SOP Reference	Title
ED-GEN-011	Calibration and Use of Lab Pipettes
ED-FLD-008, -009	Groundwater Sampling and Flow Monitoring
ED-FLD-014	Wastewater Sampling
ED-FLD-001 thru -010	Field Analytical Parameters
ED-GEN-007	Subsampling
ED-SPM-007	Disposal of Samples and Associated Laboratory Waste
ED-SPM-006	Procedure for Acceptance and Handling of Regulated Domestic and Foreign Soils

SECTION 3. INTRODUCTION, SCOPE AND APPLICABILITY

3.1 Introduction and Compliance References

TestAmerica Edison's Quality Assurance Manual (QAM) is a document prepared to define the overall policies, organization objectives and functional responsibilities for achieving TestAmerica's data quality goals. The laboratory maintains a local perspective in its scope of services and client relations and maintains a national perspective in terms of quality.

The QAM has been prepared to assure compliance with The NELAC Institute (TNI) Standard, dated 2009, Volume 1 Modules 2 and 4. In addition, the policies and procedures outlined in this manual are compliant with TestAmerica's Corporate Quality Management Plan (CQMP) and the various accreditation and certification programs listed in Appendix 3. The CQMP provides a summary of TestAmerica's quality and data integrity system. It contains requirements and general guidelines under which all TestAmerica facilities shall conduct their operations.

The QAM has been prepared to be consistent with the requirements of the following documents:

- ANSI/ASQC, E4-1994, "Specifications and Guidelines for Quality Management Systems for Environmental Data Collection and Environmental Technology Programs" (American National Standard, January 5, 1995, or most recent version)
- "EPA Requirements for Quality Management Programs" (QA/R-2) (EPA/240/B-01/002, May 31, 2006).
- EPA 600/4-88/039, *Methods for the Determination of Organic Compounds in Drinking Water,* EPA, Revised July 1991.
- EPA 600/R-95/131, *Methods for the Determination of Organic Compounds in Drinking Water,* Supplement III, EPA, August 1995.
- EPA 600/4-79-019, *Handbook for Analytical Quality Control in Water and Wastewater Laboratories,* EPA, March 1979.
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008; Final Update V, August 2015.*
- Federal Register, 40 CFR Parts 136, 141, 172, 173, 178, 179 and 261.
- *Manual for the Certification of Laboratories Analyzing Drinking Water (EPA 815-R-05-004, January 2005) (DW labs only)*
- *Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.*
- APHA, *Standard Methods for* the Examination of Water and Wastewater, 18th Edition, 19th, 20th, 21st, and on-line Editions.
- Nuclear Regulatory Commission (NRC) Quality Assurance Requirements.
- Marine Protection, Research, and Sanctuaries Act (MPRSA).
- Toxic Substances Control Act (TSCA).

3.2 Terms and Definitions

A Quality Assurance Program is a company-wide system designed to ensure that data produced by the laboratory conforms to the standards set by state and/or federal regulations. The program functions at the management level through company goals and management policies, and at the analytical level through Standard Operating Procedures (SOPs) and quality control. The TestAmerica program is designed to minimize systematic error, encourage constructive, documented problem solving, and provide a framework for continuous improvement within the organization.

Refer to Appendix 2 for the Glossary/Acronyms.

3.3 Scope / Fields of Testing

The laboratory analyzes a broad range of environmental and industrial samples every month. Sample matrices vary among air, drinking water, effluent water, groundwater, hazardous waste, sludge and soils. The Quality Assurance Program contains specific procedures and methods to test samples of differing matrices for chemical, physical and biological parameters. The Program also contains guidelines on maintaining documentation of analytical processes, reviewing results, servicing clients and tracking samples through the laboratory. The technical and service requirements of all analytical requests are thoroughly evaluated before commitments are made to accept the work. Measurements are made using published reference methods or methods developed and validated by the laboratory.

The methods covered by this manual include the most frequently requested methodologies needed to provide analytical services in the United States and its territories. The specific list of test methods used by the laboratory can be found TestAmerica Edison Work Instruction No. EDS-WI-009 (Analytical Capabilities). The approach of this manual is to define the minimum level of quality assurance and quality control necessary to meet these requirements. All methods performed by the laboratory shall meet these criteria as appropriate. In some instances, quality assurance project plans (QAPPs), project specific data quality objectives (DQOs) or local regulations may require criteria other than those contained in this manual. In these cases, the laboratory will abide by the requested criteria following review and acceptance of the requirements by the Laboratory Director and the Quality Assurance (QA) Manager. In some cases, QAPPs and DQOs may specify less stringent requirements. The Laboratory Director and the QA Manager must determine if it is in the lab's best interest to follow the less stringent requirements.

3.4 Management of the Manual

3.4.1 Review Process

The template on which this manual is based is reviewed annually by Corporate Quality Management Personnel to assure that it remains in compliance with Section 3.1. This manual itself is reviewed every two years by senior laboratory management to assure that it reflects current practices and meets the requirements of the laboratory's clients and regulators as well as the CQMP. Occasionally, the manual may need changes in order to meet new or changing regulations and operations. The QA Manager will review the changes in the normal course of business and incorporate changes into revised sections of the document. All updates will be reviewed by the senior laboratory management staff. The laboratory updates and approves such changes according to our Document Control & Updating procedures (refer to SOP No. ED-GEN-002, Document Control).

SECTION 4. MANAGEMENT REQUIREMENTS

4.1 Overview

TestAmerica Edison is a local operating unit of TestAmerica Laboratories, Inc.. The organizational structure, responsibilities and authorities of the corporate staff of TestAmerica Laboratories, Inc. are presented in the CQMP. The laboratory has day-to-day independent operational authority overseen by corporate officers (e.g., President and Chief Executive Officer (CEO), Chief Operating Officer (COO), Executive Vice President (VP) Operations, Corporate Quality, etc.). The laboratory operational and support staff work under the direction of the Laboratory Director. The organizational structure for both Corporate & TestAmerica Edison is presented in Figure 4-1.

4.2 Roles and Responsibilities

In order for the Quality Assurance Program to function properly, all members of the staff must clearly understand and meet their individual responsibilities as they relate to the quality program. The following descriptions briefly define each role in its relationship to the Quality Assurance Program.

4.2.1 Additional Requirements for Laboratories

The responsibility for quality resides with every employee of the laboratory. All employees have access to the QAM, are trained to this manual, and are responsible for upholding the standards therein. Each person carries out his/her daily tasks in a manner consistent with the goals and in accordance with the procedures in this manual and the laboratory's SOPs. Role descriptions for Corporate personnel are defined in the CQMP. This manual is specific to the operations of TestAmerica's Edison laboratory.

4.2.2 President and Chief Executive Officer (CEO)

The President and CEO is a member of the Board of Directors and is ultimately responsible for the quality and performance of all TestAmerica facilities. The President and CEO establishes

the overall quality standard and data integrity program for the Analytical Business, providing the necessary leadership and resources to assure that the standard and integrity program are met.

4.2.3 Chief Operation Officer (COO)

The COO reports directly to the President and CEO of TestAmerica. The COO~~VPO~~ oversees the operations of all TestAmerica laboratories and the EMLab P&K business unit. The VP's of Operations report directly to COO

4.2.4 Vice President of Operations

Each VP of Operations reports directly to the Executive VP of Operations and is a part of the Executive Committee. Each VP of Operations is responsible for the overall administrative and operational management of their respective laboratories. The VP's responsibilities include allocation of personnel and resources, long-term planning, goal setting, and achieving the financial, business, and quality objectives of TestAmerica. The VP's ensure timely compliance with Corporate Management directives, policies, and management systems reviews. The VP's are also responsible for restricting any laboratory from performing analyses that cannot be consistently and successfully performed to meet the standards set forth in this manual.

4.2.5 Vice President of Quality and Environmental Health and Safety (VP-QA/EHS)

The Vice President (VP) of QA/EHS reports directly to the President and CEO. With the aid of the Executive Committee, Laboratory Directors, Quality Directors, Safety Manager, EH&S Coordinators and QA Managers, the VP-QA/EHS has the responsibility for the establishment, general overview and Corporate maintenance of the Quality Assurance and EH&S Programs within TestAmerica. Additional responsibilities include:

- Review of QA/QC and EHS aspects of Corporate SOPs & Policies, national projects and expansions or changes in services.
- Work with various organizations outside of TestAmerica to further the development of quality standards and represent TestAmerica at various trade meetings.
- Preparation of a monthly report that includes quality metrics across the analytical laboratories and a summary of any quality related initiatives and issues.
- Preparation of a monthly report that includes EH&S metrics across the analytical laboratories and a summary of any EH&S related initiatives and issues.
- Work with various organizations outside of TestAmerica to further the development of quality standards and represent TestAmerica at various trade meetings.
- With the assistance of the Corporate Senior Management Teams and the EHS Director~~s~~, development and implementation of the TestAmerica Environmental, Health and Safety Program.

4.2.6 Vice President of Client Service

The VP of Client Services leads the Client Service Organization (CSO) and is responsible for client satisfaction, driving operational excellence and improving client responsiveness. The VP provides direction to the Client Service Directors, Programs Managers and Project Managers.

4.2.7 Quality Assessment Director

The Quality Assessment Director reports to the VP-QA/EHS. The Quality Assessment Director has QA oversight of laboratories; responsible for the internal audit system, schedule and procedure; monitors laboratory internal audit findings; identifies common laboratory weaknesses; and monitors corrective action closures. Together with the Quality Compliance Director, the Quality Systems Director, and the VP-QA/EHS, the Quality Assessment Director has the responsibility for the establishment, general overview and maintenance of the Analytical Quality Assurance Program within TestAmerica.

4.2.8 Quality Compliance Director

The Quality Compliance Director reports to the VP-QA/EHS. The Quality Compliance Director has QA oversight of laboratories; monitors and communicates DoD / DoE requirements; develops corporate tools for ensuring and improving compliance; develops corporate assessment tools; identifies common laboratory weaknesses; and monitors corrective action closures. Together with the Quality Assessment Director, Quality Systems Director and the VP-QA/EHS, the Quality Compliance Director has the responsibility for the establishment, general overview and maintenance of the Analytical Quality Assurance Program within TestAmerica.

4.2.9 Quality Systems Director

The Quality Systems Director reports to the VP-QA/EHS. The Quality Systems Director has QA oversight of laboratories; develops quality policies, procedures and management tools; monitors and communicates regulatory and certification requirements; identifies common laboratory weaknesses; and monitors corrective action closures. Together with the Quality Assessment Director, Quality Compliance Director and the VP-QA/EHS, the Quality Systems Director has the responsibility for the establishment, general overview and maintenance of the Analytical Quality Assurance Program within TestAmerica.

4.2.10 Quality Information Manager

The Quality Information Manager is responsible for managing all company official documents (e.g., Policies, Procedures, Work Instructions), the company's accreditation database, intranet websites, external laboratory subcontracting, regulatory limits for clients on the company's TotalAccess website; internal and external client support for various company groups (e.g., Client Services, EH&S, Legal, IT, Sales) for both quality and operational functions. The Quality Information Manager reports to the VP-QA/EHS; and works alongside the Quality Assessment, Quality Compliance and Quality System Directors and EHS Managers to support both the Analytical Quality Assurance and EHS Programs within TestAmerica.

4.2.11 Technical Services Director

The Technical Services Director is responsible for establishing, implementing and communicating TestAmerica's Analytical Business's Technical Policies, SOPs, and Manuals. Other responsibilities include conducting technical assessments as required, acting as a

technical resource in national contracts review, coordinating new technologies, establishing best practices, advising staff on technology advances, innovations, and applications.

4.2.12 Ethics and Compliance Officers (ECOs)

TestAmerica has designated two senior members of the Corporate staff to fulfill the role of Ethics and Compliance Officer (ECO) – Corporate Counsel & VP of Human Resources and the VP-QA/EHS. Each ECO acts as a back-up to the other ECO and both are involved when data investigations occur. Each ECO has a direct line of communication to the entire senior Corporate and lab management staff.

The ECOs ensure that the organization distributes the data integrity and ethical practices policies to all employees and ensures annual trainings and orientation of new hires to the ethics program and its policies. The ECO is responsible for establishing a mechanism to foster employee reporting of incidents of illegal, unethical, or improper practices in a safe and confidential environment.

The ECOs monitor and audit procedures to determine compliance with policies and to make recommendations for policy enhancements to the President and CEO, VPOs, Laboratory Director or other appropriate individuals within the laboratory. The ECO will assist the laboratory QA Manager in the coordination of internal auditing of ethical policy related activities and processes within the laboratory, in conjunction with the laboratories regular internal auditing function.

The ECOs will also participate in investigations of alleged violations of policies and work with the appropriate internal departments to investigate misconduct, remedy the situation, and prevent recurrence of any such activity.

4.2.13 Chief Information Officer (CIO)

The CIO is responsible for establishing, implementing and communicating TestAmerica's Information Technology (IT) Policies, SOPs and Manuals. Other responsibilities include coordinating new technologies, development of electronic communication tools such as TestAmerica's intranet and internet sites, ensuring data security and documentation of software, ensuring compliance with the NELAC standard, and assistance in establishing, updating, and maintaining Laboratory Information Management Systems (LIMS) at the various TestAmerica facilities.

4.2.14 Environmental Health and Safety Managers (Corporate)

The EHS Managers report directly to the VP-QA/EHS. The EHS Managers are responsible for the development and implementation of the TestAmerica Environmental, Health and Safety program. Responsibilities include:

- Consolidation and tracking all safety and health-related information and reports for the company, and managing compliance activities for TestAmerica locations.
- Coordination/preparation of the corporate Environmental, Health and Safety Manual Template that is used by each laboratory to prepare its own laboratory-specific Safety Manual/ CHP.

- Preparation of information and training materials for laboratory EHS Coordinators.
- Assistance in the internal and external coordination of employee exposure and medical monitoring programs to insure compliance with applicable safety and health regulations.
- Serving as Department of Transportation (D.O.T.) focal point and providing technical assistance to location management.
- Serving as Hazardous Waste Management main contact and providing technical assistance to location management.

4.2.15 Laboratory Director/Lead Technical Manager

TestAmerica Edison's Laboratory Director is responsible for the overall quality, safety, financial, technical, human resource and service performance of the whole laboratory and reports to their respective VPO. The Laboratory Director provides the resources necessary to implement and maintain an effective and comprehensive Quality Assurance and Data Integrity Program.

Specific responsibilities include, but are not limited to:

- Serves as lead Technical Manager for all fields of testing.
- Ensures that all analysts and supervisors have the appropriate education and training to properly carry out the duties assigned to them and ensures that this training has been documented.
- Ensures that personnel are free from any commercial, financial and other undue pressures which might adversely affect the quality of their work.
- Ensures TestAmerica's human resource policies are adhered to and maintained.
- Ensures that sufficient numbers of qualified personnel are employed to supervise and perform the work of the laboratory.
- Ensures that appropriate corrective actions are taken to address analyses identified as requiring such actions by internal and external performance or procedural audits. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs may be temporarily suspended by the Laboratory Director.
- Monitors standards of performance in quality control and quality assurance.
- Monitors the validity of analyses performed and data generated in the lab to assure reliable data.
- Reviews and approves all SOPs prior to their implementation and ensures all approved SOPs are implemented and adhered to.
- Interfaces with Project Management and Customer Service to forecast receipts, provide quality analytical data to clients and meet on-time delivery dates.
- Ensures that the facility has appropriate Information Technology resources and that they are used effectively to support operational requirements.
- Actively participates in the process of sharing and adopting best practices within TestAmerica. Provides technical assistance to other TestAmerica laboratories as needed to improve productivity and customer service.

- Ensures client specific reporting and quality control requirements are met.
- Captains the management team, consisting of the QA Manager, the Operations Manager, the Laboratory Client Services Manager, the Client Services Manager, the Service Center Manager, the Environmental, Health and Safety Manager and the Support Services Manager as direct reports.

4.2.16 Quality Assurance (QA) Manager

The QA Manager has responsibility and authority to ensure the continuous implementation of the quality system.

The QA Manager reports directly to the Laboratory Director their Corporate Quality Director. This position is able to evaluate data objectively and perform assessments without outside (e.g., managerial) influence. Corporate QA may be used as a resource in dealing with regulatory requirements, certifications and other quality assurance related items. The QA Manager directs the activities of the QA officers to accomplish specific responsibilities, which include, but are not limited to:

- Serves as the focal point for QA/QC in the laboratory.
- Having functions independent from laboratory operations for which he/she has quality assurance oversight.
- Maintaining and updating the QAM.
- Monitoring and evaluating laboratory certifications; scheduling proficiency testing samples.
- Monitoring and communicating regulatory changes that may affect the laboratory to management.
- Training and advising the laboratory staff on quality assurance/quality control procedures that are pertinent to their daily activities.
- Have documented training and/or experience in QA/QC procedures and the laboratory's Quality System.
- Having a general knowledge of the analytical test methods for which data audit/review is performed (and/or having the means of getting this information when needed).
- Arranging for or conducting internal audits on quality systems and the technical operation.
- The laboratory QA Manager will maintain records of all ethics-related training, including the type and proof of attendance.
- Maintain, improve, and evaluate the corrective action database and the corrective and preventive action systems.
- Notifying laboratory management of deficiencies in the quality system and ensuring corrective action is taken. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs shall be investigated following procedures outlined in Section 12 and if deemed necessary may be temporarily suspended during the investigation.

- Objectively monitor standards of performance in quality control and quality assurance without outside (e.g., managerial) influence.
- Coordinating of document control of SOPs, MDLs, control limits, and miscellaneous forms and information.
- Review a percentage of all final data reports for internal consistency. Review of Chain of Custody (COC), correspondence with the analytical request, batch QC status, completeness of any corrective action statements, 5% of calculations, format, holding time, sensibility and completeness of the project file contents.
- Review of external audit reports and data validation requests.
- Follow-up with audits to ensure client QAPP requirements are met.
- Establishment of reporting schedule and preparation of various quality reports for the Laboratory Director, clients and/or Corporate QA.
- Development of suggestions and recommendations to improve quality systems.
- Research of current state and federal requirements and guidelines.
- Captains the QA team to enable communication and to distribute duties and responsibilities.

- Ensuring Communication & monitoring standards of performance to ensure that systems are in place to produce the level of quality as defined in this document.
- Notifying laboratory management of deficiencies in the quality system and ensuring corrective action is taken. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs are temporarily suspended following the procedures outlined in Section 12.
- Evaluation of the thoroughness and effectiveness of training.
- Compliance with ISO 17025. (where applicable)

4.2.17 Quality Assurance (QA) Specialist

The Quality Assurance (QA) Specialist is responsible for performing data audits, special audits, assisting with external and systems audits, overseeing the maintenance of QC records, certifications, Standard Operating Procedures (SOPs), training records, DOCs, arranging and managing PT samples. Additional responsibilities may include assisting with systematic problems within the laboratory, assisting in reviewing and/or writing of Quality Assurance Project Plans, and technical and QC specifications in contracts and other functions in support of the QA Manager's responsibilities as assigned.

- Assist QA Manager in conducting QA training courses, including ethics training.
- Performs data audits.
- Assist in performing special audits as deemed necessary by data audits, client inquiries, etc.
- Assisting in, conducting and responding to external audits conducted by clients and regulatory agencies.

- Assisting in reviewing and/or writing of Quality Assurance Project Plans, and technical and QC specifications in contracts.
- Maintaining all necessary laboratory certifications.
- Arranging and managing PT samples.
- Reviewing laboratory SOPs. Writing SOPs as needed.
- Maintaining historical indices of all technical records including SOPs, QC records, laboratory data, etc.
- Ensuring maintenance of records archives.
- Assisting in and monitoring laboratory's method compliance.
- Ensuring maintenance of DOCs for all analysts.
- Ensuring maintenance of training records for all employees.
- Assisting in identification of systematic problems within laboratories.
- Recommends resolutions for ongoing or recurring nonconformance.
- Providing statistical feedback to Departments on error rates, and assisting in identifying systematic improvements to minimize errors.
- Assists in tracking of customer complaints, providing statistical feedback to the laboratory, and assisting in identifying improvements.
- Overseeing and reviewing MDL studies.
- Ensuring control charts are generated; oversees and approves setting of control limits.
- Assists in monitoring new regulations and communicating them to the laboratory.

4.2.18 Operations/Technical Manager(s)

The Organics and Inorganics Operations/Technical Managers report directly to the Laboratory Director (throughout this text the term 'Technical Manager' refers to these individuals).. He/she is accountable for all analyses and analysts under their experienced supervision The scope of responsibility ranges from the new-hire process and existing technology through the ongoing training and development programs for existing analysts and new instrumentation. Specific responsibilities include, but are not limited to:

- Exercises day-to-day supervision of laboratory operations for the appropriate field of accreditation and reporting of results. Coordinating, writing, and reviewing preparation of all test methods, i. e., SOPs, with regard to quality, integrity, regulatory and optimum and efficient production techniques, and subsequent analyst training and interpretation of the SOPs for implementation and unusual project samples. He/she insures that the SOPs are properly managed and adhered to at the bench. He/she develops standard costing of SOPs to include supplies, labor, overhead, and capacity (design vs. demonstrated versus first-run yield) utilization.
- Reviewing and approving, with input from the QA Manager, proposals from marketing, in accordance with an established procedure for the review of requests and contracts. This

procedure addresses the adequate definition of methods to be used for analysis and any limitations, the laboratory's capability and resources, the client's expectations. Differences are resolved before the contract is signed and work begins. A system documenting any significant changes is maintained, as well as pertinent discussions with the client regarding their requirements or the results of the analyses during the performance of the contract. All work subcontracted by the laboratory must be approved by the client. Any deviations from the contract must be disclosed to the client. Once the work has begun, any amendments to the contract must be discussed with the client and so documented.

- Monitoring the validity of the analyses performed and data generated in the laboratory. This activity begins with reviewing and supporting all new business contracts, insuring data quality, analyzing internal and external non-conformances to identify root cause issues and implementing the resulting corrective and preventive actions, facilitating the data review process (training, development, and accountability at the bench), and providing technical and troubleshooting expertise on routine and unusual or complex problems.
- Providing training and development programs to applicable laboratory staff as new hires and, subsequently, on a scheduled basis. Training includes instruction on calculations, instrumentation management to include troubleshooting and preventive maintenance.
- Enhancing efficiency and improving quality through technical advances and improved LIMS utilization. Capital forecasting and instrument life cycle planning for second generation methods and instruments as well as asset inventory management.
- Coordinating sample management from "cradle to grave," insuring that no time is lost in locating samples.
- Scheduling all QA/QC-related requirements for compliance, e.g., MDLs, etc..
- Captains department personnel to communicate quality, technical, personnel, and instrumental issues for a consistent team approach.
- Coordinates audit responses with the QA Manager.

4.2.19 Department Manager(s)

The Department Managers manage and direct the analytical production sections of the laboratory and act as Technical Manager of their department. He/She reports directly to either the Organics or Inorganics Operations/Technical Manager (as applicable). He/She assists the Operations/Technical Manager in determining the most efficient instrument utilization. More specifically, he/she:

- Evaluates the level of internal/external non-conformances for all departments.
- Continuously evaluates production capacity and improves capacity utilization.
- Continuously evaluates turnaround time and addresses any problems that may hinder meeting the required and committed turnaround time from the various departments.
- Develops and improves the training of all analysts in cooperation with the Operations/Technical Manager and QA Manager and in compliance with regulatory requirements.
- Ensures that scheduled instrument maintenance is completed.
- Is responsible for efficient utilization of supplies.

- Constantly monitors and modifies the processing of samples through the departments.
- Fully supports the quality system and, if called upon in the absence of the QA Manager, serves as his substitute in the interim.

4.2.20 Environmental, Health and Safety Manager

The Environmental, Health and Safety Manager reports directly to the VP of Quality, Environmental, Heath and Safety. The duties of this position consist of:

- Supervises the Environmental, Health and Safety/Facilities Team.
- Conduct ongoing, necessary safety training and conduct new employee safety orientation.
- Assist in developing and maintaining the Chemical Hygiene/Safety Manual.
- Administer dispersal of all Material Safety Data Sheet (MSDS) information.
- Perform regular chemical hygiene and housekeeping instruction.
- Give instruction on proper labeling and practice.
- Serve as chairman of the laboratory safety committee.
- Provide and train personnel on protective equipment.
- Oversee the inspection and maintenance of general safety equipment – fire extinguishers, safety showers, eyewash fountains, etc. and ensure prompt repairs as needed.
- Supervise and schedule fire drills and emergency evacuation drills.
- Determine what initial and subsequent exposure monitoring, if necessary to determine potential employee exposure to chemicals used in the laboratory.
- When determined necessary, conduct exposure monitoring assessments.
- Determine when a complaint of possible over-exposure is “reasonable” and should be referred for medical consultation.
- Assist in the internal and external coordination of the medical consultation/monitoring program conducted by TestAmerica’s medical consultants.
- Staying current with the hazardous waste regulations.
- Continuing training on hazardous waste issues.
- Reviewing and updating annually the Hazardous Waste Contingency Plan in the Environmental Health & Safety Manual.
- Auditing the staff with regard to compliance with the Hazardous Waste Contingency Plan.
- Contacting the hazardous waste subcontractors for review of procedures and opportunities for minimization of waste.

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4.2.21 EH&S/Facilities Coordinator

The EH&S/Facilities Coordinator reports directly to the Laboratory Director with a dotted line to the Environmental, Health and Safety Manager. The duties of this position consist of:

- Monitors laboratory for unsafe conditions or acts to keep lab in compliance with the Chemical Hygiene Plan, EH&S Procedures, and company policies.
- Ensures the proper personal protective equipment is available and personnel are properly trained in its use.
- Assists the Environmental, Health and Safety Manager in the investigation of accidents, incidents, and near misses and identifies and eliminates root cause.
- Conducts monthly facility inspections for compliance with health, safety and environmental regulations and procedures. Completes and forwards monthly inspection report to safety committee and laboratory management for corrective actions.
- Conducts safety equipment checks to ensure proper working order and sufficient inventory.
- Plans and tracks completion of monthly general awareness training sessions and compliance training, including new employee EH&S orientation.
- Coordinates emergency response team to provide prompt medical attention and stabilize emergency situation. After emergency is over, assists in determining appropriate clean up procedures.
- Conducts the monthly EH&S committee meeting.
- Participates in monthly EH&S conference call.
- Reviews and maintains MSDS's for laboratory materials.
- Coordinates the management and disposal of laboratory wastes.
- Assists in the preparation and maintenance of the laboratory Integrated Contingency Plan.
- Monitors air quality in facility, including monitoring fume hoods for proper operation and ventilation.
- Maintains overall building facilities and equipment as well as administers prevention maintenance measures.
- Contacts outside contractors as necessary to repair/maintain items outside the realm of reasonable maintenance.
- Performs miscellaneous errands, buying parts for labs, janitorial supplies.
- Oversees storage facilities, files and outside storage.

4.2.22 Laboratory Analysts and Technicians

Laboratory analysts and technicians are responsible for conducting analysis and performing all tasks assigned to them by the group leader or supervisor. The responsibilities of the analysts are listed below:

- Perform analyses by adhering to analytical and quality control protocols prescribed by current SOPs, this QA Manual, and project-specific plans honestly, accurately, timely, safely, and in the most cost-effective manner.
- Document standard and sample preparation, instrument calibration and maintenance, data calculations, sample matrix effects, and any observed non-conformance on worklists, benchsheets, lab notebooks and/or the Non-Conformance Database.
- Report all non-conformance situations, instrument problems, matrix problems and QC failures, which might affect the reliability of the data, to their supervisor, the Technical Manager, and/or the QA Manager or member of QA staff.
- Perform 100% review of the data generated prior to entering and submitting for secondary level review.
- Suggest method improvements to their supervisor, the Technical Manager, and the QA Manager. These improvements, if approved, will be incorporated. Ideas for the optimum performance of their assigned area, for example, through the proper cleaning and maintenance of the assigned instruments and equipment, are encouraged.
- Work cohesively as a team in their department to achieve the goals of accurate results, optimum turnaround time, cost effectiveness, cleanliness, complete documentation, and personal knowledge of environmental analysis.
- Adhere to all environmental, health and safety protocols and attend safety meetings as required.
- Attend and participate in all staff meetings.

4.2.23 Sample Control Manager

The Sample Control Manager reports to the Inorganics Operation Manager. The responsibilities are outlined below:

- Direct the logging of incoming samples into the LIMS.
- Ensure the verification of data entry from login.
- Manages the preparation and shipment of bottle kits to clients.
- Oversees the responsibilities of all Sample Control Technicians.
- Supervises the storage and disposal of all samples.

4.2.24 Senior Client Services Director

The Senior Client Services Director reports to the Vice President of Operations and Client Services with a dotted line to the laboratory director and serves as the primary interface between the laboratory and the Sales and Marketing staff. Responsibilities include:

- Laboratory's primary client representative.
- Ensures client complaints are handled professionally, and resolved in a timely manner.
- Compiles and interprets receipts forecast to show near term business trends.

- Manages a minimal list of projects/programs for key client accounts. (Note: sufficient time is needed to manage the PM group and the CSM must not be overwhelmed with project management.)
- Prepares proposals for new business opportunities.
- Compiles and interprets Bid Activity Report.
- Compiles and interprets receipts forecast to show near term business trends.
- Prepares proposals for new business opportunities.
- Provides general sales support to Account Executives for business development activities started in the field.
- Develops and maintains business materials and organized information resource files that include project descriptions, resumes, original proposals, boilerplates, and company qualifications materials.

4.2.25 Manager of Project Managers

The Manager of Project Managers reports to the Senior Client Services Director and serves as the interface between the laboratory's technical Departments and the laboratory's clients. The staff consists of the Project Management team. With the overall goal of total client satisfaction, the functions of this position are outlined below:

- Technical training and growth of the Project Management team.
- Technical liaison for the Project Management team.
- Human resource management of the Project Management team.
- Responsible for ensuring that clients receive the proper sampling supplies, as appropriate.
- Accountable for response to client inquiries concerning sample status.
- Responsible for assistance to clients regarding the resolution of problems concerning COC.
- Ensuring that client specifications, when known, are met by communicating project and quality assurance requirements to the laboratory.
- Notifying the supervisors of incoming projects and sample delivery schedules.
- Accountable to clients for communicating sample progress in daily status meeting with agreed-upon due dates.
- Responsible for discussing with client any project-related problems, resolving service issues, and coordinating technical details with the laboratory staff.
- Responsible for staff familiarization with specific quotes, sample log-in review, and final report completeness.
- Monitor the status of all data package projects in-house to ensure timely and accurate delivery of reports.
- Inform clients of data package-related problems and resolve service issues.
- Coordinate requests for sample containers and other services (data packages).

4.2.26 Project Manager (PM)

The Project Managers report directly to the Director of Project Management and serve as liaisons between the laboratory and its clients. The Project Manager's responsibilities include:

- Ensure client specifications are met by communicating project and quality assurance requirements to the laboratory.
- Notify laboratory personnel of incoming projects and sample delivery schedules.
- Monitor the status of all projects in-house to ensure timely delivery of reports.
- Inform clients of project-related problems, resolving service issues and coordinating technical issues with the laboratory staff.
- Accountable for response to client inquiries concerning sample status.
- Responsible for assistance to clients regarding the resolution of problems concerning COC.
- Ensuring that client specifications, when known, are met by communicating project and quality assurance requirements to the laboratory.
- Notifying the supervisors of incoming projects and sample delivery schedules.
- Coordinate client requests for sample containers and other services.
- Schedule sample pick-ups from client offices or project sites and notifying the laboratory staff of incoming samples.
- Coordinate subcontract work.
- Respond to client inquiries concerning sample status.
- Generates final laboratory reports and has signature authority for those reports (as designated and approved by the Laboratory Director).
- Performs final completeness review of data packages prior to release to client.

4.2.27 Project Management Assistant

The Project Management Assistant coordinates and monitors scheduling, timely completion and maintenance of project documentation files and completion of project set up and final report review, invoicing, and EDD's. Assists the Project Manager in servicing the client's needs. Specific responsibilities include:

- Reviews login confirmation reports for accuracy and corrects as needed.
- Generates diskettes for electronic data deliverables (EDD's) for electronic delivery to clients.
- Enters data that was subcontracted to other laboratories.
- Monitors report due dates for timely delivery.
- Assists Project Manager in changing compound lists, TAT, deliverables and other client specific requirements in the LIMs project and/or job database.

- Invoices completed data packages and generates credit or debit invoices to ensure proper payment.

4.2.28 Service Center Manager

The Service Center Manager (SCM) manages the service center and acts as a liaison between the laboratory and the local client base. The SCM is in charge of maintaining the Service Center facility, managing service center couriers, samplers and other personnel, and working with sales to develop, maintain and grow the client base in the area.

- Local area primary client representative for service center location.
- May head project start up meetings to ensure project objectives are successfully met and hands off project detail to assigned Project Manager(s).
- Works with the Quality Assurance Manager and Account Executives (AE) to evaluate and establish project requirements for the service center area.
- Ensures client complaints are handled professionally, and resolved in a timely manner.
- Is in charge of scheduling service center couriers and samplers, preparing bottle orders for delivery, scheduling sample pick ups and shipping samples to the designated laboratory for analysis.
- May manage a minimal list of projects/programs for key client accounts.
- Maintains the facilities at the service center and is responsible for all EH&S policies of TestAmerica at the service center.
- Responsible for all company vehicles that operate out of the service center.
- Provides general sales support to AEs for business development activities started in the field.

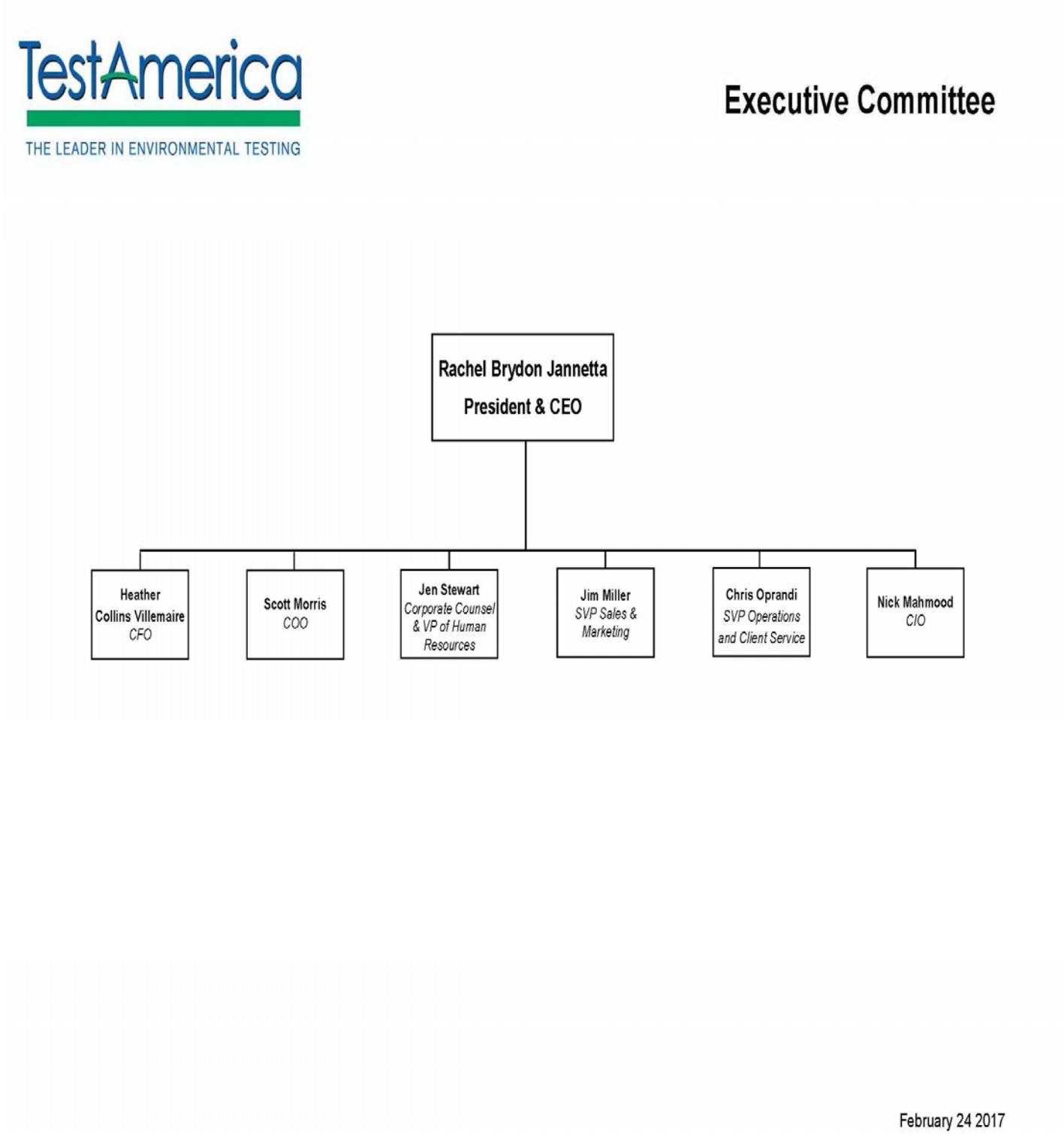
4.3 Deputies

The following table defines who assumes the responsibilities of key personnel in their absence:

Key Personnel	Deputy
Mark Acierno Laboratory Director	In the event of absence the Laboratory Director's responsibilities are shared by the Laboratory Operations Manager, the Quality Assurance Manager and the Client Services Manager, as appropriate
Carl Armbruster Quality Assurance Manager	Emmylou Digiacomo Quality Assurance Specialist Mark Acierno Laboratory Director
Sylvanus Klusey Organic Technical Manager	Donald Evans Inorganic Technical Manager

Key Personnel	Deputy
Donald Evans Inorganic Technical Manager	Sylvanus Klusey Organic Technical Manager
VOA, SVOA & Organic Prep Technical Managers	Sylvanus Klusey Organic Technical Manager
Wet Chemistry, Metals and Sample Control Managers	Donald Evans Inorganic Technical Manager
Dan Helfrich EH&S Manager	Edward Roche EH&S Coordinator
Mark Nemec Client Services Manager	Kristyn Tempe Project Manager
Kate Harrelson South Jersey/King of Prussia Service Center Manager	Alonzo Hall, Sample Control Tech. South Jersey Service Center Jeffery Keehn, Sample Control Tech. King of Prussia Service Center
John Kates Fields Services Manager	Stephen Schulze Thomas Lesinski Field Specialists – Edison Rick Toogood Dustin Miller Field Specialists – South Jersey

Figure 4-1. Corporate and Laboratory Organization Charts



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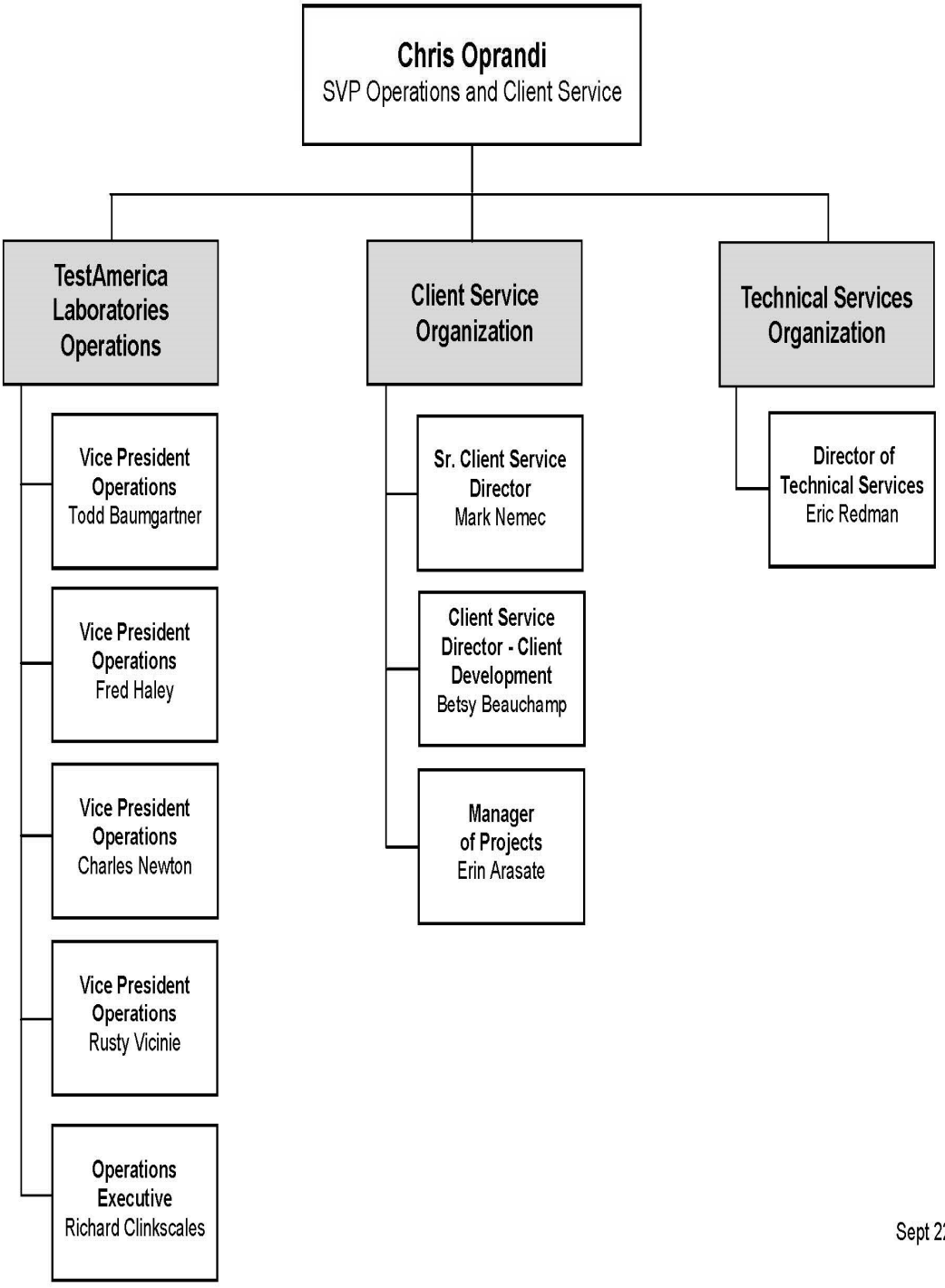

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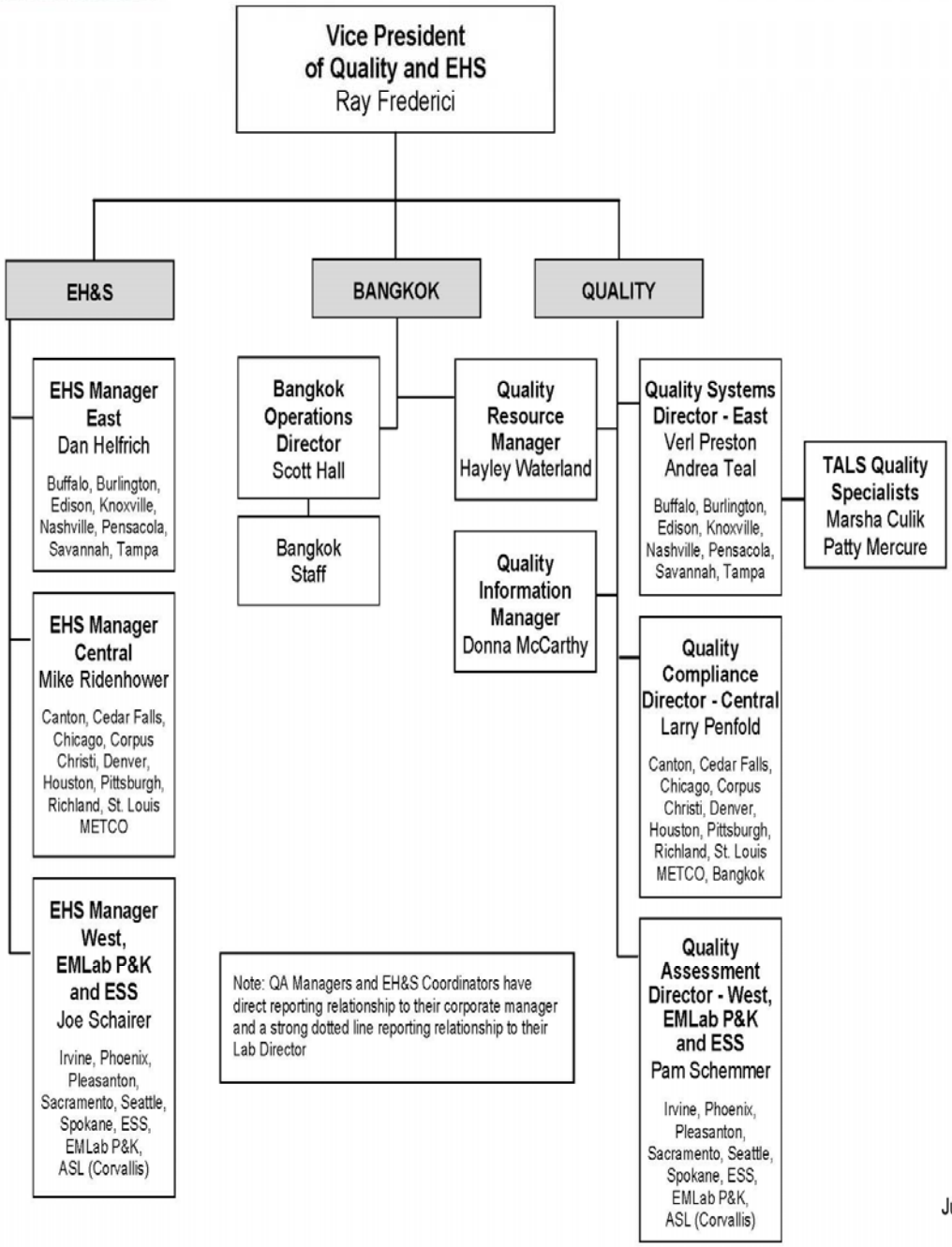
Quality, EHS, Bangkok



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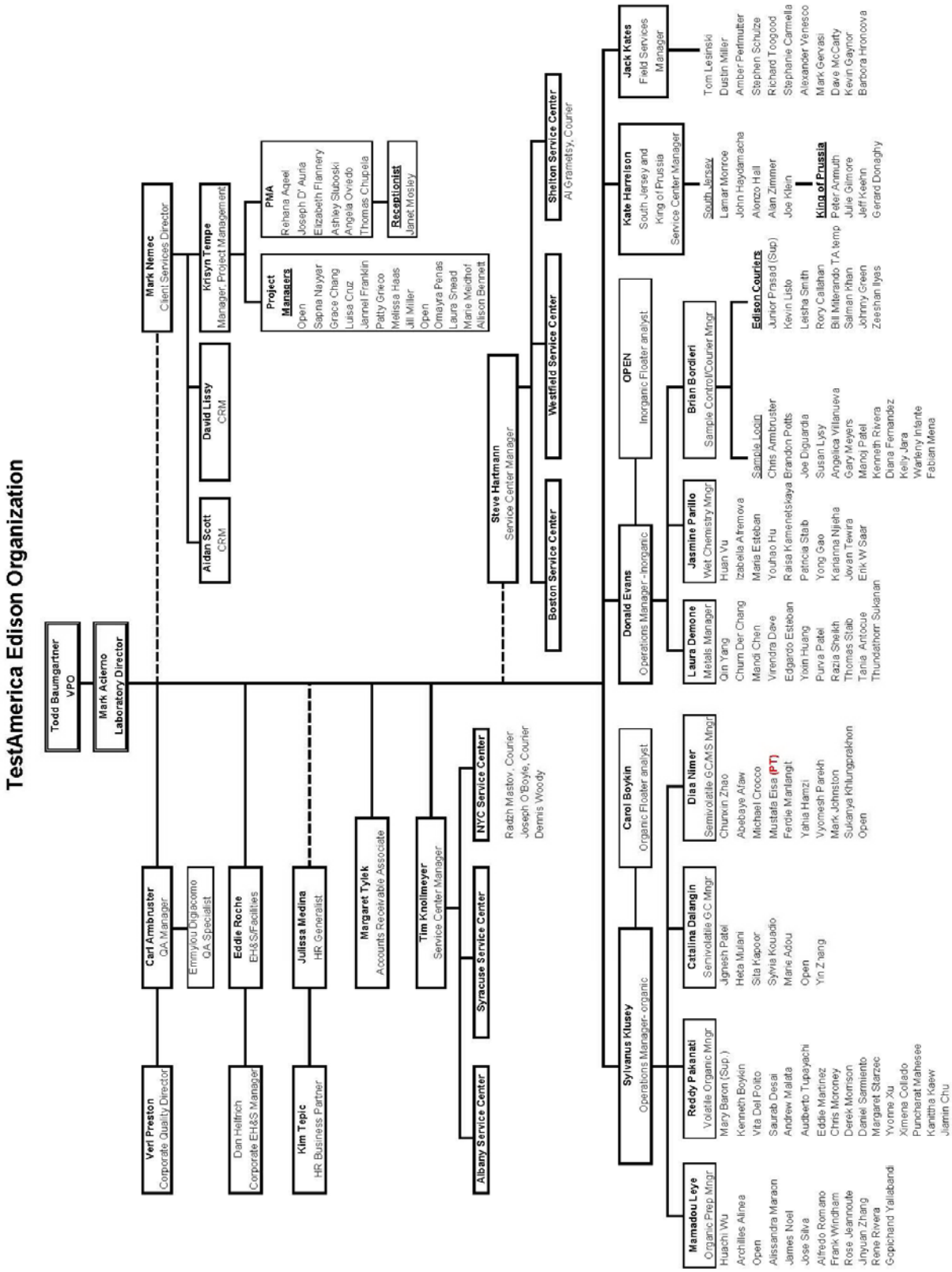

Rev. 04 Dec 2017

SECTION 5. QUALITY SYSTEM

5.1 Quality Policy Statement

It is TestAmerica's Policy to:

- ❖ Provide data of known quality to its clients by adhering to approved methodologies, regulatory requirements and the QA/QC protocols.
- ❖ Effectively manage all aspects of the laboratory and business operations by the highest ethical standards.
- ❖ Continually improve systems and provide support to quality improvement efforts in laboratory, administrative and managerial activities. TestAmerica recognizes that the implementation of a quality assurance program requires management's commitment and support as well as the involvement of the entire staff.
- ❖ Provide clients with the highest level of professionalism and the best service practices in the industry.
- ❖ To comply with the ISO/IEC 17025:2005(E) International Standard, the 2009 TNI Standard and to continually improve the effectiveness of the management system.

Every staff member at the laboratory plays an integral part in quality assurance and is held responsible and accountable for the quality of their work. It is, therefore, required that all laboratory personnel are trained and agree to comply with applicable procedures and requirements established by this document.

5.2 Ethics and Data Integrity

TestAmerica is committed to ensuring the integrity of its data and meeting the quality needs of its clients. The elements of TestAmerica's Ethics and Data Integrity Program include:

- An Ethics Policy (Corporate Policy No. CW-L-P-004) and Employee Ethics Statements.
- Ethics and Compliance Officers (ECOs).
- A Training Program.
- Self-governance through disciplinary action for violations.
- A Confidential mechanism for anonymously reporting alleged misconduct and a means for conducting internal investigations of all alleged misconduct. (Corporate SOP No. CW-L-S-002).
- Procedures and guidance for recalling data if necessary (Corporate SOP No. CA-Q-S-005).
- Effective external and internal monitoring system that includes procedures for internal audits (Section 15).
- Produce results, which are accurate and include QA/QC information that meets client pre-defined Data Quality Objectives (DQOs).
- Present services in a confidential, honest and forthright manner.

- Provide employees with guidelines and an understanding of the Ethical and Quality Standards of our Industry.
- Operate our facilities in a manner that protects the environment and the health and safety of employees and the public.
- Obey all pertinent federal, state and local laws and regulations and encourage other members of our industry to do the same.
- Educate clients as to the extent and kinds of services available.
- Assert competency only for work for which adequate personnel and equipment are available and for which adequate preparation has been made.
- Promote the status of environmental laboratories, their employees, and the value of services rendered by them.

5.3 Quality System Documentation

The laboratory's Quality System is communicated through a variety of documents.

- Quality Assurance Manual – Each laboratory has a lab-specific quality assurance manual.
- Corporate SOPs and Policies – Corporate SOPs and Policies are developed for use by all relevant laboratories. They are incorporated into the laboratory's normal SOP distribution, training and tracking system. Corporate SOPs may be general or technical.
- Work Instructions – A subset of procedural steps, tasks or forms associated with an operation of a management system (e.g., checklists, preformatted bench sheets, forms).
- Laboratory SOPs – General and Technical
- Laboratory QA/QC Policy Memorandums

5.3.1 Order of Precedence

In the event of a conflict or discrepancy between policies, the order of precedence is as follows:

- Corporate Quality Management Plan (CQMP)
- Corporate SOPs and Policies
- Laboratory QA/QC Policy Memorandum
- Laboratory Quality Assurance Manual (QAM)
- Laboratory SOPs and Policies
- Other (Work Instructions (WI), memos, flow charts, etc.)

NOTE: The laboratory has the responsibility and authority to operate in compliance with regulatory requirements of the jurisdiction in which the work is performed. Where the CQMP conflicts with those regulatory requirements, the regulatory requirements of the jurisdiction shall hold primacy. The laboratory's QAM shall take precedence over the CQMP in those cases.

5.4 QA/QC Objectives for the Measurement of Data

Quality Assurance (QA) and Quality Control (QC) are activities undertaken to achieve the goal of producing data that accurately characterize the sites or materials that have been sampled. Quality Assurance is generally understood to be more comprehensive than Quality Control. Quality Assurance can be defined as the integrated system of activities that ensures that a product or service meets defined standards.

Quality Control is generally understood to be limited to the analyses of samples and to be synonymous with the term *"analytical quality control"*. QC refers to the routine application of statistically based procedures to evaluate and control the accuracy of results from analytical measurements. The QC program includes procedures for estimating and controlling precision and bias and for determining reporting limits.

Request for Proposals (RFPs) and Quality Assurance Project Plans (QAPP) provide a mechanism for the client and the laboratory to discuss the data quality objectives in order to ensure that analytical services closely correspond to client needs. The client is responsible for developing the QAPP. In order to ensure the ability of the laboratory to meet the Data Quality Objectives (DQOs) specified in the QAPP, clients are advised to allow time for the laboratory to review the QAPP before being finalized. Additionally, the laboratory will provide support to the client for developing the sections of the QAPP that concern laboratory activities.

Historically, laboratories have described their QC objectives in terms of precision, accuracy, representativeness, comparability, completeness, selectivity and sensitivity (PARCCSS).

5.4.1 Precision

The laboratory objective for precision is to meet the performance for precision demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Precision is defined as the degree of reproducibility of measurements under a given set of analytical conditions (exclusive of field sampling variability). Precision is documented on the basis of replicate analysis, usually duplicate or matrix spike (MS) duplicate samples.

5.4.2 Accuracy

The laboratory objective for accuracy is to meet the performance for accuracy demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Accuracy is defined as the degree of bias in a measurement system. Accuracy may be documented through the use of laboratory control samples (LCS) and/or MS. A statement of accuracy is expressed as an interval of acceptance recovery about the mean recovery.

5.4.3 Representativeness

The laboratory objective for representativeness is to provide data which is representative of the sampled medium. Representativeness is defined as the degree to which data represent a characteristic of a population or set of samples and is a measurement of both analytical and field sampling precision. The representativeness of the analytical data is a function of the procedures used in procuring and processing the samples. The representativeness can be documented by the relative percent difference between separately procured, but otherwise identical samples or sample aliquots.

The representativeness of the data from the sampling sites depends on both the sampling procedures and the analytical procedures. The laboratory may provide guidance to the client regarding proper sampling and handling methods in order to assure the integrity of the samples.

5.4.4 Comparability

The comparability objective is to provide analytical data for which the accuracy, precision, representativeness and reporting limit statistics are similar to these quality indicators generated by other laboratories for similar samples, and data generated by the laboratory over time.

The comparability objective is documented by inter-laboratory studies carried out by regulatory agencies or carried out for specific projects or contracts, by comparison of periodically generated statements of accuracy, precision and reporting limits with those of other laboratories.

5.4.5 Completeness

The completeness objective for data is 90% (or as specified by a particular project), expressed as the ratio of the valid data to the total data over the course of the project. Data will be considered valid if they are adequate for their intended use. Data usability will be defined in a QAPP, project scope or regulatory requirement. Data validation is the process for reviewing data to determine its usability and completeness. If the completeness objective is not met, actions will be taken internally and with the data user to improve performance. This may take the form of an audit to evaluate the methodology and procedures as possible sources for the difficulty or may result in a recommendation to use a different method.

5.4.6 Selectivity

Selectivity is defined as: The capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. Target analytes are separated from non-target constituents and subsequently identified/detected through one or more of the following, depending on the analytical method: extractions (separation), digestions (separation), interelement corrections (separation), use of matrix modifiers (separation), specific retention times (separation and identification), confirmations with different columns or detectors (separation and identification), specific wavelengths (identification), specific mass spectra (identification), specific electrodes (separation and identification), etc..

5.4.7 Sensitivity

Sensitivity refers to the amount of analyte necessary to produce a detector response that can be reliably detected (Method Detection Limit) or quantified (Reporting Limit).

5.5 Criteria for Quality Indicators

The laboratory maintains Quality Control Limits within the Method Limit Group tables in TALS (the laboratory's LIMS) that summarize the precision and accuracy acceptability limits for performed analyses. This summary includes an effective date, is updated each time new limits are generated and are managed by the laboratory's QA department. Unless otherwise noted, limits within these tables are laboratory generated. Some acceptability limits are derived from US EPA methods when they are required. Where US EPA method limits are not required, the laboratory has developed limits from evaluation of data from similar matrices. Criteria for development of control limits is contained in Section 24.

5.6 Statistical Quality Control

Statistically-derived precision and accuracy limits are required by selected methods (such as SW-846) and programs [such as the Ohio Voluntary Action Plan (VAP)]. The laboratory routinely utilizes statistically-derived limits to evaluate method performance and determine when corrective action is appropriate. The analysts are instructed to use the current limits in the laboratory (dated and approved by the Technical Manager and QA Manager) and entered into the Laboratory Information Management System (LIMS). The Quality Assurance Department maintains an archive of all limits used within the Method Limit Group tables in TALS (LIMS). If a method defines the QC limits, the method limits are used.

If a method requires the generation of historical limits, the lab develops such limits from recent data in the QC database of the LIMS following the guidelines described in Section 24. All calculations and limits are documented and dated when approved and effective. On occasion, a client requests contract-specified limits for a specific project.

Current QC limits are entered and maintained in the LIMS analyte database. As sample results and the related QC are entered into LIMS, the sample QC values are compared with the limits in LIMS to determine if they are within the acceptable range. The analyst then evaluates if the sample needs to be rerun or re-extracted/rerun or if a comment should be added to the report explaining the reason for the QC outlier.

5.6.1 QC Charts

The QA Manager generates QC charts using the TALS Control Chart program as detailed in SOP No. ED-GEN-026 (Evaluation of Analytical Accuracy and Precision Through The Use of Control Charts). In addition to their use in generating lab specific spike recovery limits and in the evaluation of MDL studies, these charts are used to determine if adjustments need to be made or for corrective actions to methods. All such findings are documented and kept on file in the QA Department.

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5.7 Quality System Metrics

In addition to the QC parameters discussed above, the entire Quality System is evaluated on a monthly basis through the use of specific metrics (refer to Section 16). These metrics are used to drive continuous improvement in the laboratory's Quality System.

SECTION 6. DOCUMENT CONTROL

6.1 Overview

The QA Department is responsible for the control of documents used in the laboratory to ensure that approved, up-to-date documents are in circulation and out-of-date (obsolete) documents are archived or destroyed. The following documents, at a minimum, must be controlled:

- Laboratory Quality Assurance Manual
- Laboratory Standard Operating Procedures (SOP)
- Laboratory Policies
- Work Instructions and Forms
- Corporate Policies and Procedures distributed outside the intranet

Corporate Quality posts Corporate Manuals, SOPs, Policies, Work Instructions, White Papers and Training Materials on the company intranet site. These Corporate documents are only considered controlled when they are read on the intranet site. Printed copies are considered uncontrolled unless the laboratory physically distributes them as controlled documents. A detailed description of the procedure for issuing, authorizing, controlling, distributing, and archiving Corporate documents is found in Corporate SOP No. CW-Q-S-001, Corporate Document Control and Archiving. The laboratory's internal document control procedure is defined in SOP No. ED-GEN-002 (Document Control).

The laboratory QA Department also maintains access to various references and document sources integral to the operation of the laboratory. This includes reference methods and regulations. Instrument manuals (hard or electronic copies) are also maintained by the laboratory.

The laboratory maintains control of records for raw analytical data and supporting records such as audit reports and responses, logbooks, standard logs, training files, MDL studies, Proficiency Testing (PT) studies, certifications and related correspondence, and corrective action reports (CARs). Raw analytical data consists of bound logbooks, instrument printouts, any other notes, magnetic media, electronic data and final reports.

6.2 Document Approval and Issue

The pertinent elements of a document control system for each document include a unique document title and number, pagination, the total number of pages of the item or an 'end of document' page, the effective date, revision number and the laboratory's name. The QA personnel are responsible for the maintenance of this system.

Controlled documents are authorized by the QA Department. In order to develop a new document, a Department (Technical) Manager submits an electronic draft to the QA Department

for suggestions and approval before use. Upon approval, QA personnel add the identifying version information to the document and retains that document as the official document on file. That document is then provided to all applicable operational units (may include electronic access). Controlled documents are identified as such and records of their distribution are kept by the QA Department. Document control may be achieved by either electronic or hardcopy distribution.

The QA Department maintains a list of the official versions of controlled documents.

Quality System Policies and Procedures will be reviewed at a minimum of every two years and revised as appropriate. Changes to documents occur when a procedural change warrants.

6.3 Procedures for Document Control Policy

For changes to the QA Manual, refer to SOP No. ED-GEN-002 (Document Control) Uncontrolled copies must not be used within the laboratory. Previous revisions and back-up data are stored by the QA Department. Electronic copies are stored on the Public server in the QA folder for the applicable revision.

For changes to SOPs, refer to SOP No. CW-Q-S-002, Writing a Standard Operating Procedure SOP or list your labs SOP on this topic. The SOP identified above also defines the process of changes to SOPs.

Forms, worksheets, work instructions and information are organized by department in the QA office. There is a table of contents. Electronic versions are kept on a hard drive in the QA Department; hard copies are kept in QA files. The procedure for the care of these documents is in SOP ED-GEN-002 (Document Control).

6.4 Obsolete Documents

All invalid or obsolete documents are removed, or otherwise prevented from unintended use. The laboratory has specific procedures as described above to accomplish this. In general, obsolete documents are collected from employees according to distribution lists and are marked obsolete on the cover or destroyed. At least one copy of the obsolete document is archived according to SOP No. ED-GEN-002 (Document Control).

SECTION 7. SERVICE TO THE CLIENT

7.1 Overview

The laboratory has established procedures for the review of work requests and contracts, oral or written. The procedures include evaluation of the laboratory's capability and resources to meet the contract's requirements within the requested time period. All requirements, including the methods to be used, must be adequately defined, documented and understood. For many environmental sampling and analysis programs, testing design is site or program specific and does not necessarily "fit" into a standard laboratory service or product. It is the laboratory's intent to provide both standard and customized environmental laboratory services to our clients.

A thorough review of technical and QC requirements contained in contracts is performed to ensure project success. The appropriateness of requested methods, and the lab's capability to perform them must be established. Projects, proposals and contracts are reviewed for adequately defined requirements and the laboratory's capability to meet those requirements. Alternate test methods that are capable of meeting the clients' requirements may be proposed by the lab. A review of the lab's capability to analyze non-routine analytes is also part of this review process.

All projects, proposals and contracts are reviewed for the client's requirements in terms of compound lists, test methodology requested, sensitivity (detection and reporting levels), accuracy, and precision requirements (% Recovery and RPD). The reviewer ensures that the laboratory's test methods are suitable to achieve these requirements and that the laboratory holds the appropriate certifications and approvals to perform the work. The laboratory and any potential subcontract laboratories must be certified, as required, for all proposed tests.

The laboratory must determine if it has the necessary physical, personnel and information resources to meet the contract, and if the personnel have the expertise needed to perform the testing requested. Each proposal is checked for its impact on the capacity of the laboratory's equipment and personnel. As part of the review, the proposed turnaround time will be checked for feasibility.

Electronic or hard copy deliverable requirements are evaluated against the laboratory's capacity for production of the documentation.

If the laboratory cannot provide all services but intends to subcontract such services, whether to another TestAmerica facility or to an outside firm, this will be documented and discussed with the client prior to contract approval. (Refer to Section 8 for Subcontracting Procedures.)

The laboratory informs the client of the results of the review if it indicates any potential conflict, deficiency, lack of accreditation, or inability of the lab to complete the work satisfactorily. Any discrepancy between the client's requirements and the laboratory's capability to meet those requirements is resolved in writing before acceptance of the contract. It is necessary that the contract be acceptable to both the laboratory and the client. Amendments initiated by the client and/or TestAmerica, are documented in writing.

All contracts, QAPPs, Sampling and Analysis Plans (SAPs), contract amendments, and documented communications become part of the project record.

The same contract review process used for the initial review is repeated when there are amendments to the original contract by the client, and the participating personnel are informed of the changes.

7.2 Review Sequence and Key Personnel

Appropriate personnel will review the work request at each stage of evaluation.

For routine projects and other simple tasks, a review by the Project Manager (PM) is considered adequate. The PM confirms that the laboratory has any required certifications, that it can meet the clients' data quality and reporting requirements and that the lab has the capacity to meet the

clients turn around needs. It is recommended that, where there is a sales person assigned to the account, an attempt should be made to contact that sales person to inform them of the incoming samples.

For new, complex or large projects, the proposed contract is given to the Client Relations Manager (CRM) or CRM Proposal Team, who will decide which lab will receive the work based on the scope of work and other requirements, including certification, testing methodology, and available capacity to perform the work. The contract review process is outlined in TestAmerica's Corporate SOP No. CA-L-P-002**,** Contract Compliance Policy.
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This review encompasses all facets of the operation. The scope of work is distributed to the appropriate personnel, as needed based on scope of contract, to evaluate all of the requirements shown above (not necessarily in the order below).

- Contract Administrator
- VP of Operations
- The Laboratory Client Services Manager
- The Laboratory Project Manager
- Laboratory and/or Corporate Technical Managers / Directors
- Laboratory and/or Corporate Information Technology Managers/Directors
- Account Executives
- Laboratory and/or Corporate Quality
- Laboratory and/or Corporate Environmental Health and Safety Managers/Directors
- The Laboratory Director reviews the formal laboratory quote and makes final acceptance for their facility.

The Sales Director, Contract Administrator, Account Executive or Proposal Coordinator then submits the final proposal to the client.

In the event that one of the above personnel is not available to review the contract, his or her back-up will fulfill the review requirements.

The Contracts Administrator maintains copies of all signed contracts**.** The applicable Project Manager maintains local copies of signed contracts.

7.3 Documentation

Appropriate records are maintained for every contract or work request. All stages of the contract review process are documented and include records of any significant changes. These records are maintained in the project file by the Project Manager and/or Key Account Executive. The contract will be distributed to and maintained by the appropriate sales/marketing personnel and the Account Executive. A copy of the contract and formal quote will be filed with the laboratory PM and the Laboratory Director.

Records are maintained of pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract. The PM keeps a phone log of conversations with the client.

7.3.1 Project-Specific Quality Planning

Communication of contract specific technical and QC criteria is an essential activity in ensuring the success of site specific testing programs. To achieve this goal, a PM is assigned to each client. It is the PM's responsibility to ensure that project-specific technical and QC requirements are effectively evaluated and communicated to the laboratory personnel before and during the project. QA department involvement may be needed to assist in the evaluation of custom QC requirements.

PM's are the primary client contact and they ensure resources are available to meet project requirements. Although PM's do not have direct reports or staff in production, they coordinate opportunities and work with laboratory management and supervisory staff to ensure available resources are sufficient to perform work for the client's project. Project management is positioned between the client and laboratory resources.

Prior to work on a new project, the dissemination of project information and/or project opening meetings may occur to discuss schedules and unique aspects of the project. Items to be discussed may include the project technical profile, turnaround times, holding times, methods, analyte lists, reporting limits, deliverables, sample hazards, or other special requirements. The PM introduces new projects to the laboratory staff through project kick-off meetings or to the supervisory staff during production meetings. These meetings provide direction to the laboratory staff in order to maximize production and client satisfaction, while maintaining quality. In addition, project notes may be associated with each sample batch as a reminder upon sample receipt and analytical processing.

During the project, any change that may occur within an active project is agreed upon between the client/regulatory agency and the PM/laboratory. These changes (e.g., use of a non-standard method or modification of a method) and approvals must be documented prior to implementation. Documentation pertains to any document, e.g., letter, e-mail, variance, contract addendum, which has been signed by both parties.

Such changes are also communicated to the laboratory during production meetings. Such changes are updated to the project notes and are introduced to the managers at these meetings. The laboratory staff is then introduced to the modified requirements via the PM or the individual laboratory Department (Technical) Manager. After the modification is implemented into the laboratory process, documentation of the modification is made in the case narrative of the data report(s).

The laboratory strongly encourages client visits to the laboratory and for formal/informal information sharing session with employees in order to effectively communicate ongoing client needs as well as project specific details for customized testing programs.

7.4 Special Services

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. It is the laboratory's goal to meet all client requirements in addition to statutory and regulatory requirements. The laboratory has procedures to ensure confidentiality to clients (Section 15 and 25).

The laboratory's standard procedures for reporting data are described in Section 25. Special services are also available and provided upon request. These services include:

- Reasonable access for our clients or their representatives to the relevant areas of the laboratory for the witnessing of tests performed for the client.
- Assist client-specified third party data validators as specified in the client's contract.
- Supplemental information pertaining to the analysis of their samples. Note: An additional charge may apply for additional data/information that was not requested prior to the time of sample analysis or previously agreed upon.

7.5 Client Communication

Project managers are the primary communication link to the clients. They shall inform their clients of any delays in project completion as well as any non-conformances in either sample receipt or sample analysis. Project management will maintain ongoing client communication throughout the entire client project.

Technical Managers are available to discuss any technical questions or concerns that the client may have.

7.6 Reporting

The laboratory works with our clients to produce any special communication reports required by the contract.

7.7 Client Surveys

The laboratory assesses both positive and negative client feedback. The results are used to improve overall laboratory quality and client service. TestAmerica's Sales and Marketing teams periodically develops lab and client specific surveys to assess client satisfaction.

SECTION 8. SUBCONTRACTING OF TESTS

8.1 Overview

For the purpose of this quality manual, the phrase subcontract laboratory refers to a laboratory external to the TestAmerica laboratories. The phrase "work sharing" refers to internal transfers of samples between the TestAmerica laboratories. The term outsourcing refers to the act of subcontracting tests.

When contracting with our clients, the laboratory makes commitments regarding the services to be performed and the data quality for the results to be generated. When the need arises to outsource testing for our clients because project scope, changes in laboratory capabilities, capacity or unforeseen circumstances, we must be assured that the subcontractors or work sharing laboratories understand the requirements and will meet the same commitments we have made to the client. Refer to TestAmerica's Corporate SOP's on Subcontracting Procedures CW-L-S-004 and the Work Sharing Process (CA-C-S-001).

When outsourcing analytical services, the laboratory will assure, to the extent necessary, that the subcontract or work sharing laboratory maintains a program consistent with the requirements of this document, the requirements specified in TNI/ISO 17025 and/or the client's Quality Assurance Project Plan (QAPP). All QC guidelines specific to the client's analytical program are transmitted to the subcontractor and agreed upon before sending the samples to the subcontract facility. Additionally, work requiring accreditation will be placed with an appropriately accredited laboratory. The laboratory performing the subcontracted work will be identified in the final report, as will non-TNI accredited work where required.

Project Managers (PMs), Client Service Managers (CSM) or Account Executives (AE) for the Export Lab (TestAmerica laboratory that transfers samples to another laboratory) are responsible for obtaining client approval prior to subcontracting any samples. The laboratory will advise the client of a subcontract arrangement in writing and when possible approval from the client shall be retained in the project folder. Standard TestAmerica Terms & Conditions include the flexibility to subcontract samples within the TestAmerica laboratories. Therefore, additional advance notification to clients for intra-laboratory subcontracting is not necessary unless specifically required by a client contract.

Note: In addition to the client, some regulating agencies (e.g., USDA) or contracts require notification prior to placing such work.

8.2 Qualifying and Monitoring Subcontractors

Whenever a PM, Account Executive (AE) or Client Service Manager (CSM) becomes aware of a client requirement or laboratory need where samples must be outsourced to another laboratory, the other laboratory(s) shall be selected based on the following:

- Subcontractors specified by the client - In these circumstances, the client assumes responsibility for the quality of the data generated from the use of a subcontractor.
- Subcontractors reviewed by TestAmerica – Firms which have been reviewed by the company and are known to meet standards for accreditations (e.g., State, TNI and

DoD/DOE); technical specifications; legal and financial information.

A listing of vendors is available on the TestAmerica intranet site.

All TestAmerica laboratories are pre-qualified for work sharing provided they hold the appropriate accreditations, can adhere to the project/program requirements, and the client approved sending samples to that laboratory. The client must provide acknowledgement that the samples can be sent to that facility (an e-mail is sufficient documentation or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented). The originating laboratory is responsible for communicating all technical, quality, and deliverable requirements as well as other contract needs. (Corporate SOP No. CA-C-S-001, Work Sharing Process).

8.2.1 When the potential sub-contract laboratory has not been previously approved, Account Executives or PMs may nominate a laboratory as a subcontractor based on need. The decision to nominate a laboratory must be approved by the Client Relations Manager (CRM) or Laboratory Director. The CRM or Laboratory Director requests that the QA Manager or PM begin the process of approving the subcontract laboratory as outlined in Corporate SOP No. CW-L-S-004, Subcontracting Procedures.

Once the appropriate accreditation and legal information is received by the laboratory, it is evaluated for acceptability (where applicable) and forwarded to the Corporate Quality Information Manager (QIM) for review. After the Corporate QIM reviews the documents for completeness, the information is forwarded to the Finance Department for formal signature and contracting with the laboratory. The approved vendor will be added to the approved subcontractor list on the intranet site and the finance group is concurrently notified for JD Edwards.

The client will assume responsibility for the quality of the data generated from the use of a subcontractor they have requested the lab to use. The qualified subcontractors on the intranet site are known to meet minimal standards. TestAmerica does not certify laboratories. The subcontractors on our approved list can only be recommended to the extent that we would use them.

8.3 Oversight and Reporting

8.3.1 The status and performance of qualified subcontractors will be monitored by the Corporate Quality department. Any problems identified will be brought to the attention of TestAmerica's Corporate Finance, Legal and Corporate Quality personnel.

- Complaints shall be investigated. Documentation of the complaint, investigation and corrective action will be maintained in the subcontractor's file on the intranet site. Complaints are posted using the Vendor Performance Report.
- Information shall be updated on the intranet when new information is received from the subcontracted laboratories.
- Subcontractors in good standing will be retained on the intranet listing. CSO personnel will notify all TestAmerica laboratories, Corporate Quality and Corporate Contracts if any laboratory requires removal from the intranet site. This notification will be posted on the intranet site and e-mailed to all CSO Personnel, Laboratory Directors, QA Managers and

Sales Personnel.

Prior to initially sending samples to the subcontracted laboratory, the PM confirms their certification status to determine if it's current and scope-inclusive. The information is documented within the project records.

8.3.2 For continued use of a subcontractor, verification of certification is placed upon the subcontractor for the defined project. Samples are subcontracted under Chain of Custody with the program defined as 'Accreditation Required' and the following statement for verification upon sample receipt:

Note: Since laboratory accreditations are subject to change, TestAmerica Laboratories, Inc. places the ownership of method, analyte & accreditation compliance upon our subcontract laboratories. This sample shipment is forwarded under Chain of Custody. If the laboratory does not currently maintain accreditation in the State of Origin listed above for analytes/tests/matrix being analyzed, the samples must be shipped back to the TestAmerica laboratory or other instructions will be provided. Any changes to accreditation status should be brought to TestAmerica Laboratories, Inc. attention immediately. If all requested accreditations are current to date, return the signed Chain of Custody attesting to said compliance to TestAmerica Laboratories, Inc.

For TestAmerica laboratories, certifications can be viewed on the company's TotalAccess Database.

8.3.3 All subcontracted samples must be accompanied by a TestAmerica Chain of Custody (COC). A copy of the original COC sent by the client must be available in TALS for all samples workshared within TestAmerica. Client COCs are only forwarded to external subcontractors when samples are shipped directly from the project site to the subcontractor lab. Under routine circumstances, client COCs are not provided to external subcontractors.

Through communication with the subcontracted laboratory, the PM monitors the status of the subcontracted analyses, facilitates successful execution of the work, and ensures the timeliness and completeness of the analytical report.

Non-TNI accredited work must be identified in the subcontractor's report as appropriate. If TNI accreditation is not required, the report does not need to include this information.

Reports submitted from subcontractor laboratories are not altered and are included in their original form in the final project report. This clearly identifies the data as being produced by a subcontractor facility. If subcontract laboratory data is incorporated into the laboratories EDD (i.e., imported), the report must explicitly indicate which lab produced the data for which methods and samples.

Note: The results submitted by a TestAmerica work sharing laboratory may be transferred electronically and the results reported by the TestAmerica work sharing lab are identified on the final report. The report must explicitly indicate which lab produced the data for which methods and samples. The final report must include a copy of the completed COC for all work sharing reports.

8.4 Contingency Planning

The full qualification of a subcontractor may be waived to meet emergency needs; however, this decision & justification must be documented in the project files, and the 'Purchase Order Terms And Conditions For Subcontracted Laboratory Services' must be sent with the samples and COC.

In the event this provision is utilized, the laboratory (e.g., PM) will be required to verify and document the applicable accreditations of the subcontractor. All other quality and accreditation requirements will still be applicable, but the subcontractor need not have signed a subcontract with TestAmerica at this time.

The use of any emergency subcontractor will require the PM to complete a JDE New Vendor Add Form in order to process payment to the vendor and add them to TALS. This form requires the user to define the subcontractor's category/s of testing and the reason for testing.

SECTION 9. PURCHASING SERVICES AND SUPPLIES

9.1 Overview

Evaluation and selection of suppliers and vendors is performed, in part, on the basis of the quality of their products, their ability to meet the demand for their products on a continuous and short term basis, the overall quality of their services, their past history, and competitive pricing. This is achieved through evaluation of objective evidence of quality furnished by the supplier, which can include certificates of analysis, recommendations, and proof of historical compliance with similar programs for other clients. To ensure that quality critical consumables and equipment conform to specified requirements, which may affect quality, all purchases from specific vendors are approved by a member of the supervisory or management staff. Capital expenditures are made in accordance with TestAmerica's Capital Expenditure, Controlled Purchase Requests and Fixed Asset Capitalization, SOP No. CW-F-S-007.

Contracts will be signed in accordance with TestAmerica's Company-Wide Authorization Matrix Policy, Policy No. CW-F-P-002. Request for Proposals (RFP's) will be issued where more information is required from the potential vendors than just price. Process details are available in TestAmerica's Corporate Procurement and Contracts Policy (Policy No. CW-F-P-004). RFP's allow TestAmerica to determine if a vendor is capable of meeting requirements such as supplying all of the TestAmerica facilities, meeting required quality standards and adhering to necessary ethical and environmental standards. The RFP process also allows potential vendors to outline any additional capabilities they may offer.

9.2 Glassware

Glassware used for volumetric measurements must be Class A or verified for accuracy according to laboratory procedure. Pyrex (or equivalent) glass should be used where possible. For safety purposes, thick-wall glassware should be used where available.

9.3 Reagents, Standards & Supplies

Purchasing guidelines for equipment, consumables, and reagents must meet the requirements of the specific method and testing procedures for which they are being purchased. Solvents and acids are pre-tested in accordance with TestAmerica's Corporate SOP on Solvent & Acid Lot

Testing & Approval, SOP No. CA-Q-S-001. Approval information for the solvents and acids tested under SOP CA-Q-S-001 is stored on the TestAmerica SharePoint, under Solvent Approvals. A master list of all tested materials, as well as the certificates of analysis for the materials, is stored in the same location.

9.3.1 Purchasing

Chemical reagents, solvents, glassware, and general supplies are ordered as needed to maintain sufficient quantities on hand. Materials used in the analytical process must be of a known quality. The wide variety of materials and reagents available makes it advisable to specify recommendations for the name, brand, and grade of materials to be used in any determination. This information is contained in the method SOP. The analyst may check the item out of the on-site consignment system that contains items approved for laboratory use.

If an item is not available from the on-site consignment, the analyst must provide the master item number (from the master item list that has been approved by the Technical Manager), item description, package size, catalogue page number, and the quantity needed. If an item being ordered is not the exact item requested, approval must be obtained from the Technical Manager prior to placing the order. The Department (Technical) Manager or the Laboratory Operations Manager places the order.

9.3.2 Receiving

It is the responsibility of the purchasing manager to receive the shipment. It is the responsibility of the analyst who ordered the materials to document the date materials were received. Once the ordered reagents or materials are received, the analyst compares the information on the label or packaging to the original order to ensure that the purchase meets the quality level specified. This is documented through the addition of the received date and initials to the information present on the daily order log.

The purchasing manager verifies the lot numbers of received solvents and acids against the pre-approval lists. If a received material is listed as unapproved, or is not listed, it is sequestered and returned to the vendor. Alternatively, the laboratory may test the material for the intended use, and if it is acceptable, document the approval on the approval list. Records of any testing performed locally are maintained on the shared “public” folder on the computer network.

Materials may not be released for use in the laboratory until they have been inspected, verified as suitable for use, and the inspection/verification has been documented.

Safety Data Sheets (SDSs) are available online through the Company’s intranet website. Anyone may review these for relevant information on the safe handling and emergency precautions of on-site chemicals.

9.3.3 Specifications

Methods in use in the laboratory specify the grade of reagent that must be used in the procedure. If the quality of the reagent is not specified, analytical reagent grade will be used. It

is the responsibility of the analyst to check the procedure carefully for the suitability of grade of reagent.

Chemicals must not be used past the manufacturer's expiration date and must not be used past the expiration time noted in a method SOP. If expiration dates are not provided, the laboratory may contact the manufacturer to determine an expiration date.

The laboratory assumes a five year expiration date on inorganic dry chemicals and solvents unless noted otherwise by the manufacturer or by the reference source method. Chemicals/solvents should not be used past the manufacturer's or SOPs expiration date unless 'verified' (refer to item 3 listed below).

- An expiration date **cannot** be extended if the dry chemical/solvent is discolored or appears otherwise physically degraded, the dry chemical/solvent must be discarded.
- Expiration dates can be extended if the dry chemical/solvent is found to be satisfactory based on acceptable performance of quality control samples (Continuing Calibration Verification (CCV), Blanks, Laboratory Control Sample (LCS), etc.).
- If the dry chemical/solvent is used for the preparation of standards, the expiration dates can be extended 6 months if the dry chemical/solvent is compared to an unexpired independent source in performing the method and the performance of the dry chemical/solvent is found to be satisfactory. The comparison must show that the dry chemical/solvent meets CCV limits. The comparison studies are maintained in the analytical Department.

Wherever possible, standards must be traceable to national or international standards of measurement or to national or international reference materials. Records to that effect are available to the user.

Compressed gases in use are checked for pressure and secure positioning daily. To prevent a tank from going to dryness, or introducing potential impurities, the pressure should be closely watched as it decreases to approximately 15% of the original reading, at which point it should be replaced. For example, a standard sized laboratory gas cylinder containing 3,000 psig of gas should be replaced when it drops to approximately 500 psig. The quality of the gases must meet method or manufacturer specification or be of a grade that does not cause any analytical interference.

Water used in the preparation of standards or reagents must have a specific conductivity of less than 1- µmho/cm (or specific resistivity of greater than 1.0 megohm-cm) at 25°C. The specific conductivity is checked and recorded daily. If the water's specific conductivity is greater than the specified limit, the Facility Manager and appropriate Technical Managers must be notified immediately in order to notify all departments, decide on cessation (based on intended use) of activities, and make arrangements for correction.

The laboratory may purchase reagent grade (or other similar quality) water for use in the laboratory. This water must be certified "clean" by the supplier for all target analytes or otherwise verified by the laboratory prior to use. This verification is documented.

Standard lots are verified before first time use if the laboratory switches manufacturers or has historically had a problem with the type of standard.

Purchased bottleware used for sampling must be certified clean and the certificates must be maintained. If uncertified sampling bottleware is purchased, all lots must be verified clean prior to use. This verification must be maintained.

Records of manufacturer's certification and traceability statements are maintained in files or binders in each laboratory section. These records include date of receipt, lot number (when applicable), and expiration date (when applicable). Incorporation of the item into the record indicates that the analyst has compared the new certificate with the previous one for the same purpose and that no difference is noted, unless approved and so documented by the Technical Manager or QA Manager.

9.3.4 Storage

Reagent and chemical storage is important from the aspects of both integrity and safety. Light-sensitive reagents may be stored in brown-glass containers. Storage conditions are per the Corporate Environmental Health & Safety Manual (Corp. Doc. No. CW-E-M-001) and method SOPs or manufacturer instructions.

9.4 Purchase of Equipment / Instruments / Software

When a new piece of equipment is needed, either for additional capacity or for replacing inoperable equipment, the analyst or supervisor makes a supply request to the Technical Manager and/or the Laboratory Director. If they agree with the request, the procedures outlined in TestAmerica's Corporate Policy No. CA-T-P-001, Qualified Products List, are followed. A decision is made as to which piece of equipment can best satisfy the requirements. The appropriate written requests are completed and purchasing places the order.

Upon receipt of a new or used piece of equipment, a unique identification name is assigned and provided to the QA Department for inclusion on the laboratory master equipment list. IT must also be notified so that they can synchronize the instrument for back-ups. Its capability is assessed to determine if it is adequate or not for the specific application. For instruments, a calibration curve is generated, followed by MDLs, Demonstration of Capabilities (DOCs), and other relevant criteria (refer to Section 19). For software, its operation must be deemed reliable and evidence of instrument verification must be retained by the IT Department or QA Department. Software certificates supplied by the vendors are filed with the LIMS Administrator. The manufacturer's operation manual is retained at the bench.

9.5 Services

Service to analytical instruments (except analytical balances) is performed on an as needed basis. Routine preventative maintenance is discussed in Section 20. The need for service is determined by analysts and/or Technical Managers. The service providers that perform the services are approved by the Technical Manager and/or the Laboratory Operations Managers.

Analytical balances are serviced and calibrated annually in accordance with TestAmerica Edison SOP ED-GEN-010 (Calibration of Analytical Balances). The calibration and maintenance services are performed on-site, and the balances are returned to use immediately following successful calibration. When the calibration certificates are received (usually within two weeks of the service), they are reviewed, and documentation of the review is filed with the certificates. If the calibration was unsuccessful, the balance is immediately removed from service and segregated pending either further maintenance or disposal.

Calibration services for support equipment such as thermometers, weight sets, autopipettors, etc, are obtained from vendors with current and valid ISO 17025 accreditation for calibration of the specific piece of equipment. Prior to utilizing the vendor's services, the vendor's accreditation status is verified. Once the equipment has been calibrated, the calibration certificates are reviewed by the QA department, and documentation of the review is filed with the calibration certificates. The equipment is then returned to service within the laboratory

9.6 Suppliers

TestAmerica selects vendors through a competitive proposal / bid process, strategic business alliances or negotiated vendor partnerships (contracts). This process is defined in the Procurement & Contracts Policy (Policy No. CW-F-P-004). The level of control used in the selection process is dependent on the anticipated spending amount and the potential impact on TestAmerica business. Vendors that provide test and measuring equipment, solvents, standards, certified containers, instrument related service contracts or subcontract laboratory services shall be subject to more rigorous controls than vendors that provide off-the-shelf items of defined quality that meet the end use requirements. The JD Edwards purchasing system includes all suppliers/vendors that have been approved for use.

Evaluation of suppliers is accomplished by ensuring the supplier ships the product or material ordered and that the material is of the appropriate quality. This is documented by signing off on packing slips or other supply receipt documents. The purchasing documents contain the data that adequately describe the services and supplies ordered.

Any issues of vendor performance are to be reported immediately by the laboratory staff to the Corporate Purchasing Group by completing a Vendor Performance Report.

The Corporate Purchasing Group will work through the appropriate channels to gather the information required to clearly identify the problem and will contact the vendor to report the problem and to make any necessary arrangements for exchange, return authorization, credit, etc.

As deemed appropriate, the Vendor Performance Reports will be summarized and reviewed to determine corrective action necessary, or service improvements required by vendors

The laboratory has access to a listing of all approved suppliers of critical consumables, supplies and services. This information is provided through the JD Edwards purchasing system.

9.6.1 New Vendor Procedure

TestAmerica employees who wish to request the addition of a new vendor must complete a J.D. Edwards Vendor Add Request Form.

New vendors are evaluated based upon criteria appropriate to the products or services provided as well as their ability to provide those products and services at a competitive cost. Vendors are also evaluated to determine if there are ethical reasons or potential conflicts of interest with TestAmerica employees that would make it prohibitive to do business with them as well as their financial stability. The QA Department and/or the Technical Services Director are consulted with vendor and product selection that have an impact on quality.

SECTION 10. COMPLAINTS

10.1 Overview

The laboratory considers an effective client complaint handling processes to be of significant business and strategic value. Listening to and documenting client concerns captures 'client knowledge' that enables our operations to continually improve processes and client satisfaction. An effective client complaint handling process also provides assurance to the data user that the laboratory will stand behind its data, service obligations and products.

A client complaint is any expression of dissatisfaction with any aspect of our business services (e.g., communications, responsiveness, data, reports, invoicing and other functions) expressed by any party, whether received verbally or in written form. Client inquiries, complaints or noted discrepancies are documented, communicated to management, and addressed promptly and thoroughly.

The laboratory has procedures for addressing both external and internal complaints with the goal of providing satisfactory resolution to complaints in a timely and professional manner.

The nature of the complaint is identified, documented and investigated, and an appropriate action is determined and taken. In cases where a client complaint indicates that an established policy or procedure was not followed, the QA Department must evaluate whether a special audit must be conducted to assist in resolving the issue. A written confirmation or letter to the client, outlining the issue and response taken is recommended as part of the overall action taken.

The process of complaint resolution and documentation utilizes the procedures outlined in Section 12 (Corrective Actions) and is documented following TestAmerica Edison SOP No. ED-GEN-003 (Control of Non-Conformances and Corrective Action).

10.2 External Complaints

An employee that receives a complaint initiates the complaint resolution process by first documenting the complaint according to TestAmerica Edison SOP No. ED-GEN-003 (Control of Non-Conformances and Corrective Action).

Complaints fall into two categories: correctable and non-correctable. An example of a correctable complaint would be one where a report re-issue would resolve the complaint. An example of a non-correctable complaint would be one where a client complains that their data was repeatedly late. Non-correctable complaints should be reviewed for preventive action measures to reduce the likelihood of future occurrence and mitigation of client impact.

The general steps in the complaint handling process are:

- Receiving and Documenting Complaints
- Complaint Investigation and Service Recovery
- Process Improvement

The laboratory shall inform the initiator of the complaint of the results of the investigation and the corrective action taken, if any.

10.3 Internal Complaints

Internal complaints include, but are not limited to: errors and non-conformances, training issues, internal audit findings, and deviations from methods. Corrective actions may be initiated by any staff member who observes a nonconformance and shall follow the procedures outlined in Section 12. In addition, Corporate Management, Sales and Marketing and IT may initiate a complaint by contacting the laboratory or through the corrective action system described in Section 12.

10.4 Management Review

The number and nature of client complaints is reported by the QA Manager to the laboratory and Quality Director in the QA Monthly report. Monitoring and addressing the overall level and nature of client complaints and the effectiveness of the solutions is part of the Annual Management Review (Section 16).

SECTION 11. CONTROL OF NON-CONFORMING WORK

11.1 Overview

When data discrepancies are discovered or deviations and departures from laboratory SOPs, policies and/or client requests have occurred, corrective action is taken immediately. First, the laboratory evaluates the significance of the nonconforming work. Then, a corrective action plan is initiated based on the outcome of the evaluation. If it is determined that the nonconforming work is an isolated incident, the plan could be as simple as adding a qualifier to the final results and/or making a notation in the case narrative. If it is determined that the nonconforming work is a systematic or improper practices issue, the corrective action plan could include a more in depth investigation and a possible suspension of an analytical method. In all cases, the actions taken are documented using the laboratory's corrective action system (refer to Section 12).

Due to the frequently unique nature of environmental samples, sometimes departures from documented policies and procedures are needed. When an analyst encounters such a situation, the problem is presented to the Department (Technical) Manager for resolution. The

manager may elect to discuss it with the Lab Director and/or QA Manager or have a representative contact the client to decide on a logical course of action. Once an approach is agreed upon, the analyst documents it using the laboratories corrective action system described in Section 12. This information can then be supplied to the client in the form of a footnote or a case narrative with the report.

Project Management may encounter situations where a client may request that a special procedure be applied to a sample that is not standard lab practice. Based on a technical evaluation, the lab may accept or opt to reject the request based on technical or ethical merit. An example might be the need to report a compound that the lab does not normally report. The lab would not have validated the method for this compound following the procedures in Section 19. The client may request that the compound be reported based only on the calibration. Such a request would need to be approved by the Laboratory Director and QA Manager, documented and included in the project folder. Deviations **must** also be noted on the final report with a statement that the compound is not reported in compliance with TNI (or the analytical method) requirements and the reason. Data being reported to a non-TNI state would need to note the change made to how the method is normally run.

11.2 Responsibilities and Authorities

Under certain circumstances, the Laboratory Director, a Technical Manager, or a member of the QA team may authorize departures from documented procedures or policies. The departures may be a result of procedural changes due to the nature of the sample; a one-time procedure for a client; QC failures with insufficient sample to reanalyze, etc.. In most cases, the client will be informed of the departure prior to the reporting of the data. Any departures must be well documented using the laboratory's corrective action procedures. This information may also be documented in logbooks and/or data review checklists as appropriate**.** Any impacted data must be referenced in a case narrative and/or flagged with an appropriate data qualifier.

Any misrepresentation or possible misrepresentation of analytical data discovered by any laboratory staff member must be reported to facility Senior Management within 24-hours. The Senior Management staff is comprised of the Laboratory Director, the QA Manager, and the Technical Managers. The reporting of issues involving alleged violations of the company's Data Integrity or Manual Integration procedures must be conveyed to an ECO (e.g., the VP-QA/EHS) and the laboratory's Quality Director within 24 hours of discovery.

Whether an inaccurate result was reported due to calculation or quantitation errors, data entry errors, improper practices, or failure to follow SOPs, the data must be evaluated to determine the possible effect.

The Laboratory Director, QA Manager, ECOs, VP of Operations and the Quality Directors have the authority and responsibility to halt work, withhold final reports, or suspend an analysis for due cause as well as authorize the resumption of work.

11.3 Evaluation of Significance and Actions Taken

For each nonconforming issue reported, an evaluation of its significance and the level of management involvement needed is made. This includes reviewing its impact on the final data,

whether or not it is an isolated or systematic issue, and how it relates to any special client requirements.

Corporate SOP entitled Data Recalls (CW-Q-S-005) is the procedure to be followed when it is discovered that erroneous or biased data may have been reported to clients or regulatory agencies.

Corporate SOP entitled Internal Investigations (CW-L-S-002) is the procedure to be followed for investigation and correction of situations involved alleged incidents of misconduct or violation of the company's ethics policy.

Laboratory level decisions are documented and approved using the laboratory's standard nonconformance/corrective action reporting in lieu of the data recall determination form contained in TestAmerica's Corporate SOP No. CW-Q-S-005.

11.4 Prevention of Nonconforming Work

If it is determined that the nonconforming work could recur, further corrective actions must be made following the laboratory's corrective action system. On a monthly basis, the QA Department evaluates non-conformances to determine if any nonconforming work has been repeated multiple times. If so, the laboratory's corrective action process may be followed.

11.5 Method Suspension / Restriction (Stop Work Procedures)

In some cases, it may be necessary to suspend/restrict the use of a method or target compound which constitutes significant risk and/or liability to the laboratory. Suspension/restriction procedures can be initiated by any of the persons noted in Section 11.2, Paragraph 5.

Prior to suspension/restriction, confidentiality will be respected, and the problem with the required corrective and preventive action will be stated in writing and presented to the Laboratory Director.

The Laboratory Director shall arrange for the appropriate personnel to meet with the QA Manager as needed. This meeting shall be held to confirm that there is a problem, that suspension/restriction of the method is required and will be concluded with a discussion of the steps necessary to bring the method/target or test fully back on line. In some cases, that may not be necessary if all appropriate personnel have already agreed there is a problem and there is agreement on the steps needed to bring the method, target or test fully back on line. The QA Manager will also initiate a corrective action report as described in Section 12 if one has not already been started. A copy of any meeting notes and agreed upon steps should be faxed or e-mailed by the laboratory to the appropriate VP of Operations and member of Corporate QA. This fax/e-mail acts as notification of the incident.

After suspension/restriction, the lab will hold all reports to clients pending review. No faxing, mailing or distributing through electronic means may occur. The report must not be posted for viewing on the internet. It is the responsibility of the Laboratory Director to hold all reporting and to notify all relevant laboratory personnel regarding the suspension/restriction (e.g., Project Management, Log-in, etc…). Clients will NOT generally be notified at this time. Analysis may proceed in some instances depending on the non-conformance issue.

Within 72 hours, the QA Manager will determine if compliance is now met and reports can be released, OR determine the plan of action to bring work into compliance, and release work. A team, with all principals involved (Laboratory Director, Laboratory Operations Managers, QA Manager, Department Technical Manager) can devise a start-up plan to cover all steps from client notification through compliance and release of reports. Project Management and the Directors of Client Services and Sales and Marketing must be notified if clients must be notified or if the suspension/restriction affects the laboratory's ability to accept work. The QA Manager must approve start-up or elimination of any restrictions after all corrective action is complete. This approval is given by final signature on the completed corrective action report.

SECTION 12. CORRECTIVE ACTION

12.1 Overview

A major component of TestAmerica's Quality Assurance (QA) Program is the problem investigation and feedback mechanism designed to keep the laboratory staff informed on quality related issues and to provide insight to problem resolution. When nonconforming work or departures from policies and procedures in the quality system or technical operations are identified, the corrective action procedure provides a systematic approach to assess the issues, restore the laboratory's system integrity, and prevent reoccurrence. Corrective actions are documented using TestAmerica's Incident and Corrective Action Tracker (iCAT) (refer to Figure 12-1).

12.2 General

Problems within the quality system or within analytical operations may be discovered in a variety of ways, such as QC sample failures, internal or external audits, proficiency testing (PT) performance, client complaints, staff observation, etc..

The purpose of a corrective action system is to:

- Identify non-conformance events and assign responsibility(s) for investigating.
- Resolve non-conformance events and assign responsibility for any required corrective action.
- Identify systematic problems before they become serious.
- Identify and track client complaints and provide resolution.

12.2.1 Non-Conformance Memo (NCM) - is used to document the following types of corrective actions:

- Deviations from an established procedure or SOP
- QC outside of limits (non-matrix related)
- Isolated reporting / calculation errors
- Client complaints
- Discrepancies in materials / goods received vs. manufacturer packing slips.

12.2.2 Corrective Action Report (CAR) - is used to document the following types of corrective actions:

- Questionable trends that are found in the review of NCMs.
- Issues found while reviewing NCMs that warrant further investigation.
- Internal and external audit findings
- Failed or unacceptable PT results.
- Corrective actions that cross multiple departments in the laboratory.
- Systematic reporting / calculation errors
- Client complaints
- Data recall investigations
- Identified poor process or method performance trends
- Excessive revised reports

This will provide background documentation to enable root cause analysis and preventive action.

12.3 Closed Loop Corrective Action Process

Any employee in the company can initiate a corrective action. There are four main components to a closed-loop corrective action process once an issue has been identified: Cause Analysis, Selection and Implementation of Corrective Actions (both short and long term), Monitoring of the Corrective Actions, and Follow-up.

12.3.1 Cause Analysis

- Upon discovery of a non-conformance event, the event must be defined and documented. A CAR must be initiated, someone is assigned to investigate the issue and the event is investigated for cause. Table 12-1 provides some general guidelines on determining responsibility for assessment.
- The cause analysis step is the key to the process as a long term corrective action cannot be determined until the cause is determined.
- If the cause is not readily obvious, the Technical Manager, Laboratory Director, or QA Manager (or QA designee) is consulted.

12.3.2 Selection and Implementation of Corrective Actions

- Where corrective action is needed, the laboratory shall identify potential corrective actions. The action(s) most likely to eliminate the problem and prevent recurrence are selected and implemented. Responsibility for implementation is assigned.
- Corrective actions shall be to a degree appropriate to the magnitude of the problem identified through the cause analysis.
- Whatever corrective action is determined to be appropriate, the laboratory shall document and implement the changes. The CAR is used for this documentation.

12.3.3 Root Cause Analysis

Root Cause Analysis is a class of problem solving (investigative) methods aimed at identifying the basic or causal factor(s) that underlie variation in performance or the occurrence of a significant failure. The root cause may be buried under seemingly innocuous events, many steps preceding the perceived failure. At first glance, the immediate response is typically directed at a symptom and not the cause. Typically, root cause analysis would be best with three or more incidents to triangulate a weakness. Corporate SOP Root Cause Analysis (No. CA-Q-S-009) describes the procedure.

Systematically analyze and document the root causes of the more significant problems that are reported. Identify, track, and implement the corrective actions required to reduce the likelihood of recurrence of significant incidents. Trend the root cause data from these incidents to identify root causes that, when corrected, can lead to dramatic improvements in performance by eliminating entire classes of problems.

Identify the one event associated with problem and ask why this event occurred. Brainstorm the root causes of failures; for example, by asking why events occurred or conditions existed; and then why the cause occurred 5 consecutive times until you get to the root cause. For each of these sub events or causes, ask why it occurred. Repeat the process for the other events associated with the incident.

Root cause analysis does not mean the investigation is over. Look at technique, or other systems outside the normal indicators. Often creative thinking will find root causes that ordinarily would be missed, and continue to plague the laboratory or operation.

12.3.4 Monitoring of the Corrective Actions

- The Technical Manager and QA Manager are responsible to ensure that the corrective action taken was effective.
- Ineffective actions are documented and re-evaluated until acceptable resolution is achieved. Technical Managers are accountable to the Laboratory Director to ensure final acceptable resolution is achieved and documented appropriately.
- Each CAR is entered into a the iCAT database for tracking purposes and a monthly summary of all corrective actions is printed out for review to aid in ensuring that the corrective actions have taken effect.
- TestAmerica laboratories began using the Incident/Corrective Action Tracker (iCAT) database developed by the company in 2015. (Previously, a local Excel database served this purpose.) An incident is an event triggering the need for one or more corrective actions as distinct from a corrective action, a potential deficiency stemming from an incident that requires investigation and possibly fixing. The database is independent of TALS, available to all local and corporate managers, and capable of notifying and tracking multiple corrective actions per event, dates, and personnel. iCAT allows associated document upload, categorization (such as, external/internal audit, client service concerns, data quality issues, proficiency testing, etc.), and trend analysis. Refer to Figure 12-1.
- The QA Manager reviews monthly CARs for trends. Highlights are included in the QA monthly report (refer to Section 16). If a significant trend develops that adversely affects quality, an audit of the area is performed and corrective action implemented.

- Any out-of-control situations that are not addressed acceptably at the laboratory level may be reported to the Corporate Quality Director by the QA Manager, indicating the nature of the out-of-control situation and problems encountered in solving the situation.

12.3.5 Follow-up Audits

- Follow-up audits may be initiated by the QA Manager and shall be performed as soon as possible when the identification of a nonconformance casts doubt on the laboratory's compliance with its own policies and procedures, or on its compliance with state or federal requirements.
- These audits often follow the implementation of the corrective actions to verify effectiveness. An additional audit would only be necessary when a critical issue or risk to business is discovered.

(Also refer to Section 15.1.4, Special Audits.)

12.4 Technical Corrective Actions

In addition to providing acceptance criteria and specific protocols for technical corrective actions in the method SOPs, the laboratory has general procedures to be followed to determine when departures from the documented policies and procedures and quality control have occurred (refer to Section 11). The documentation of these procedures is through the use of a CAR.

Table 12-1 includes examples of general technical corrective actions. For specific criteria and corrective actions, refer to the analytical methods or specific method SOPs. The laboratory may also maintain Work Instructions on these items that are available upon request.

Table 12-1 provides some general guidelines for identifying the individual(s) responsible for assessing each QC type and initiating corrective action. The table also provides general guidance on how a data set should be treated if associated QC measurements are unacceptable. Specific procedures are included in Method SOPs, Work Instructions, QAM Sections 19 and 20. All corrective actions are reviewed monthly, at a minimum, by the QA Manager and highlights are included in the QA monthly report.

To the extent possible, samples shall be reported only if all quality control measures are acceptable. If the deficiency does not impair the usability of the results, data will be reported with an appropriate data qualifier and/or the deficiency will be noted in the case narrative. Where sample results may be impaired, the Project Manager is notified and appropriate corrective action (e.g., reanalysis) is taken and documented**.**

12.5 Basic Corrections

When mistakes occur in records, each mistake shall be crossed-out, [not obliterated (e.g. no white-out)], and the correct value entered alongside. All such corrections shall be initialed (or signed) and dated by the person making the correction. In the case of records stored electronically, the original “uncorrected” file must be maintained intact and a second “corrected” file is created.

This same process applies to adding additional information to a record. All additions made later than the initial must also be initialed (or signed) and dated.

When corrections are due to reasons other than obvious transcription errors, the reason for the corrections (or additions) shall also be documented.

Figure 12-1.
Example - Corrective Action Report

TestAmerica Edison - Quality Assurance

Corrective Action 8698

Incident 3098: WS0717 PT Failures
Incident Status: Closed
Response Due to Client: Sunday, Oct 8, 2017

Created By:	Carl Armbruster	Created On:	Friday, Sep 8, 2017
Laboratory Function:	Other Lab Functions	Date Follow-up Due:	
Corrective Action Type:	PT and/or Double Blind Failures	Date Follow-up Done:	
Department:	Metals	Response Due to QA:	Sunday, Oct 8, 2017
Finding Number:	1	Planned Closure Date:	Sunday, Oct 8, 2017
Is Repeat Finding?:	No	Date Closed:	Monday, Oct 16, 2017
Finding Reference:			
Assigned To/Lead:	Laura Demone		
Priority:	2 (High Importance)		
Follow-up Assigned To:			
C.A. Status:	Closed		

Issue Requiring Corrective Action:

Rec'd evaluation of 'Not Acceptable for Arsenic by EPA 200.8: Assigned value: 8.17 ug/l Reported result: 10.9 ug/l Acceptance limits: 5.72 - 10.6 ug/l. Rec'd evaluation of 'Not Acceptable for Iron by EPA 200.7: Assigned value: 304 ug/l Reported result: 218 ug/l Acceptance limits: 258 - 349 ug/l. Investigate and submit correction action plan along with completed PT corrective action checklist (attached to this iCAT item).

Investigation/Response:

Drinking water PT 460-137368 sample 12 (PT study WS0717) failed low for iron by EPA 200.7 and failed high for arsenic by EPA 200.8.

Root Cause:

PT sample results as well as instrument and batch QC samples were checked for any anomalies or issues that may have contributed to the failures. For EPA 200.7, the calibration curve and blanks look very good for iron, and QC recoveries are within the acceptable range. For EPA 200.8, the same is true, the arsenic curve and all blanks are very good and all QC recoveries are also within the acceptable range for this method. The only issue noticed in the evaluation of the 200.8 data is that the serial dilution result for arsenic went down with higher dilution. For example,. the serial dilution at 5x was 9.62 ug/L (this is high but within the acceptance limits for arsenic) and at 10x the result was 8.12 ug/L, which is essentially the assigned value of arsenic. Perhaps there was an interference (both copper and zinc needed dilution for this sample) that caused high bias for the arsenic that was removed by the dilution of the sample.

Corrective Action Plan:

As per an older corrective action response, when laboratory sample is logged in for both an ICP and an ICP-MS method, the final data is compared before reporting, and this of course is also true for PT samples. The iron result on the ICP-MS for EPA 200.8 was 301 ug/L but since iron was not logged in as a reportable analyte for this method, this data was not compared to the ICP result. The same is true for arsenic, this analyte was not reported via Method 200.7 so the data was not compared either, (the arsenic result via method 200.7 was 9.98 ug/L, which is high but within the acceptable range) Had these results been compared, the discrepancies would certainly have been noticed and investigated further. Going forward, all data will be compared between the two methods, even when only one method is actually needed for reporting purposes, and all QC data will be examined more carefully to check for possible interferences. In addition, part of the issue is simply that the metals PT samples are either started early but then not reviewed/ compared until close to the due date or they are not started until well after they are received. If there were more time to carefully review data and compare results, it is much more likely that any issues would be caught and resolved. With all future PT studies, metals samples will be digested, analyzed and reviewed within two weeks of login to TALS and if all data is acceptable, results will also be submitted in this time frame. Phenova sent a QC sample (Trace Metals QC Lot #9066-04) with the rapid response PT sample for drinking water by EPA 200.7 and 200.8 with a certified value of 933 ug/L for iron and acceptance limits of 790-1070 ug/L, and a certified value of 21.1 ug/L for arsenic and acceptance limits of 14.8-27.4 ug/L. This sample (460-140875-2) was digested and analyzed with the rapid response PT sample and we got an iron result of 1020 ug/L which is within the acceptable recovery range. We also ran this rapid response QC sample on the ICP-MS for method 200.8 arsenic and we got a result of 23.2 ug/L (this is on A468012, not identified since it is not logged in for this method in TALS) which is within the acceptable range. We also carefully checked QC recoveries on the ICP/ ICPMS and ran the samples on the ICPMS and compared the results from the two instruments as usual, so we feel confident with the rapid response results as reported. Going forward for drinking water by method 200.8, analysts have been reminded to matrix match the standards with the samples (eg, rinse water, internal standard, calibration standards all use 2% HNO3 to match non-digested drinking waters). According to the batch notes this was done in the initial run of the PT.

Corrective Action Documents (3)

iCAT3098_PT corrective action narrative checklist_WS0717_Fe_460-137368.pdf	Con4AanA4.LONG_DATE_STRING 6:58 AM
iCAT3098_PT corrective action narrative checklist_WS0717_As_460-137368.pdf	Con58AanA58.LONG_DATE_STRING 7:3 AM
iCAT3098_PT corrective action QC sample Iron_140875-2.pdf	Con29PanP29.LONG_DATE_STRING 12:32 PM

For QA Use Only

QA Comments	Follow Up
Enter a QA Comment	*Enter Follow Up*

Notifications

Location QA (notification required)

Name	Title
Carl Armbruster	Quality Assurance Manager
Emmylou DiGiacomo	Quality Assurance Specialist
Hayley Waterland	

Additional Notifications

Name	Title
Mark Acierno	Laboratory Director
Laura Demone	Department Manager I
Donald Evans	Operations Manager

Table 12-1. Example – General Corrective Action Procedures

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Initial Instrument Blank *(Analyst)*	- Instrument response < MDL.	- Prepare another blank. - If same response, determine cause of contamination: reagents, environment, instrument equipment failure, etc..
Initial Calibration Standards *(Analyst, Technical Manager(s))*	- Correlation coefficient > 0.99 or standard concentration value. - % Recovery within acceptance range. - See details in Method SOP.	- Reanalyze standards. - If still unacceptable, remake standards and recalibrate instrument.
Independent Calibration Verification (Second Source) *(Analyst, Technical Manager(s))*	- % Recovery within control limits.	- Remake and reanalyze standard. - If still unacceptable, then remake calibration standards or use new primary standards and recalibrate instrument.
Continuing Calibration Standards *(Analyst, Data Reviewer)*	% Recovery within control limits.	- Reanalyze standard. - If still unacceptable, then recalibrate and rerun affected samples.
Matrix Spike / Matrix Spike Duplicate (MS/MSD) *(Analyst, Data Reviewer)*	- % Recovery within limits documented in TALS Method Limit Groups.	- If the acceptance criteria for duplicates or matrix spikes are not met because of matrix interferences, the acceptance of the analytical batch is determined by the validity of the LCS. - If the LCS is within acceptable limits the batch is acceptable. - The results of the duplicates, matrix spikes and the LCS are reported with the data set. - For matrix spike or duplicate results outside criteria the data for that sample shall be reported with qualifiers.

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Laboratory Control Sample (LCS) *(Analyst, Data Reviewer)*	- % Recovery within limits specified in TALS Method Limit Groups.	- Batch must be re-prepared and re-analyzed. This includes any allowable marginal exceedance. When not using marginal exceedances, the following exceptions apply: 1) when the acceptance criteria for the positive control are exceeded high (i.e., high bias) and there are associated samples that are non-detects, then those non-detects may be reported with data qualifying codes; 2) when the acceptance criteria for the positive control are exceeded low (i.e., low bias), those sample results may be reported if they exceed a maximum regulatory limit/decision level with data qualifying codes. **Note:** If there is insufficient sample or the holding time cannot be met, contact client and report with flags.
Surrogates *(Analyst, Data Reviewer)*	- % Recovery within limits of method or within three standard deviations of the historical mean.	- Individual sample must be repeated. Place comment in LIMS. - Surrogate results outside criteria shall be reported with qualifiers.
Method Blank (MB) *(Analyst, Data Reviewer)*	< Reporting Limit [1]	- Reanalyze blank. - If still positive, determine source of contamination. If necessary, reprocess (i.e. digest or extract) entire sample batch. Report blank results. - Qualify the result(s) if the concentration of a targeted analyte in the MB is at or above the reporting limit AND is > 1/10 of the amount measured in the sample.
Proficiency Testing (PT) Samples *(QA Manager, Technical Manager(s))*	- Criteria supplied by PT Supplier.	- Any failures or warnings must be investigated for cause. Failures may result in the need to repeat a PT sample to show the problem is corrected.
Internal / External Audits *(QA Manager, Technical Manager(s), Laboratory Director)*	- Defined in Quality System documentation such as SOPs, QAM, etc..	- Non-conformances must be investigated through CAR system and necessary corrections must be made.

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Reporting / Calculation Errors (Depends on issue – possible individuals include: Analysts, Data Reviewers, Project Managers, Technical Managers, QA Manager, Corporate QA, Corporate Management)	- SOP CW-Q-S-005, Data Recall	- Corrective action is determined by type of error. Follow the procedures in SOP CW-L-S-002 or TestAmerica Edison's Corrective Action SOP (ED-GEN-003),
Client Complaints *(Project Managers, Lab Director/Manager, Sales and Marketing)*	-	- Corrective action is determined by the type of complaint. For example, a complaint regarding an incorrect address on a report will result in the report being corrected and then follow-up must be performed on the reasons the address was incorrect (e.g., database needs to be updated).
QA Monthly Report (Refer to Section 16 for an example) (QA Manager, Lab Director/Manager, *Technical Manager(s)*)	- QAM, SOPs.	- Corrective action is determined by the type of issue. For example, CARs for the month are reviewed and possible trends are investigated.
Health and Safety Violation (Safety Officer, Lab Director/Manager, *Technical Manager(s)*)	- Environmental Health and Safety (EHS) Manual.	- Non-conformance is investigated and corrected through CAR system.

Note:

1. See specific method SOPs for blank acceptance criteria. Concentrations up to five times the reporting limit will be allowed for the ubiquitous laboratory and reagent contaminants: methylene chloride, toluene, acetone, 2-butanone and phthalate.. This allowance presumes that the detection limit is significantly below any regulatory limit to which the data are to be compared and that blank subtraction will not occur.

SECTION 13. PREVENTIVE ACTION / IMPROVEMENT

13.1 Overview

The laboratory's preventive action programs improve or eliminate potential causes of nonconforming product and/or nonconformance to the quality system. This preventive action process is a proactive and continuous process of improvement activities that can be initiated through feedback from clients, employees, business providers, and affiliates. The QA Department has the overall responsibility to ensure that the preventive action process is in place, and that relevant information on actions is submitted for management review.

Dedicating resources to an effective preventive action system emphasizes the laboratory's commitment to its Quality Program. It is beneficial to identify and address negative trends before they develop into complaints, problems and corrective actions. Additionally, the laboratory continually strives to improve customer service and client satisfaction through continuous improvements to laboratory systems.

Opportunities for improvement may be discovered through any of the following:

- review of the monthly QA Metrics Report,
- trending NCMs,
- review of control charts and QC results,
- trending proficiency testing (PT) results,
- performance of management system reviews,
- trending client complaints,
- review of processing operations, or
- staff observations.

The monthly Management Systems Metrics Report shows performance indicators in all areas of the laboratory and quality system. These areas include revised reports, corrective actions, audit findings, internal auditing and data authenticity audits, client complaints, PT samples, holding time violations, SOPs, ethics training, etc. The metrics report is reviewed monthly be the laboratory management, Corporate QA and TestAmerica's Executive Committee. These metrics are used ~~to~~ in evaluating the management and quality system performance on an ongoing basis and provide a tool for identifying areas for improvement.

Items identified as continuous improvement opportunities to the management system may be issued as goals from the annual management systems review, recommendations from internal audits, white papers, Lesson Learned, Technical Services audit report, Technical Best Practices, or as Corporate or management initiatives.

The laboratory's corrective action process is integral to implementation of preventive actions. A critical piece of the corrective action process is the implementation of actions to prevent further occurrence of a non-compliance event. Historical review of corrective action and non-conformances provides a valuable mechanism for identifying preventive action opportunities.

13.1.1 The following elements are part of a preventive action/process improvement system:

- Identification of an opportunity for preventive action or process improvement.
- Process for the preventive action or improvement.
- Define the measurements of the effectiveness of the process once undertaken.
- Execution of the preventive action or improvement.
- Evaluation of the plan using the defined measurements.
- Verification of the effectiveness of the preventive action or improvement.
- Close-Out by documenting any permanent changes to the Quality System as a result of the Preventive Action or Process Improvement. Documentation of Preventive Action/process Improvement is incorporated into the monthly QA reports, corrective action process and management review.

13.1.2 Any Preventive Actions/Process Improvement undertaken or attempted shall be taken into account during the annual Management Systems Review (Section 16). A highly detailed report is not required; however, a summary of successes and failures within the preventive action program is sufficient to provide management with a measurement for evaluation.

13.2 Management of Change

The Management of Change process is designed to manage significant events and changes that occur within the laboratory. Through these various tracking indicators, the potential risks inherent with a new event or change are identified and evaluated. The risks are minimized or eliminated through pre-planning and the development of preventive measures. The types of indicators monitored under this collective system include:

- SOP Tracking
  Current Revisions w/ Effective Dates
  Required Biennial Revisions w/ Due Date

- Proficiency Testing (PT) Sample Tracking
  Pass / Fail – most current 2 out of 3 studies.

- Instrument / Equipment List
  Current / Location

- Accreditations
  New / Expiring

- Method Capabilities
  Current Listing by program (e.g., Potable Water, Soils, etc.)

- Key Personnel
  Technical Managers, Department Supervisors, etc..

These items are maintained on TestAmerica's Intranet (Proposal Library) or on our internal database (TotalAccess) which uploads to our company internet site

SECTION 14. CONTROL OF RECORDS

The laboratory maintains a records management system appropriate to its needs and that complies with applicable standards or regulations as required. The system produces unequivocal, accurate records that document all laboratory activities. The laboratory retains all original observations, calculations and derived data, calibration records and a copy of the analytical report for a minimum of five years after it has been issued. Exceptions for programs with longer retention requirements are discussed in Section 14.1.2.

14.1 Overview

The laboratory has established procedures for identification, collection, indexing, access, filing, storage, maintenance and disposal of quality and technical records. A record index is listed in Table 14-1. More detailed information on retention of specific records is provided in CW-L-P-001, Records Retention Policy and CW-L-WI-001, TestAmerica Records Retention/Storage Schedule. Quality records are maintained by the QA department in a database, which is backed up as part of the regular laboratory backup. Records are of two types; either electronic or hard copy paper formats depending on whether the record is computer or hand generated (some records may be in both formats). Technical records are maintained by Laboratory Operations under the direction of the Laboratory Operations Managers.

Table 14-1. Record Index[1]

	Record Types [1]:	**Retention Time:**
Technical Records	- Raw Data - Logbooks[2] - Standards - Certificates - Analytical Records - MDLs/IDLs/DOCs - Lab Reports	5 Years from analytical report issue*
Official Documents	- Quality Assurance Manual (QAM) - Work Instructions - Policies - SOPs - Policy Memorandums - Manuals - Published Methods	Indefinitely
QA Records	- Certifications - Method and Software Validation / Verification Data	Indefinitely
QA Records	- Internal & External Audits/Responses - Corrective/Preventive Actions - Management Reviews -- Data Investigation	5 Years from archival* **Data Investigation:** 5 years or the life of the affected raw data storage whichever is greater (beyond 5 years if ongoing project or pending investigation)

	Record Types [1]:	Retention Time:
Project Records	- Sample Receipt & COC Documents - Contracts and Amendments - Correspondence - QAPP - SAP - Telephone Logbooks - Lab Reports	5 Years from analytical report issue*
Administrative Records	Financial and Business Operations	Refer to CW-L-WI-001
	EH&S Manual, Permits	Indefinitely
	Disposal Records	Indefinitely
	Employee Handbook	Indefinitely
	Personnel files, Employee Signature & Initials, Administrative Training Records (e.g., Ethics)	Refer to HR Manual
	Administrative Policies	Indefinitely
	Technical Training Records	7 years
	Legal Records	Indefinitely
	HR Records	Refer to CW-L-WI-001
	IT Records	Refer to CW-L-WI-001
	Corporate Governance Records	Refer to CW-L-WI-001
	Sales & Marketing	5 years
	Real Estate	Indefinitely

[1] Record Types encompass hardcopy and electronic records.
[2] Examples of Logbook types: Maintenance, Instrument Run, Preparation (standard and samples), Standard and Reagent Receipt, Archiving, Balance Calibration, Temperature (hardcopy or electronic records).
* Exceptions listed in Table 14-2.

14.1.1 All records are stored and retained in such a way that they are secure and readily retrievable at the laboratory facility which provides a suitable environment to prevent damage or deterioration and to prevent loss. All records shall be protected against fire, theft, loss, environmental deterioration, and vermin. In the case of electronic records, electronic or magnetic sources, storage media are protected from deterioration caused by magnetic fields and/or electronic deterioration.

Access to the data is limited to laboratory and company employees. Records are maintained for a minimum of five years unless otherwise specified by a client or regulatory requirement.

For raw data and project records, record retention shall be calculated from the date the project report is issued. For other records, such as Controlled Documents, QA, or Administrative Records, the retention time is calculated from the date the record is formally retired. Records related to the programs listed in Table 14-2 have lengthier retention requirements and are subject to the requirements in Section 14.1.3.

14.1.2 Programs with Longer Retention Requirements

Some regulatory programs have longer record retention requirements than the standard record retention time. These are detailed in Table 14-2 with their retention requirements. In these cases, the longer retention requirement is enacted. If special instructions exist such that client data cannot be destroyed prior to notification of the client, the container or box containing that data is marked as to who to contact for authorization prior to destroying the data.

Table 14-2. Example: Special Record Retention Requirements

Program	[1]Retention Requirement
Drinking Water – All States	10 years (lab reports and raw data) 10 years - Radiochemistry (project records)
Drinking Water Lead and Copper Rule	12 years (project records)
TSCA - 40 CFR Part 792	10 years after publication of final test rule or negotiated test agreement
OSHA	30 years

[1]Note: Extended retention requirements must be noted with the archive documents or addressed in facility-specific records retention procedures.

14.1.3 The laboratory has procedures to protect and back-up records stored electronically and to prevent unauthorized access to or amendment of these records. All analytical data is maintained as hard copy or in a secure readable electronic format. For analytical reports that are maintained as copies in PDF format, refer to Section 19.14.1 for more information. For additional details please refer to refer to TestAmerica Edison SOP No. ED-GEN-024 (Record Storage and Retention).

14.1.4 The record keeping system allows for historical reconstruction of all laboratory activities that produced the analytical data, as well as rapid recovery of historical data. The history of the sample from when the laboratory took possession of the samples must be readily understood through the documentation. This shall include inter-laboratory transfers of samples and/or extracts.

- The records include the identity of personnel involved in sampling, sample receipt, preparation, or testing. All analytical work contains the initials (at least) of the personnel involved. The laboratory's copy of the COC is stored with the invoice and the work order sheet generated by the LIMS.The chain of custody would indicate the name of the sampler. If any sampling notes are provided with a work order, they are kept with this package.

- All information relating to the laboratory facilities equipment, analytical test methods, and related laboratory activities, such as sample receipt, sample preparation, or data verification are documented.

- The record keeping system facilitates the retrieval of all working files and archived records for inspection and verification purposes (e.g., set format for naming electronic files, set format for what is included with a given analytical data set. Reference TestAmerica Edison SOP No. ED-GEN-024 (Record Storage and Retention).

- Instrument data is stored sequentially by instrument. A given day's analyses are maintained in the order of the analysis. Run logs are maintained for each instrument or method; a copy of each day's run log or instrument sequence is stored with the data to aid in re-constructing an analytical sequence. Where an analysis is performed without an instrument, bound logbooks or bench sheets are used to record and file data. Standard and reagent information is recorded in logbooks or entered into the LIMS for each method as required.

- Changes to hardcopy records shall follow the procedures outlined in Section 12 and 19. Changes to electronic records in LIMS or instrument data are recorded in audit trails.

- The reason for a signature or initials on a document is clearly indicated in the records such as "sampled by," "prepared by," "reviewed by", or "analyzed by".

- All generated data except those that are generated by automated data collection systems, are recorded directly, promptly and legibly in permanent dark ink.

- Hard copy data may be scanned into PDF format for record storage as long as the scanning process can be verified in order to ensure that no data is lost and the data files and storage media must be tested to verify the laboratory's ability to retrieve the information prior to the destruction of the hard copy that was scanned.

- Also refer to Section 19.14.1 'Computer and Electronic Data Related Requirements'**.**

14.2 Technical and Analytical Records

14.2.1 The laboratory retains records of original observations, derived data and sufficient information to establish an audit trail, calibration records, staff records and a copy of each analytical report issued, for a minimum of five years unless otherwise specified by a client or regulatory requirement. The records for each analysis shall contain sufficient information to enable the analysis to be repeated under conditions as close as possible to the original. The records shall include the identity of laboratory personnel responsible for the sampling, performance of each analysis and reviewing results.

14.2.2 Observations, data and calculations are recorded real-time and are identifiable to the specific task.

14.2.3 Changes to hardcopy records shall follow the procedures outlined in Section 12 and 19. Changes to electronic records in LIMS or instrument data are recorded in audit trails.

The essential information to be associated with analysis, such as strip charts, tabular printouts, computer data files, analytical notebooks, and run logs, include:

- laboratory sample ID code**;**
- Date of analysis; Time of Analysis is also required if the holding time is seventy-two (72) hours or less, or when time critical steps are included in the analysis (e.g., drying times, incubations, etc.); instrumental analyses have the date and time of analysis recorded as part of their general operations. Where a time critical step exists in an analysis, location for such a time is included as part of the documentation in a specific logbook or on a benchsheet.

- Instrumentation identification and instrument operating conditions/parameters. Operating conditions/parameters are typically recorded in instrument maintenance logs where available.
- analysis type;
- all manual calculations and manual integrations;
- analyst's or operator's initials/signature;
- sample preparation including cleanup, separation protocols, incubation periods or subculture, ID codes, volumes, weights, instrument printouts, meter readings, calculations, reagents;
- test results;
- standard and reagent origin, receipt, preparation, and use;
- calibration criteria, frequency and acceptance criteria;
- data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions;
- quality control protocols and assessment;
- electronic data security, software documentation and verification, software and hardware audits, backups, and records of any changes to automated data entries; and
- Method performance criteria including expected quality control requirements. These are indicated both in the LIMS and on specific analytical report formats.

14.2.4 All logbooks used during receipt, preparation, storage, analysis, and reporting of samples or monitoring of support equipment shall undergo a documented supervisory or peer review on a monthly basis.

14.3 Laboratory Support Activities

In addition to documenting all the above-mentioned activities, the following are retained QA records and project records (previous discussions in this section relate where and how these data are stored):

- all original raw data, whether hard copy or electronic, for calibrations, samples and quality control measures, including analysts' work sheets and data output records (chromatograms, strip charts, and other instrument response readout records);
- a written description or reference to the specific test method used which includes a description of the specific computational steps used to translate parametric observations into a reportable analytical value;
- copies of final reports;
- archived SOPs;
- correspondence relating to laboratory activities for a specific project;
- all corrective action reports, audits and audit responses;
- proficiency test results and raw data; and

- results of data review, verification, and crosschecking procedures

14.3.1 Sample Handling Records

Records of all procedures to which a sample is subjected while in the possession of the laboratory are maintained. These include but are not limited to records pertaining to:

- sample preservation including appropriateness of sample container and compliance with holding time requirement;
- sample identification, receipt, acceptance or rejection and login;
- sample storage and tracking including shipping receipts, sample transmittal / COC forms; and
- procedures for the receipt and retention of samples, including all provisions necessary to protect the integrity of samples.

14.4 Administrative Records

The laboratory also maintains the administrative records in either electronic or hard copy form. Refer to Table 14-1.

14.5 Records Management, Storage and Disposal

All records (including those pertaining to test equipment), certificates and reports are safely stored, held secure and in confidence to the client. Certification related records are available upon request.

All information necessary for the historical reconstruction of data is maintained by the laboratory. Records that are stored only on electronic media must be supported by the hardware and software necessary for their retrieval.

Records that are stored or generated by computers or personal computers have hard copy, write-protected backup copies, or an electronic audit trail controlling access**.**

The laboratory has a record management system (a.k.a., document control) for control of laboratory notebooks, instrument logbooks, standards logbooks, and records for data reduction, validation, storage and reporting. Laboratory notebooks are issued on a per analysis basis, and are numbered sequentially. All data are recorded sequentially within a series of sequential notebooks. Bench sheets are filed sequentially. Standards are maintained in the LIMS – no logbooks are used to record that data**.** Records are considered archived when noted as such in the records management system (a.k.a., document control.)

14.5.1 Transfer of Ownership

In the event that the laboratory transfers ownership or goes out of business, the laboratory shall ensure that the records are maintained or transferred according to client's instructions. Upon ownership transfer, record retention requirements shall be addressed in the ownership transfer agreement and the responsibility for maintaining archives is clearly established. In addition, in cases of bankruptcy, appropriate regulatory and state legal requirements concerning laboratory

records must be followed. In the event of the closure of the laboratory, all records will revert to the control of the corporate headquarters. Should the entire company cease to exist, as much notice as possible will be given to clients and the accrediting bodies who have worked with the laboratory during the previous 5 years of such action.

14.5.2 Records Disposal

Records are removed from the archive and destroyed after 5 years unless otherwise specified by a client or regulatory requirement. On a project specific or program basis, clients may need to be notified prior to record destruction. Records are destroyed in a manner that ensures their confidentiality such as shredding, mutilation or incineration. (Refer to Tables 14-1 and 14-2).

Electronic copies of records must be destroyed by erasure or physically damaging off-line storage media so no records can be read.

If a third party records management company is hired to dispose of records, a "Certificate of Destruction" is required.

SECTION 15. AUDITS

15.1 Internal Audits

Internal audits are performed to verify that laboratory operations comply with the requirements of the lab's quality system and with the external quality programs under which the laboratory operates. Audits are planned and organized by the QA staff. Personnel conducting the audits should be independent of the area being evaluated. Auditors will have sufficient authority, access to work areas, and organizational freedom necessary to observe all activities affecting quality and to report the assessments to laboratory management and, when requested, to corporate management.

Audits are conducted and documented as described in the TestAmerica Corporate SOP on performing Internal Auditing, SOP No. CW-Q-S-003. The types and frequency of routine internal audits are described in Table 15-1. Special or ad hoc assessments may be conducted as needed under the direction of the QA staff.

Table 15-1. Types of Internal Audits and Frequency

Description	Performed by	Frequency
Quality Systems Audits	QA Department, QA approved designee, or Corporate QA	All areas of the laboratory annually
Method Audits QA Technical Audits	Joint responsibility: a) QA Manager or designee b) Technical Manager or Designee (Refer to CW-Q-S-003)	QA Technical Audits Frequency: 50% of methods annually

Description	Performed by	Frequency
SOP Method Compliance	Joint responsibility: a) QA Manager or designee b) Technical Manager or Designee (Refer to CW-Q-S-003)	SOP Compliance Review Frequency: • Every 2 years
Special	QA Department or Designee	Surveillance or spot checks performed as needed, e.g., to confirm corrective actions from other audits.
Performance Testing	Analysts with QA oversight	Two successful per year for each TNI-field of testing or as dictated by regulatory requirements

15.1.1 Annual Quality Systems Audit

An annual quality systems audit is required to ensure compliance to analytical methods and SOPs, TestAmerica's Data Integrity and Ethics Policies, TNI quality systems, client and state requirements, and the effectiveness of the internal controls of the analytical process, including but not limited to data review, quality controls, preventive action and corrective action. The completeness of earlier corrective actions is assessed for effectiveness & sustainability. The audit is divided into sections for each operating or support area of the lab, and each section is comprehensive for a given area. The area audits may be performed on a rotating schedule throughout the year to ensure adequate coverage of all areas. This schedule may change as situations in the laboratory warrant.

15.1.2 QA Technical Audits

QA technical audits assess data authenticity and analyst integrity. These audits are based on client projects, associated sample delivery groups, and the methods performed. Reported results are compared to raw data to verify the authenticity of results. The validity of calibrations and QC results are compared to data qualifiers, footnotes, and case narratives. Documentation is assessed by examining run logs and records of manual integrations. Manual calculations are checked. Where possible, electronic audit miner programs (e.g., Chrom AuditMiner) are used to identify unusual manipulations of the data deserving closer scrutiny. QA technical audits will include all methods within a two-year period. All analysts should be reviewed over the course of a two year period through at least one QA Technical Audit

15.1.3 SOP Method Compliance

Compliance of all SOPs with the source methods and compliance of the operational groups with the SOPs will be assessed by the Technical Manager or qualified designee at least every two years. It is also recommended that the work of each newly hired analyst is assessed within 3 months of working independently, (e.g., completion of method IDOC). In addition, as analysts add methods to their capabilities, (new IDOC) reviews of the analyst work products will be performed within 3 months of completing the documented training.

15.1.4 Special Audits

Special audits are conducted on an as needed basis, generally as a follow up to specific issues such as client complaints, corrective actions, PT results, data audits, system audits, validation

comments, regulatory audits or suspected ethical improprieties. Special audits are focused on a specific issue, and report format, distribution, and timeframes are designed to address the nature of the issue.

15.1.5 Performance Testing

The laboratory participates semi-annually in performance audits conducted through the analysis of PT samples provided by a third party. The laboratory generally participates in the following types of PT studies: Drinking Water, Non-potable Water, Soil and Hazardous Waste.

It is TestAmerica's policy that PT samples be treated as typical samples in the production process. Furthermore, where PT samples present special or unique problems, in the regular production process they may need to be treated differently, as would any special or unique request submitted by any client. The QA Manager must be consulted and in agreement with any decisions made to treat a PT sample differently due to some special circumstance.

Written responses to unacceptable PT results are required. In some cases it may be necessary for blind QC samples to be submitted to the laboratory to show a return to control.

15.2 External Audits

External audits are performed when certifying agencies or clients conduct on-site inspections or submit performance testing samples for analysis. It is TestAmerica's policy to cooperate fully with regulatory authorities and clients. The laboratory makes every effort to provide the auditors with access to personnel, documentation, and assistance. Laboratory supervisors are responsible for providing corrective actions to the QA Manager who coordinates the response for any deficiencies discovered during an external audit. Audit responses are due in the time allotted by the client or agency performing the audit. When requested, a copy of the audit report and the labs corrective action plan will be forwarded to Corporate Quality.

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. The client may only view data and systems related directly to the client's work. All efforts are made to keep other client information confidential.

15.2.1 Confidential Business Information (CBI) Considerations

During on-site audits, auditors may come into possession of information claimed as business confidential. A business confidentiality claim is defined as "a claim or allegation that business information is entitled to confidential treatment for reasons of business confidentiality or a request for a determination that such information is entitled to such treatment." When information is claimed as business confidential, the laboratory must place on (or attach to) the information at the time it is submitted to the auditor, a cover sheet, stamped or typed legend or other suitable form of notice, employing language such as "trade secret", "proprietary" or "company confidential". Confidential portions of documents otherwise non-confidential must be clearly identified. CBI may be purged of references to client identity by the responsible laboratory official at the time of removal from the laboratory. However, sample identifiers may not be obscured from the information. Additional information regarding CBI can be found in within the 2009 TNI standards.

15.3 Audit Findings

Audit findings are documented using the corrective action process and database. The laboratory's corrective action responses for both types of audits may include action plans that could not be completed within a predefined timeframe. In these instances, a completion date must be set and agreed to by operations management and the QA Manager.

Developing and implementing corrective actions to findings is the responsibility of the Technical Managers where the finding originated. Findings that are not corrected by specified due dates are reported monthly to management in the QA monthly report. When requested, a copy of the audit report and the labs corrective action plan will be forwarded to Corporate Quality.

If any audit finding casts doubt on the effectiveness of the operations or on the correctness or validity of the laboratory's test results, the laboratory shall take timely corrective action, and shall notify clients in writing if the investigations show that the laboratory results have been affected. Once corrective action is implemented, a follow-up audit is scheduled to ensure that the problem has been corrected.

Clients must be notified promptly in writing, of any event such as the identification of defective measuring or test equipment that casts doubt on the validity of results given in any test report or amendment to a test report. The investigation must begin within 24-hours of discovery of the problem and all efforts are made to notify the client within two weeks after the completion of the investigation.

SECTION 16. MANAGEMENT REVIEWS

16.1 Quality Assurance Report

A comprehensive QA Report shall be prepared each month by the laboratory's QA Department and forwarded to the Laboratory Director, their Quality Director as well as the VP of Operations. All aspects of the QA system are reviewed to evaluate the suitability of policies and procedures. During the course of the year, the Laboratory Director, VP of Operations or Corporate QA may request that additional information be added to the report.

On a monthly basis, Corporate QA compiles information from all the monthly laboratory reports. The Corporate Quality Directors prepare a report that includes a compilation of all metrics and notable information and concerns regarding the QA programs within the laboratories. The report also includes a listing of new regulations that may potentially impact the laboratories. This report is presented to the Senior Management Team and VPs of Operations.

16.2 Annual Management Review

The senior lab management team (Laboratory Director, Technical Managers, QA Manager) conducts a review annually of its quality systems and LIMS to ensure its continuing suitability and effectiveness in meeting client and regulatory requirements and to introduce any necessary changes or improvements. It will also provide a platform for defining goals, & objectives and action items that feed into the laboratory planning system. Corporate Operations and Corporate

QA personnel is be included in this meeting at the discretion of the Laboratory Director. The LIMS review consists of examining any audits, complaints or concerns that have been raised through the year that are related to the LIMS. The laboratory will summarize any critical findings that cannot be solved by the lab and report them to Corporate IT.

This management systems review (Corporate SOP No. CW-Q-S-004 and Work Instruction No. CW-Q-WI-003) uses information generated during the preceding year to assess the "big picture" by ensuring that routine actions taken and reviewed on a monthly basis are not components of larger systematic concerns. The monthly review should keep the quality systems current and effective; therefore, the annual review is a formal senior management process to review specific existing documentation. Significant issues from the following documentation are compiled or summarized by the QA Manager prior to the review meeting:

- Matters arising from the previous annual review.
- Prior Monthly QA Reports issues.
- Laboratory QA Metrics.
- Review of report reissue requests.
- Review of client feedback and complaints.
- Issues arising from any prior management or staff meetings.
- Minutes from prior senior lab management meetings. Issues that may be raised from these meetings include:
    - Adequacy of staff, equipment and facility resources.
    - Adequacy of policies and procedures.
    - Future plans for resources and testing capability and capacity.
- The annual internal double blind PT program sample performance (if performed),
- Compliance to the Ethics Policy and Data Integrity Plan. Including any evidence/incidents of inappropriate actions or vulnerabilities related to data Integrity.

A report is generated by the QA Manager and management. The report is distributed to the appropriate VP of Operation and the Quality Director. The report includes, but is not limited to:

- The date of the review and the names and titles of participants.
- A reference to the existing data quality related documents and topics that were reviewed.
- Quality system or operational changes or improvements that will be made as a result of the review [e.g., an implementation schedule including assigned responsibilities for the changes (Action Table)].

Changes to the quality systems requiring update to the laboratory QA Manual shall be included in the next revision of the QA Manual.

16.3 Potential Integrity Related Managerial Reviews

Potential integrity issues (data or business related) must be handled and reviewed in a confidential manner until such time as a follow-up evaluation, full investigation, or other appropriate actions have been completed and issues clarified. TestAmerica's Corporate Internal

Investigations SOP shall be followed (SOP No. CW-L-S-002). All investigations that result in finding of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients.

TestAmerica's President and CEO, Executive VP of Operations, VP of Client & Technical Services, VPs of Operations and Quality Directors receive a monthly report from the VP-QA/EHS summarizing any current data integrity or data recall investigations. The VPs of Operations are also made aware of progress on these issues for their specific labs.

SECTION 17. PERSONNEL

17.1 Overview

The laboratory's management believes that its highly qualified and professional staff is the single most important aspect in assuring a high level of data quality and service. The staff consists of professionals and support personnel as outlined in the organization chart in Figure 4-1.

All personnel must demonstrate competence in the areas where they have responsibility. Any staff that is undergoing training shall have appropriate supervision until they have demonstrated their ability to perform their job function on their own. Staff shall be qualified for their tasks based on appropriate education, training, experience and/or demonstrated skills as required.

The laboratory employs sufficient personnel with the necessary education, training, technical knowledge and experience for their assigned responsibilities.

All personnel are responsible for complying with all QA/QC requirements that pertain to the laboratory and their area of responsibility. Each staff member must have a combination of experience and education to adequately demonstrate a specific knowledge of their particular area of responsibility. Technical staff must also have a general knowledge of lab operations, test methods, QA/QC procedures and records management.

Laboratory management is responsible for formulating goals for lab staff with respect to education, training and skills and ensuring that the laboratory has a policy and procedures for identifying training needs and providing training of personnel. The training shall be relevant to the present and anticipated responsibilities of the lab staff.

The laboratory only uses personnel that are employed by or under contract to, the laboratory. Contracted personnel, when used, must meet competency standards of the laboratory and work in accordance to the laboratory's quality system.

17.2 Education and Experience Requirements for Technical Personnel

The laboratory makes every effort to hire analytical staffs that possess a college degree (AA, BA, BS) in an applied science with some chemistry in the curriculum. Exceptions can be made based upon the individual's experience and ability to learn. Selection of qualified candidates for laboratory employment begins with documentation of minimum education, training, and experience prerequisites needed to perform the prescribed task. Minimum education and training requirements for TestAmerica employees are outlined in job descriptions and are generally summarized for analytical staff in the table below.

The laboratory maintains job descriptions for all personnel who manage, perform or verify work affecting the quality of the environmental testing the laboratory performs. Job Descriptions are located on the TestAmerica intranet site's Human Resources web-page (Also see Section 4 for position descriptions/responsibilities).

Experience and specialized training are occasionally accepted in lieu of a college degree (basic lab skills such as using a balance, colony counting, aseptic or quantitation techniques, etc., are also considered).

As a general rule for analytical staff:

Specialty	Education	Experience
Extractions, Digestions, some electrode methods (pH, DO, Redox, etc.), or Titrimetric and Gravimetric Analyses	H.S. Diploma	On the job training (OJT)
GFAA, CVAA, FLAA, Single component or short list Chromatography (e.g., Fuels, BTEX-GC, IC	A college degree in an applied science or 2 years of college and at least 1 year of college chemistry	Or 2 years prior analytical experience is required
ICP, ICPMS, Long List or complex chromatography (e.g., Pesticides, PCB, Herbicides, HPLC, etc.), GCMS	A college degree in an applied science or 2 years of college chemistry	or 5 years of prior analytical experience
Spectra Interpretation	A college degree in an applied science or 2 years of college chemistry	And 2 years relevant experience Or 5 years of prior analytical experience
Department Managers (i.e,Technical Managers) - **General**	Bachelor's Degree in an applied science or engineering with 24 semester hours in chemistry An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years experience in environmental analysis of representative analytes for which they will oversee
Department Managers (i.e,Technical Managers)– **Wet Chem** only (no advanced instrumentation)	Associates degree in an applied science or engineering or 2 years of college with 16 semester hours in chemistry	And 2 years relevant experience

When an analyst does not meet these requirements, they can perform a task under the direct supervision of a qualified analyst, peer reviewer or Technical Manager, and are considered an analyst in training. The person supervising an analyst in training is accountable for the quality of the analytical data and must review and approve data and associated corrective actions.

17.3 Training

The laboratory is committed to furthering the professional and technical development of employees at all levels.

Orientation to the laboratory's policies and procedures, in-house method training, and employee attendance at outside training courses and conferences all contribute toward employee proficiency. Below are examples of various areas of required employee training:

Required Training	Time Frame	Employee Type
Environmental Health & Safety	Prior to lab work	All
Ethics – New Hires	1 week of hire	All
Ethics – Comprehensive	90 days of hire	All
Data Integrity	30 days of hire	Technical and PMs
Quality Assurance	90 days of hire	All
Ethics – Comprehensive Refresher	Annually	All
Initial Demonstration of Capability (DOC)	Prior to unsupervised method performance	Technical

The laboratory maintains records of relevant authorization/competence, education, professional qualifications, training, skills and experience of technical personnel (including contracted personnel) as well as the date that approval/authorization was given. These records are kept on file at the laboratory. Also refer to "Demonstration of Capability" in Section 19.

The training of technical staff is kept up to date by:

- Each employee must have documentation in their training file that they have read, understood and agreed to follow the most recent version of the laboratory QA Manual and SOPs in their area of responsibility. This documentation is updated as SOPs are updated.
- Documentation from any training courses or workshops on specific equipment, analytical techniques or other relevant topics are maintained in their training file.
- Documentation of proficiency (refer to Section 19).
- An Ethics Agreement signed by each staff member (renewed each year) and evidence of annual ethics training.
- A Confidentiality Agreement signed by each staff member signed at the time of employment.
- Human Resources maintains documentation and attestation forms on employment status & records; benefit programs; timekeeping/payroll; and employee conduct (e.g., ethics violations). This information is maintained in the employee's secured personnel file.

Further details of the laboratory's training program are described in the Laboratory Training SOP (TestAmerica Edison SOP No. ED-GEN-022).

17.4 Data Integrity and Ethics Training Program

Establishing and maintaining a high ethical standard is an important element of a Quality System. Ethics and data integrity training is integral to the success of TestAmerica and is provided for each employee at TestAmerica. It is a formal part of the initial employee orientation within 1 week of hire followed by technical data integrity training within 30 days, comprehensive training within 90 days, and an annual refresher for all employees. Senior management at each facility performs the ethics training for their staff.

In order to ensure that all personnel understand the importance TestAmerica places on maintaining high ethical standards at all times; TestAmerica has established a Corporate Ethics Policy (Policy No. CW-L-P-004) and an Ethics Statement. All initial and annual training is documented by signature on the signed Ethics Statement demonstrating that the employee has participated in the training and understands their obligations related to ethical behavior and data integrity.

Violations of this Ethics Policy will not be tolerated. Employees who violate this policy will be subject to disciplinary actions up to and including termination. Criminal violations may also be referred to the Government for prosecution. In addition, such actions could jeopardize TestAmerica's ability to do work on Government contracts, and for that reason, TestAmerica has a Zero Tolerance approach to such violations.

Employees are trained as to the legal and environmental repercussions that result from data misrepresentation. Key topics covered in the presentation include:

- Organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting.
- Ethics Policy
- How and when to report ethical/data integrity issues. Confidential reporting.
- Record keeping.
- Discussion regarding data integrity procedures.
- Specific examples of breaches of ethical behavior (e.g. peak shaving, altering data or computer clocks, improper macros, etc., accepting/offering kickbacks, illegal accounting practices, unfair competition/collusion)
- Internal monitoring. Investigations and data recalls.
- Consequences for infractions including potential for immediate termination, debarment, or criminal prosecution.
- Importance of proper written narration / data qualification by the analyst and project manager with respect to those cases where the data may still be usable but are in one sense or another partially deficient.

Additionally, a data integrity hotline (1-800-736-9407) is maintained by TestAmerica and administered by the Corporate Quality Department.

SECTION 18. ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS

18.1 Overview

The laboratory is a 42,000 ft^2 secure laboratory facility with controlled access and designed to accommodate an efficient workflow and to provide a safe and comfortable work environment for employees. All visitors sign in and are escorted by laboratory personnel. Access is controlled by various measures.

The laboratory is equipped with structural safety features. Each employee is familiar with the location, use, and capabilities of general and specialized safety features associated with their workplace. The laboratory provides and requires the use of protective equipment including safety glasses, protective clothing, gloves, etc., OSHA and other regulatory agency guidelines regarding required amounts of bench and fume hood space, lighting, ventilation (temperature and humidity controlled), access, and safety equipment are met or exceeded.

Traffic flow through sample preparation and analysis areas is minimized to reduce the likelihood of contamination. Adequate floor space and bench top area is provided to allow unencumbered sample preparation and analysis space. Sufficient space is also provided for storage of reagents and media, glassware, and portable equipment. Ample space is also provided for refrigerated sample storage before analysis and archival storage of samples after analysis. Laboratory HVAC and deionized water systems are designed to minimize potential trace contaminants.

The laboratory is separated into specific areas for sample receiving, sample preparation, volatile organic sample analysis, non-volatile organic sample analysis, inorganic sample analysis, and administrative functions.

18.2 Environment

Laboratory accommodation, test areas, energy sources, lighting are adequate to facilitate proper performance of tests. The facility is equipped with heating, ventilation, and air conditioning (HVAC) systems appropriate to the needs of environmental testing performed at this laboratory.

The environment in which these activities are undertaken does not invalidate the results or adversely affect the required accuracy of any measurements.

The laboratory provides for the effective monitoring, control and recording of environmental conditions that may affect the results of environmental tests as required by the relevant specifications, methods, and procedures. Such environmental conditions include humidity, voltage, temperature, and vibration levels in the laboratory.

When any of the method or regulatory required environmental conditions change to a point where they may adversely affect test results, analytical testing will be discontinued until the environmental conditions are returned to the required levels.

Environmental conditions of the facility housing the computer network and LIMS are regulated to protect against raw data loss.

18.3 Work Areas

There is effective separation between neighboring areas when the activities therein are incompatible with each other. Examples include:

- Volatile organic chemical handling areas, including sample preparation and waste disposal, and volatile organic chemical analysis areas.

Access to and use of all areas affecting the quality of analytical testing is defined and controlled by secure access to the laboratory building as described below in the Building Security section.

Adequate measures are taken to ensure good housekeeping in the laboratory and to ensure that any contamination does not adversely affect data quality. These measures include regular cleaning to control dirt and dust within the laboratory. Work areas are available to ensure an unencumbered work area. Work areas include:

- Access and entryways to the laboratory.
- Sample receipt areas.
- Sample storage areas.
- Chemical and waste storage areas.
- Data handling and storage areas.
- Sample processing areas.
- Sample analysis areas.

18.4 Floor Plan

A floor plan can be found in Appendix 1.

18.5 Building Security

Building keys are distributed to employees as necessary.

Visitors to the laboratory sign in and out in a visitor's logbook. A visitor is defined as any person who visits the laboratory who is not an employee of the laboratory. In addition to signing into the laboratory, the Environmental, Health and Safety Manual contains requirements for visitors and vendors. There are specific safety forms that must be reviewed and signed. Visitors (with the exception of company employees) are escorted by laboratory personnel at all times, or the location of the visitor is noted in the visitor's logbook.

SECTION 19. TEST METHODS AND METHOD VALIDATION

19.1 Overview

The laboratory uses methods that are appropriate to meet our clients' requirements and that are within the scope of the laboratory's capabilities. These include sampling, handling, transport, storage and preparation of samples, and, where appropriate, an estimation of the measurement of uncertainty as well as statistical techniques for analysis of environmental data.

Instructions are available in the laboratory for the operation of equipment as well as for the handling and preparation of samples. All instructions, Standard Operating Procedures (SOPs), reference methods and manuals relevant to the working of the laboratory are readily available to all staff. Deviations from published methods are documented (with justification) in the laboratory's approved SOPs. SOPs are submitted to clients for review at their request. Significant deviations from published methods require client approval and regulatory approval where applicable.

19.2 Standard Operating Procedures (SOPS)

The laboratory maintains SOPs that accurately reflect all phases of the laboratory such as assessing data integrity, corrective actions, handling customer complaints as well as all analytical methods and sampling procedures. The method SOPs are derived from the most recently promulgated/approved, published methods and are specifically adapted to the laboratory facility. Modifications or clarifications to published methods are clearly noted in the SOPs. All SOPs are controlled in the laboratory.

- All SOPs contain a revision number, effective date, and appropriate approval signatures. Controlled copies are available to all staff.
- Procedures for writing an SOP are incorporated by reference to TestAmerica's Corporate SOP entitled 'Writing a Standard Operating Procedure', No. CW-Q-S-002.
- SOPs are reviewed at a minimum of every 2 years (annually for Drinking Water and DoD/DOE SOPs), and where necessary, revised to ensure continuing suitability and compliance with applicable requirements.

19.3 Laboratory Methods Manual

For each test method, the laboratory shall have available the published referenced method as well as the laboratory developed SOP.

Note: If more stringent standards or requirements are included in a mandated test method or regulation than those specified in this manual, the laboratory shall demonstrate that such requirements are met. If it is not clear which requirements are more stringent, the standard from the method or regulation is to be followed. Any exceptions or deviations from the referenced methods or regulations are noted in the specific analytical SOP.

The laboratory maintains an SOP Index for both technical and non-technical SOPs. Technical SOPs are maintained to describe a specific test method. Non-technical SOPs are maintained to describe functions and processes not related to a specific test method.

19.4 Selection of Methods

Since numerous methods and analytical techniques are available, continued communication between the client and laboratory is imperative to assure the correct methods are utilized. Once client methodology requirements are established, this and other pertinent information is summarized by the Project Manager. These mechanisms ensure that the proper analytical methods are applied when the samples arrive for log-in. For non-routine analytical services (e.g., special matrices, non-routine compound lists), the method of choice is selected based on client needs and available technology. The methods selected should be capable of measuring the specific parameter of interest, in the concentration range of interest, and with the required precision and accuracy.

19.4.1 Sources of Methods

Routine analytical services are performed using standard EPA-approved methodology. In some cases, modification of standard approved methods may be necessary to provide accurate analyses of particularly complex matrices. When the use of specific methods for sample

analysis is mandated through project or regulatory requirements, only those methods shall be used.

When clients do not specify the method to be used or methods are not required, the methods used will be clearly validated and documented in an SOP and available to clients and/or the end user of the data.

The analytical methods used by the laboratory are those currently accepted and approved by the U. S. EPA and the state or territory from which the samples were collected. Reference methods include:

- *Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act; Analysis and Sampling Procedures; 40CFR Part 136 as amended by Method Update Rule; May 18, 2012.*
- *Methods for Chemical Analysis of Water and Wastes, EPA 600 (4-79-020), 1983.*
- *Methods for the Determination of Inorganic Substances in Environmental Samples, EPA-600/R-93/100, August 1993.*
- *Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91/010, June 1991. Supplement I: EPA-600/R-94/111, May 1994.*
- *Methods for the Determination of Organic Compounds in Drinking Water, EPA-600/4-88-039, December 1988, Revised, July 1991, Supplement I, EPA-600-4-90-020, July 1990, Supplement II, EPA-600/R-92-129, August 1992. Supplement III EPA/600/R-95/131 - August 1995 (EPA 500 Series) (EPA 500 Series methods)*
- *Technical Notes on Drinking Water Methods, EPA-600/R94-173, October 1994*
- *NIOSH Manual of Analytical Methods, 4th ed., August 1994.*
- *Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.*
- *Standard Methods for the Examination of Water and Wastewater, 18th/19th /20th/ on-line edition; Eaton, A.D. Clesceri, L.S. Greenberg, A.E. Eds; American Water Works Association, Water Pollution Control Federation, American Public Health Association: Washington, D.C.*
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008; Final Update V, August 2015.*
- *Annual Book of ASTM Standards, American Society for Testing & Materials (ASTM), Philadelphia, PA.*
- *National Status and Trends Program, National Oceanographic and Atmospheric Administration, Volume I-IV, 1985-1994.*
- *Manual for the Certification of Laboratories Analyzing Drinking Water (EPA 815-R-05-004, January 2005)* ***(DW labs only)***
- *Code of Federal Regulations (CFR) 40, Parts 136, 141, 172, 173, 178, 179 and 261*

The laboratory reviews updated versions to all the aforementioned references for adaptation based upon capabilities, instrumentation, etc., and implements them as appropriate. As such, the laboratory strives to perform only the latest versions of each approved method as regulations allow or require.

Other reference procedures for non-routine analyses may include methods established by specific states (e.g., Underground Storage Tank methods), ASTM or equipment manufacturers. Sample type, source, and the governing regulatory agency requiring the analysis will determine the method utilized.

The laboratory shall inform the client when a method proposed by the client may be inappropriate or out of date. After the client has been informed, and they wish to proceed contrary to the laboratory's recommendation, it will be documented.

19.4.2 Demonstration of Capability

Before the laboratory may institute a new method and begin reporting results, the laboratory shall confirm that it can properly operate the method. In general, this demonstration does not test the performance of the method in real world samples, but in an applicable and available clean matrix sample. If the method is for the testing of analytes that are not conducive to spiking, demonstration of capability may be performed on quality control samples.

A demonstration of capability (DOC) (reference TestAmerica Edison Training SOP No. ED-GEN-022) is performed whenever there is a change in instrument type (e.g., new instrumentation), matrix, method or personnel (e.g., analyst hasn't performed the test within the last 12 months).

Note: The laboratory shall have a DOC for all analytes included in the methods that the laboratory performs, and proficiency DOCs for each analyst shall include all analytes that the laboratory routinely performs. Addition of non-routine analytes does not require new DOCs for all analysts if those analysts are already qualified for routine analytes tested using identical chemistry and instrument conditions.

The initial demonstration of capability must be thoroughly documented and approved by the Department Manager (i.e., Technical Manager) and QA Manager prior to independently analyzing client samples. All associated documentation must be retained in accordance with the laboratories archiving procedures.

The laboratory must have an approved SOP, demonstrate satisfactory performance, and conduct an MDL study (when applicable). There may be other requirements as stated within the published method or regulations (i.e., retention time window study).

Note: In some instances, a situation may arise where a client requests that an unusual analyte be reported using a method where this analyte is not normally reported. If the analyte is being reported for regulatory purposes, the method must meet all procedures outlined within this QA Manual (SOP, MDL, and Demonstration of Capability). If the client states that the information is not for regulatory purposes, the result may be reported as long as the following criteria are met:

- The instrument is calibrated for the analyte to be reported using the criteria for the method and ICV/CCV criteria are met (unless an ICV/CCV is not required by the method or criteria are per project DQOs).

- The laboratory's nominal or default reporting limit (RL) is equal to the quantitation limit (QL), must be at or above the lowest non-zero standard in the calibration curve and must be reliably determined. Project RLs are client specified reporting levels which may be higher than the QL. Results reported below the QL must be qualified as estimated values. Also see Section 19.6.1.3, Relationship of Limit of Detection (LOD) to Quantitation Limit (QL).
- The client request is documented and the lab informs the client of its procedure for working with unusual compounds. The final report must be footnoted: *Reporting Limit based on the low standard of the calibration curve.*

19.4.3 Initial Demonstration of Capability (IDOC) Procedures

19.4.3.1 The spiking standard used must be prepared independently from those used in instrument calibration.

19.4.3.2 The analyte(s) shall be diluted in a volume of clean matrix sufficient to prepare four aliquots at the concentration specified by a method or the laboratory SOP.

19.4.3.3 At least four aliquots shall be prepared (including any applicable clean-up procedures) and analyzed according to the test method (either concurrently or over a period of days).

19.4.3.4 Using all of the results, calculate the mean recovery in the appropriate reporting units and the standard deviations for each parameter of interest.

19.4.3.5 When it is not possible to determine the mean and standard deviations, such as for presence, absence and logarithmic values, the laboratory will assess performance against criteria described in the Method SOP.

19.4.3.6 Compare the information obtained above to the corresponding acceptance criteria for precision and accuracy in the test method (if applicable) or in laboratory generated acceptance criteria (LCS or interim criteria) if there is no mandatory criteria established. If any one of the parameters do not meet the acceptance criteria, the performance is unacceptable for that parameter.

19.4.3.7 When one or more of the tested parameters fail at least one of the acceptance criteria, the analyst must proceed according to either option listed below:

- Locate and correct the source of the problem and repeat the test for all parameters of interest beginning with 19.4.3.3 above.
- Beginning with 19.4.3.3 above, repeat the test for all parameters that failed to meet criteria. Repeated failure, however, will confirm a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds of interest beginning with 19.4.3.1 above.

Note: Results of successive LCS analyses can be used to fulfill the DOC requirement.

A certification statement (refer to Figure 19-1 as an example shall be used to document the completion of each initial demonstration of capability. A copy of the certification is archived in the analyst's training folder.

Methods on line prior to the effective date of this Section shall be updated to the procedures outlined above as new analysts perform their demonstration of capability. A copy of the new record will replace that which was used for documentation in the past. At a minimum, the precision and accuracy of four mid-level laboratory control samples must have been compared to the laboratory's quality control acceptance limits.

19.5 Laboratory Developed Methods and Non-Standard Methods

Any new method developed by the laboratory must be fully defined in an SOP and validated by qualified personnel with adequate resources to perform the method. Method specifications and the relation to client requirements must be clearly conveyed to the client if the method is a non-standard method (not a published or routinely accepted method). The client must also be in agreement to the use of the non-standard method.

19.6 Validation of Methods

Validation is the confirmation by examination and the provision of objective evidence that the particular requirements for a specific intended use are fulfilled.
All non-standard methods, laboratory designed/developed methods, standard methods used outside of their scope, and major modifications to published methods must be validated to confirm they are fit for their intended use. The validation will be as extensive as necessary to meet the needs of the given application. The results are documented with the validation procedure used and contain a statement as to the fitness for use.

19.6.1 Method Validation and Verification Activities for All New Methods

While method validation can take various courses, the following activities can be required as part of method validation. Method validation records are designated QC records and are archived accordingly.

19.6.1.1 Determination of Method Selectivity – Method selectivity is the demonstrated ability to discriminate the analyte(s) of interest from other compounds in the specific matrix or matrices from other analytes or interference. In some cases to achieve the required selectivity for an analyte, a confirmation analysis is required as part of the method.

19.6.1.2 Determination of Method Sensitivity – Sensitivity can be both estimated and demonstrated. Whether a study is required to estimate sensitivity depends on the level of method development required when applying a particular measurement system to a specific set of samples. Where estimations and/or demonstrations of sensitivity are required by regulation or client agreement, such as the procedure in 40 CFR Part 136 Appendix B, under the Clean Water Act, these shall be followed.

19.6.1.3 Relationship of Limit of Detection (LOD) to the Quantitation Limit (QL) – An important characteristic of expression of sensitivity is the difference in the LOD and the QL. The LOD is the minimum level at which the presence of an analyte can be reliably concluded. The QL is the minimum concentration of analyte that can be quantitatively determined with acceptable precision and bias. For most instrumental measurement systems, there is a region where semi-quantitative data is generated around the LOD (both above and below the estimated MDL or LOD) and below the QL. In this region, detection of an analyte may be confirmed but quantification of the analyte is unreliable within the accuracy and precision

guidelines of the measurement system. When an analyte is detected below the QL, and the presence of the analyte is confirmed by meeting the qualitative identification criteria for the analyte, the analyte can be reliably reported, but the amount of the analyte can only be estimated. If data is to be reported in this region, it must be done so with a qualification that denotes the semi-quantitative nature of the result.

19.6.1.4 Determination of Interferences – A determination that the method is free from interferences in a blank matrix is performed.

19.6.1.5 Determination of Range – Where appropriate to the method, the quantitation range is determined by comparison of the response of an analyte in a curve to established or targeted criteria. Generally the upper quantitation limit is defined by highest acceptable calibration concentration. The lower quantitation limit or QL cannot be lower than the lowest non-zero calibration level, and can be constrained by required levels of bias and precision.

19.6.1.6 Determination of Accuracy and Precision – Accuracy and precision studies are generally performed using replicate analyses, with a resulting percent recovery and measure of reproducibility (standard deviation, relative standard deviation) calculated and measured against a set of target criteria.

19.6.1.7 Documentation of Method – The method is formally documented in an SOP. If the method is a minor modification of a standard laboratory method that is already documented in an SOP, an SOP Attachment describing the specific differences in the new method is acceptable in place of a separate SOP.

19.6.1.8 Continued Demonstration of Method Performance – Continued demonstration of Method Performance is addressed in the SOP. Continued demonstration of method performance is generally accomplished by batch specific QC samples such as LCS, method blanks or PT samples.

19.7 Method Detection Limits (MDL) / Limits of Detection (LOD)

Method detection limits (MDL) are initially determined in accordance with 40 CFR Part 136, Appendix B or alternatively by other technically acceptable practices that have been accepted by regulators. MDL is also sometimes referred to as Limit of Detection (LOD). The MDL theoretically represents the concentration level for each analyte within a method at which the analyst is 99% confident that the true value can be differentiated from blanks. The MDL is determined for each analyte initially during the method validation process and updated as required in the analytical methods, whenever there is a significant change in the procedure or equipment, or based on project specific requirements. Generally, the analyst prepares at least seven replicates of solution spiked at one to five times the estimated method detection limit (most often at the lowest standard in the calibration curve) into the applicable matrix with all the analytes of interest. Each of these aliquots is extracted (including any applicable clean-up procedures) and analyzed in the same manner as the samples. Where possible, the seven replicates should be analyzed over 2-4 days to provide a more realistic MDL.

Refer to the Corporate SOP No. CA-Q-S-006 for details on the laboratory's MDL process.

19.8 Instrument Detection Limits (IDL)

The IDL is sometimes used to assess the reasonableness of the MDLs or in some cases required by the analytical method or program requirements. IDLs are most used in metals analyses but may be useful in demonstration of instrument performance in other areas.

IDLs are calculated to determine an instrument's sensitivity independent of any preparation method. IDLs are calculated either using 7 replicate spike analyses, like MDL but without sample preparation, or by the analysis of 10 instrument blanks and calculating 3 x the absolute value of the standard deviation.

If IDL is > than the MDL, it may be used as the reported MDL.

19.9 Verification of Detection and Reporting Limits

Once an MDL is established, it must be verified, on each instrument, by analyzing a quality control sample (prepared as a sample) at no more than 3 times the calculated MDL for single analyte analyses (e.g. most wet chemistry methods, Atomic Absorption, etc.) and no more than 4 times the calculated MDL for multiple analyte methods (e.g. GC, GCMS, ICP, etc.). The analytes must be qualitatively identified. This verification does not apply to methods that are not readily spiked (e.g. pH, turbidity, etc.) or where the lab does not report to the MDL. If the MDL does not verify, then the lab will not report to the MDL, or redevelop their MDL or use the level where qualitative identification is established. MDLs must be verified at least annually

When the laboratory establishes a quantitation limit, it must be initially verified by the analysis of a low level standard or QC sample at 1-2 times the reporting limit and annually thereafter. The annual requirement is waived for methods that have an annually verified MDL. The laboratory will comply with any regulatory requirements.

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19.10 Retention Time Windows

Most organic analyses and some inorganic analyses use chromatography techniques for qualitative and quantitative determinations. For every chromatography analysis or as specific in the reference method, each analyte will have a specific time of elution from the column to the detector. This is known as the analyte's retention time. The variance in the expected time of elution is defined as the retention time window. As the key to analyte identification in chromatography, retention time windows must be established on every column for every analyte used for that method. These records are kept with the files associated with an instrument for later quantitation of the analytes. Complete details are available in the laboratory SOPs.

19.11 Evaluation of Selectivity

The laboratory evaluates selectivity by following the checks within the applicable analytical methods, which include mass spectral tuning, second column confirmation, ICP interelement interference checks, chromatography retention time windows, sample blanks, spectrochemical, atomic absorption or fluorescence profiles, co-precipitation evaluations and specific electrode response factors.

19.12 Estimation of Uncertainty of Measurement

19.12.1 Uncertainty is "a parameter associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand" (as defined by the International Vocabulary of Basic and General Terms in Metrology, ISO Geneva, 1993, ISBN 92-67-10175-1). Knowledge of the uncertainty of a measurement provides additional confidence in a result's validity. Its value accounts for all the factors which could possibly affect the result, such as adequacy of analyte definition, sampling, matrix effects and interferences, climatic conditions, variances in weights, volumes, and standards, analytical procedure, and random variation. Some national accreditation organizations require the use of an "expanded uncertainty": the range within which the value of the measurand is believed to lie within at least a 95% confidence level with the coverage factor k=2.

19.12.2 Uncertainty is not error. Error is a single value, the difference between the true result and the measured result. On environmental samples, the true result is never known. The measurement is the sum of the unknown true value and the unknown error. Unknown error is a combination of systematic error, or bias, and random error. Bias varies predictably, constantly, and independently from the number of measurements. Random error is unpredictable, assumed to be Gaussian in distribution, and reducible by increasing the number of measurements.

19.12.3 The minimum uncertainty associated with results generated by the laboratory can be determined by using the Laboratory Control Sample (LCS) accuracy range for a given analyte. The LCS limits are used to assess the performance of the measurement system since they take into consideration all of the laboratory variables associated with a given test over time (except for variability associated with the sampling and the variability due to matrix effects). The percent recovery of the LCS is compared either to the method-required LCS accuracy limits or to the statistical, historical, in-house LCS accuracy limits.

19.12.4 To calculate the uncertainty for the specific result reported, multiply the result by the decimal of the lower end of the LCS range percent value for the lower end of the uncertainty range, and multiply the result by the decimal of the upper end of the LCS range percent value for the upper end of the uncertainty range. These calculated values represent uncertainties at approximately the 99% confidence level with a coverage factor of k = 3. As an example, for a reported result of 1.0 mg/L with an LCS recovery range of 50 to 150%, the estimated uncertainty in the result would be 1.0 +/- 0.5 mg/L.

19.12.5 In the case where a well-recognized test method specifies limits to the values of major sources of uncertainty of measurement (e.g., 524.2, 525, etc.) and specifies the form of presentation of calculated results, no further discussion of uncertainty is required.

19.13 Sample Reanalysis Guidelines

Because there is a certain level of uncertainty with any analytical measurement, a sample re-preparation (where appropriate) and subsequent analysis (hereafter referred to as 'reanalysis') may result in either a higher or lower value from an initial sample analysis. There are also variables that may be present (e.g., sample homogeneity, analyte precipitation over time, etc.) that may affect the results of a reanalysis. Based on the above comments, the laboratory will reanalyze samples at a client's request with the following caveats. Client specific Contractual Terms & Conditions for reanalysis protocols may supersede the following items.

- Homogenous samples: If a reanalysis agrees with the original result to within the RPD limits for MS/MSD or Duplicate analyses, or within ± 1 reporting limit for samples ≤ 5x the reporting limit, the original analysis will be reported. At the client's request, both results may be reported on the same report but not on two separate reports.

- If the reanalysis does not agree (as defined above) with the original result, then the laboratory will investigate the discrepancy and reanalyze the sample a third time for confirmation if sufficient sample is available.

- Any potential charges related to reanalysis are discussed in the contract terms and conditions or discussed at the time of the request. The client will typically be charged for reanalysis unless it is determined that the lab was in error.

- Due to the potential for increased variability, reanalysis may not be applicable to Non-homogenous, Encore, and Sodium Bisulfate preserved samples. See the Area Supervisor *or* Laboratory Director if unsure.

19.14 Control of Data

The laboratory has policies and procedures in place to ensure the authenticity, integrity, and accuracy of the analytical data generated by the laboratory.

19.14.1 Computer and Electronic Data Related Requirements

The three basic objectives of our computer security procedures and policies are shown below. More detail is outlined in the TestAmerica Corporate IT SOPs and in TestAmerica Edison SOPs No. ED-GEN-001 (Data Management and Handling Procedures) and ED-GEN-002 (Document Control). The laboratory is currently running the TALS LIMS which is a custom in-house developed LIMS system that has been highly customized to meet the needs of the laboratory. It is referred to as LIMS for the remainder of this section. The LIMS utilizes Microsoft SQL Server which is an industry standard relational database platform. It is referred to as Database for the remainder of this section.

19.14.1.1 Maintain the Database Integrity – Assurance that data is reliable and accurate through data verification (review) procedures, password-protecting access, anti-virus protection, data change requirements, as well as an internal LIMS permissions procedure.

- LIMS Database Integrity is achieved through data input validation, internal user controls, and data change requirements.
- Spreadsheets and other software developed in-house must be verified with documentation through hand calculations prior to use. Cells containing calculations must be lock-protected and controlled.
- Instrument hardware and software adjustments are safeguarded through maintenance logs, audit trails and controlled access.

19.14.1.2 Ensure Information Availability – Protection against loss of information or service is ensured through scheduled back-ups, stable file server network architecture,

secure storage of media, line filter, Uninterruptible Power Supply (UPS), and maintaining older versions of software as revisions are implemented.

19.14.1.3 **Maintain Confidentiality** – Ensure data confidentiality through physical access controls such as password protection or website access approval when electronically transmitting data.

19.14.2 Data Reduction

The complexity of the data reduction depends on the analytical method and the number of discrete operations involved (e.g., extractions, dilutions, instrument readings and concentrations). The analyst calculates the final results from the raw data or uses appropriate computer programs to assist in the calculation of final reportable values.

For manual data entry, e.g., Wet Chemistry, the data is reduced by the analyst and then verified by the Department Technical Manager or alternate analyst prior to updating the data in LIMS. The spreadsheets, or any other type of applicable documents, are signed by both the analyst and alternate reviewer to confirm the accuracy of the manual entry(s).

Manual integration of peaks will be documented and reviewed and the raw data will be flagged in accordance with the TestAmerica Corporate SOP No. CA-Q-S-002, *Acceptable Manual Integration Practices*.

Analytical results are reduced to appropriate concentration units specified by the analytical method, taking into account factors such as dilution, sample weight or volume, etc. Blank correction will be applied only when required by the method or per manufacturer's indication; otherwise, it should not be performed. Calculations are independently verified by appropriate laboratory staff. Calculations and data reduction steps for various methods are summarized in the respective analytical SOPs or program requirements.

19.14.2.1 All raw data must be retained in the worklist folder, computer file (if appropriate), and/or runlog. All criteria pertinent to the method must be recorded. The documentation is recorded at the time observations or calculations are made and must be signed or initialed/dated (month/day/year). It must be easily identifiable who performed which tasks if multiple people were involved.

19.14.2.2 In general, concentration results are reported in milligrams per liter (mg/l) or micrograms per liter (µg/l) for liquids and milligrams per kilogram (mg/kg) or micrograms per kilogram (µg/kg) for solids. For values greater than 10,000 mg/l, results can be reported in percent, i.e., 10,000 mg/l = 1**%.** Units are defined in each lab SOP.

19.14.2.3 In reporting, the analyst or the instrument output records the raw data result using values of known certainty plus one uncertain digit. If final calculations are performed external to LIMS, the results should be entered in LIMS with at least three significant figures. In general, results are reported to 2 significant figures on the final report.

19.14.2.4 For those methods that do not have an instrument printout or an instrumental output compatible with the LIMS System, the raw results and dilution factors are entered directly into LIMS by the analyst, and the software calculates the final result for the analytical report. LIMS has a defined significant figure criterion for each analyte.

19.14.2.5 The laboratory strives to import data directly from instruments or calculation spreadsheets to ensure that the reported data are free from transcription and calculation errors. For those analyses with an instrumental output compatible with the LIMS, the raw results and dilution factors are transferred into LIMS electronically after reviewing the quantitation report, and removing unrequested or poor spectrally-matched compounds. The analyst prints a copy of what has been entered to check for errors. This printout and the instrument's printout of calibrations, concentrations, retention times, chromatograms, and mass spectra, if applicable, are retained with the data file. The data file is stored in a monthly folder on the instrument computer; periodically, this file is transferred to the server and, eventually, to a tape file.

19.14.3 Logbook / Worksheet Use Guidelines

Logbooks and worksheets are filled out 'real time' and have enough information on them to trace the events of the applicable analysis/task. (e.g. calibrations, standards, analyst, sample ID, date, time on short holding time tests, temperatures when applicable, calculations are traceable, etc.)

- Corrections are made following the procedures outlined in Section 12.
- Logbooks are controlled by the QA department. A record is maintained of all logbooks in the lab.
- Unused portions of pages must be "Z"'d out, signed and dated.
- Worksheets are created with the approval of the Department Technical Manager/QA Manager at the facility. The QA Manager controls all worksheets following the procedures in Section 6.

19.14.4 Review / Verification Procedures

Review procedures are out lined in several SOPs (including but not limited to, TestAmerica Edison SOP Nos. ED-GEN-021: Data Review, ED-SPM-001:Login, and ED-RP-001:Reports Production) to ensure that reported data are free from calculation and transcription errors, that QC parameters have been reviewed and evaluated before data is reported. The general review concepts are discussed below, more specific information can be found in the SOPs

19.14.4.1 Log-In Review - The data review process starts at the sample receipt stage. Sample control personnel review chain-of-custody forms and project instructions from the project management group. This is the basis of the sample information and analytical instructions entered into the LIMS. The log-in instructions are reviewed by the personnel entering the information, and a second level review is conducted by the project management staff.

19.14.4.2 First Level Data Review - The next level of data review occurs with the analysts. As data are generated, analysts review their work to ensure that the results meet project and SOP requirements. First level reviews include inspection of all raw data (e.g., instrument output for continuous analyzers, chromatograms, spectra, and manual integrations), evaluation of calibration/calibration verification data in the day's

analytical run, evaluation of QC data, and reliability of sample results. The analyst transfers data into LIMS, data qualifiers are added as needed. All first level reviews are documented.

19.14.4.3 Second Level Data Review – All analytical data are subject to review by a second qualified analyst or supervisor. Second level reviews include inspection of all raw data (e.g., instrument output, chromatograms, and spectra) including 100% of data associated with any changes made by the primary analyst, such as manual integrations or reassignment of peaks to different analytes, or elimination of false negative analytes. The second review also includes evaluation of initial calibration/calibration verification data in the day's analytical run, evaluation of QC data, reliability of sample results, qualifiers and NCM narratives. Manual calculations are checked in second level review. All second level reviews are documented.

Issues that deem further review include the following:

- QC data are outside the specified control limits for accuracy and precision
- Reviewed sample data does not match with reported results
- Unusual detection limit changes are observed
- Samples having unusually high results
- Samples exceeding a known regulatory limit
- Raw data indicating some type of contamination or poor technique
- Inconsistent peak integration
- Transcription errors
- Results outside of calibration range

19.14.4.4 Unacceptable analytical results may require reanalysis of the samples. Any problems are brought to the attention of the Laboratory Director, Project Manager, Quality Director/Manager, Technical Manager, or Supervisor for further investigation. Corrective action is initiated whenever necessary.

19.14.4.5 The results are then entered or directly transferred into the computer database and a hard copy (or .pdf) is printed for the client.

19.14.4.6 As a final review prior to the release of the report, the Project Manager reviews the results for appropriateness and completeness. This review and approval ensures that client requirements have been met and that the final report has been properly completed. The process includes, but is not limited to, verifying that the COC is followed, cover letters / narratives are present, flags are appropriate, and project specific requirements are met. The Project Manager may also evaluate the validity of results for different test methods given expected chemical relationships.

19.14.4.7 Any project that requires a data package is subject to a tertiary data review for transcription errors and acceptable quality control requirements. The Project Manager then signs the final report. The accounting personnel also check the report for any clerical or invoicing errors. When complete, the report is sent out to the client.

19.14.5 Manual Integrations

Computerized data systems provide the analyst with the ability to re-integrate raw instrument data in order to optimize the interpretation of the data. Though manual integration of data is an invaluable tool for resolving variations in instrument performance and some sample matrix problems, when used improperly, this technique would make unacceptable data appear to meet quality control acceptance limits. Improper re-integrations lead to legally indefensible data, a poor reputation, or possible laboratory decertification. Because guidelines for re-integration of data are not provided in the methods and most methods were written prior to widespread implementation of computerized data systems, the laboratory trains all analytical staff on proper manual integration techniques using TestAmerica's Corporate SOP (CA-Q-S-002).

19.14.5.1 The analyst must adjust baseline or the area of a peak in some situations, for example when two compounds are not adequately resolved or when a peak shoulder needs to be separated from the peak of interest. The analyst must use professional judgment and common sense to determine when manual integrating is required. Analysts are encouraged to ask for assistance from a senior analyst or manager when in doubt.

19.14.5.2 Analysts shall not increase or decrease peak areas for the sole purpose of achieving acceptable QC recoveries that would have otherwise been unacceptable. The intentional recording or reporting of incorrect information (or the intentional omission of correct information) is against company principles and policy and is grounds for immediate termination.

19.14.5.3 Client samples, performance evaluation samples, and quality control samples are all treated equally when determining whether or not a peak area or baseline should be manually adjusted.

19.14.5.4 All manual integrations receive a second level review. Manual integrations must be indicated on an expanded scale "after" chromatograms such that the integration performed can be easily evaluated during data review. Expanded scale "before" chromatograms are also required for all manual integrations on QC parameters (calibrations, calibration verifications, laboratory control samples, internal standards, surrogates, etc.) unless the laboratory has another documented corporate approved procedure in place that can demonstrate an active process for detection and deterrence of improper integration practices.

Figure 19-1. Example - Demonstration of Capability Documentation

DEMONSTRATION OF CAPABILITIY (DOC)

Laboratory Name:_____
Laboratory Address:_____
Method:_____ Matrix:_____
Date:_____ Analyst(s):_____
Source of Analyte(s):_____

Analytical Results

Analyst	Conc. (Units)	Rep 1	Rep 2	Rep 3	Rep 4	Avg. % Recovery	% RSD

% RSD = Percent relative standard deviation = standard deviation divided by average % Recovery

Raw data reference: _____

Certification Statement:

We, the undersigned, certify that:
1. The cited test method has met Demonstration of Capability requirements.
2. The test method was performed by the analyst(s) identified on this certification.
3. A copy of the test method and the laboratory-specific SOPs are available for all personnel on site.
4. The data associated with the method demonstration of capability are true, accurate, complete, and self-explanatory.
5. All raw data necessary to reconstruct and validate these analyses have been retained at the facility, and the associated information is well organized and available for review.
6.

_____ _____
Analyst Signature Date

_____ _____
Technical Manager Signature Date

_____ _____
Quality Assurance Coordinator Signature Date

SECTION 20. EQUIPMENT and CALIBRATIONS

20.1 Overview

The laboratory purchases the most technically advanced analytical instrumentation for sample analyses. Instrumentation is purchased on the basis of accuracy, dependability, efficiency and sensitivity. Each laboratory is furnished with all items of sampling, preparation, analytical testing and measurement equipment necessary to correctly perform the tests for which the laboratory has capabilities. Each piece of equipment is capable of achieving the required accuracy and complies with specifications relevant to the method being performed. Before being placed into use, the equipment (including sampling equipment) is calibrated and checked to establish that it meets its intended specification. The calibration routines for analytical instruments establish the range of quantitation. Calibration procedures are specified in laboratory SOPs. A list of laboratory instrumentation is presented in Table 20-1. The most current list of laboratory instrumentation can be found in TestAmerica Edison Work Instruction No. ED-WI-002 (Equipment Inventory).

Equipment is only operated by authorized and trained personnel. Manufacturer's instructions for equipment use are readily accessible to all appropriate laboratory personnel.

20.2 Preventive Maintenance

The laboratory follows a well-defined maintenance program to ensure proper equipment operation and to prevent the failure of laboratory equipment or instrumentation during use. This program of preventive maintenance helps to avoid delays due to instrument failure.

Routine preventive maintenance procedures and frequency, such as cleaning and replacements, should be performed according to the procedures outlined in the manufacturer's manual. Qualified personnel must also perform maintenance when there is evidence of degradation of peak resolution, a shift in the calibration curve, loss of sensitivity, or failure to continually meet one of the quality control criteria.

Table 20-2 lists examples of scheduled routine maintenance. It is the responsibility of each Department Technical Manager to ensure that instrument maintenance logs are kept for all equipment in his/her department. Preventative maintenance procedures may also be outlined in analytical SOPs or instrument manuals. (Note: for some equipment, the log used to monitor performance is also the maintenance log. Multiple pieces of equipment may share the same log as long as it is clear as to which instrument is associated with an entry.)

Instrument maintenance logs are controlled and are used to document instrument problems, instrument repair and maintenance activities. Maintenance logs shall be kept for all major pieces of equipment. Instrument maintenance logs may also be used to specify instrument parameters.

- Documentation must include all major maintenance activities such as contracted preventive maintenance and service and in-house activities such as the replacement of electrical components, lamps, tubing, valves, columns, detectors, cleaning and adjustments.
- Each entry in the instrument log includes the Analyst's initials, the date, a detailed description of the problem (or maintenance needed/scheduled), a detailed explanation of the solution or maintenance performed, and a verification that the equipment is functioning properly (state what was used to determine a return to control. e.g. CCV run on *'date'* was acceptable, or instrument recalibrated on 'date' with acceptable verification, etc.) must also be documented in the instrument records.
- When maintenance or repair is performed by an outside agency, service receipts detailing the service performed can be affixed into the logbooks adjacent to pages describing the maintenance performed. This stapled in page must be signed across the page entered and the logbook so that it is clear that a page is missing if only half a signature is found in the logbook.

If an instrument requires repair (subjected to overloading or mishandling, gives suspect results, or otherwise has shown to be defective or outside of specified limits) it shall be taken out of operation and tagged as out-of-service or otherwise isolated until such a time as the repairs have been made and the instrument can be demonstrated as operational by calibration and/or verification or other test to demonstrate acceptable performance. The laboratory shall examine the effect of this defect on previous analyses.

In the event of equipment malfunction that cannot be resolved, service shall be obtained from the instrument vendor manufacturer, or qualified service technician, if such a service can be tendered. If on-site service is unavailable, arrangements shall be made to have the instrument shipped back to the manufacturer for repair. Back up instruments, which have been approved, for the analysis shall perform the analysis normally carried out by the malfunctioning instrument. If the back-up is not available and the analysis cannot be carried out within the needed timeframe, the samples shall be subcontracted.

At a minimum, if an instrument is sent out for service or transferred to another facility, it must be recalibrated and the laboratory MDL verified (using an MDLV) prior to return to lab operations.

20.3 Support Equipment

This section applies to all devices that may not be the actual test instrument, but are necessary to support laboratory operations. These include but are not limited to: balances, ovens, refrigerators, freezers, incubators, water baths, field sampling devices, temperature measuring devices, thermal/pressure sample preparation devices and volumetric dispensing devices if quantitative results are dependent on their accuracy, as in standard preparation and dispensing or dilution into a specified volume. All raw data records associated with the support equipment are retained to document instrument performance.

20.3.1 Weights and Balances

The accuracy of the balances used in the laboratory is checked every working day, before use. All balances are placed on stable counter tops.

Each balance is checked prior to initial serviceable use with at least two certified ASTM type 1 weights spanning its range of use (weights that have been calibrated to ASTM type 1 weights may also be used for daily verification). ASTM type 1 weights used only for calibration of other weights (and no other purpose) are inspected for corrosion, damage or nicks at least annually and if no damage is observed, they are calibrated at least every 5 years by an outside calibration laboratory. Any weights (including ASTM Type 1) used for daily balance checks or other purposes are recalibrated/recertified annually to NIST standards (this may be done internally if laboratory maintains “calibration only” ASTM type 1 weights).
All balances are serviced annually by a qualified service representative, who supplies the laboratory with a certificate that identifies traceability of the calibration to the NIST standards.

All of this information is recorded in logs, and the recalibration/recertification certificates are kept on file.

20.3.2 pH, Conductivity, and Turbidity Meters

The pH meters used in the laboratory are accurate to ± 0.1 pH units, and have a scale readability of at least 0.05 pH units. The meters automatically compensate for the temperature, and are calibrated with at least two working range buffer solutions before each use.

Conductivity meters are also calibrated before each use with a known standard to demonstrate the meters do not exceed an error of 1% or one umhos/cm.

Turbidity meters are also calibrated before each use. All of this information is documented in logs.

Consult pH and Conductivity, and Turbidity SOPs for further information.

20.3.3 Thermometers

All thermometers are calibrated on an annual basis with a NIST-traceable thermometer.

- If the temperature measuring device is used over a range of 10°C or less, then a single point verification within the range of use is acceptable;
- If the temperature measuring device is used over a range of greater than 10°C, then the verification must bracket the range of use.

IR thermometers, digital probes and thermocouples are calibrated quarterly. IR Thermometers should be calibrated over the full range of use, including ambient, iced (4°C) and frozen (0°C to -5°C), per the Drinking Water Manual.

The digital NIST thermometer is recalibrated every five years (unless thermometer has been exposed to temperature extremes or apparent separation of internal liquid) by an approved outside service and the provided certificate of traceability is kept on file. The NIST thermometer(s) have increments of 1 degree (0.5 degree or less increments are required for drinking water microbiological laboratories), and have ranges applicable to method and certification requirements. The NIST traceable thermometer is used for no other purpose than to calibrate other thermometers.

All of this information is documented in logbooks. Monitoring method-specific temperatures, including incubators, heating blocks, water baths, and ovens, is documented in method-specific logbooks. More information on this subject can be found in the laboratory SOP No. ED-GEN-014 (Thermometer Calibration***).***

20.3.4 Refrigerators/Freezer Units, Waterbaths, Ovens and Incubators

The temperatures of all refrigerator units and freezers used for sample and standard storage are monitored each working day.

Ovens, waterbaths and incubators are monitored on days of use.

All of this equipment has a unique identification number, and is assigned a unique thermometer for monitoring.

Sample storage refrigerator temperatures are kept between > 0ºC and $\leq$ 6 ºC.

Specific temperature settings/ranges for other refrigerators, ovens waterbaths, and incubators can be found in method specific SOPs.

All of this information is documented in Daily Temperature Logbooks and method-specific logbooks.

20.3.5 Autopipettors, Dilutors, and Syringes

Mechanical volumetric dispensing devices including burettes (except Class A Glassware and Glass microliter syringes) are given unique identification numbers and the delivery volumes are verified gravimetrically, at a minimum, on a quarterly basis.

For those dispensers that are not used for analytical measurements, a label is / can be applied to the device stating that it is not calibrated. Any device not regularly verified cannot be used for any quantitative measurements. Refer to TestAmerica Edison SOP No. ED-GEN-011 (Calibration and Use of Lab Pipettes).

Micro-syringes are purchased from Hamilton Company. Each syringe is traceable to NIST. The laboratory keeps on file an "Accuracy and Precision Statement of Conformance" from Hamilton attesting established accuracy.

20.3.6 Field Sampling Devices (Isco Auto Samplers)

Each Auto Sampler (ISCO) is assigned a unique identification number in order to keep track of the calibration. This number is also recorded on the sampling documentation.

The Auto Sampler is calibrated as needed based on manufacturer's recommendations.

20.4 Instrument Calibrations

Calibration of analytical instrumentation is essential to the production of quality data. Strict calibration procedures are followed for each method. These procedures are designed to determine and document the method detection limits, the working range of the analytical instrumentation and any fluctuations that may occur from day to day.

Sufficient raw data records are retained to allow an outside party to reconstruct all facets of the initial calibration. Records contain, but are not limited to, the following: calibration date, method, instrument, analyst(s) initials or signatures, analysis date, analytes, concentration, response, type of calibration (Avg RF, curve, or other calculations that may be used to reduce instrument responses to concentration.)

Sample results must be quantitated from the initial calibration and may not be quantitated from any continuing instrument calibration verification unless otherwise required by regulation, method or program.

If the initial calibration results are outside of the acceptance criteria, corrective action is performed and any affected samples are reanalyzed if possible. If the reanalysis is not possible, any data associated with an unacceptable initial calibration will be reported with appropriate data qualifiers (refer to Section 12).

Note: Instruments are calibrated initially and as needed after that and at least annually *(the annual requirement does not apply to Isotope dilution).*

20.4.1 Calibration Standards

Calibration standards are prepared using the procedures indicated in the Reagents and Standards section of the determinative method SOP. If a reference method does not specify the number of calibration standards, a minimum of 3 calibration points will be used.

Standards for instrument calibration are obtained from a variety of sources. All standards are traceable to national or international standards of measurement, or to national or international standard reference materials.

The lowest concentration calibration standard that is analyzed during an initial calibration must be at or below the stated reporting limit for the method based on the final volume of extract (or sample).

The other concentrations define the working range of the instrument/method or correspond to the expected range of concentrations found in actual samples that are also within the working range of the instrument/method. Results of samples not bracketed by initial instrument calibration standards (within calibration range to at least the same number of significant figures used to report the data) must be reported as having less certainty, e.g., defined qualifiers or flags (additional information may be included in the case narrative). The exceptions to these rules. ICP and ICPMS methods which define the working range with periodic linear dynamic range studies, rather than through the range of concentrations of daily calibration standards.

All initial calibrations are verified with a standard obtained from a second source and traceable to a national standard, when available (or vendor certified different lot if a second source is not available). For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst at a different time or a different preparation would be considered a second source. This verification occurs immediately after the calibration curve has been analyzed, and before the analysis of any samples.

20.4.1.1 Calibration Verification

The calibration relationship established during the initial calibration must be verified initially and at least daily as specified in the laboratory method SOPs in accordance with the referenced analytical methods and in the 2009 TNI Standard. The process of calibration verification applies to both external standard and internal standard calibration techniques, as well as to linear and non-linear calibration models. Initial calibration verification is with a standard source secondary (second source standard) to the calibration standards, but continuing calibration verifications may use the same source standards as the calibration curve.

Note: The process of calibration verification referred to here is fundamentally different from the approach called "calibration" in some methods. As described in those methods, the calibration factors or response factors calculated during calibration are used to update the calibration factors or response factors used for sample quantitation. This approach, while employed in other EPA programs, amounts to a daily single-point calibration.

All target analytes and surrogates, including those reported as non-detects, must be included in periodic calibration verifications for purposes of retention time confirmation and to demonstrate that calibration verification criteria are being met, i.e., RPD, per 2009 TNI Std. EL-V1M4 Sec. 1.7.2.

All samples must be bracketed by periodic analyses of standards that meet the QC acceptance criteria (e.g., calibration and retention time). The frequency is found in the determinative methods or SOPs.

Note: If an internal standard calibration is being used then bracketing calibration verification standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

Generally, the initial calibrations must be verified at the beginning of each 12-hour analytical shift during which samples are analyzed. (Some methods may specify more or less frequent verifications). The 12-hour analytical shift begins with the injection of the calibration verification standard (or the MS tuning standard in MS methods). The shift ends after the completion of the analysis of the last sample, QC, or standard that can be injected within 12-hours of the beginning of the shift.

A continuing instrument calibration verification (CCV) must be repeated at the beginning and, for methods that have quantitation by external calibration models, at the end of each analytical batch. Some methods have more frequent CCV requirements see specific SOPs. Most Inorganic methods require the CCV to be analyzed after ever 10 samples or injections, including matrix or batch QC samples.

Note: If an internal standard calibration is being used (basically GCMS) then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

If the results of a CCV are outside the established acceptance criteria and analysis of a second consecutive (and immediate) CCV fails to produce results within acceptance criteria, corrective action shall be performed. Once corrective actions have been completed & documented, the laboratory shall demonstrate acceptable instrument / method performance by analyzing two consecutive CCVs, or a new initial instrument calibration shall be performed.

Sample analyses and reporting of data may not occur or continue until the analytical system is calibrated or calibration verified. However, data associated with an unacceptable calibration verification may be fully useable under the following special conditions:

a). when the acceptance criteria for the CCV are exceeded high (i.e., high bias) and the associated samples within the batch are non-detects, then those non-detects may be reported with a footnote or case narrative explaining the high bias. Otherwise the samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted; or

b). when the acceptance criteria for the CCV are exceeded low (i.e., low bias), those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise the samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted.

Samples reported by the 2 conditions identified above will be appropriately flagged.

20.4.1.2 Verification of Linear and Non-Linear Calibrations

Calibration verification for calibrations involves the calculation of the percent drift or the percent difference of the instrument response between the initial calibration and each subsequent analysis of the verification standard. (These calculations are available in the laboratory method SOPs. Verification standards are evaluated based on the % Difference from the average CF or RF of the initial calibration or based on % Drift or % Recovery if a linear or quadratic curve is used.

Regardless of whether a linear or non-linear calibration model is used, if initial verification criterion is not met, then no sample analyses may take place until the calibration has been verified or a new initial calibration is performed that meets the specifications listed in the method SOPs. If the calibration cannot be verified after the analysis of a single verification standard, then adjust the instrument operating conditions and/or perform instrument maintenance, and analyze another aliquot of the verification standard. If the calibration cannot be verified with the second standard, then a new initial calibration is performed.

- When the acceptance criteria for the calibration verification are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported. Otherwise, the samples affected by the unacceptable calibration verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted.

- When the acceptance criteria for the calibration verification are exceeded low, i.e., low bias, those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise, the samples affected by the unacceptable verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted. Alternatively, a

reporting limit standard may be analyzed to demonstrate that the laboratory can still support non-detects at their reporting limit.

20.5 Tentatively Identified Compounds (TICs) – GC/MS Analysis

For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by the purpose of the analyses being conducted. Data system library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other.

Note: If the TIC compound is not part of the client target analyte list but is calibrated by the laboratory and is both qualitatively and/or quantitatively identifiable, it should not be reported as a TIC. If the compound is reported on the same form as true TICs, it should be qualified and/or narrated that the reported compound is qualitatively and quantitatively (if verification in control) reported compared to a known standard that is in control (where applicable).

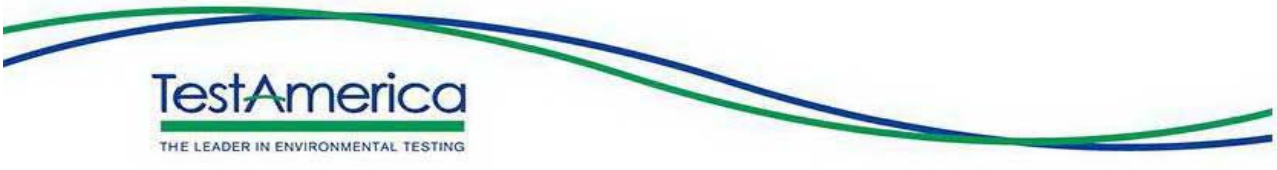
For example, the RCRA permit or waste delisting requirements may require the reporting of non-target analytes. Only after visual comparison of sample spectra with the nearest library searches may the analyst assign a tentative identification.

20.6 GC/MS Tuning

Prior to any GCMS analytical sequence, including calibration, the instrument parameters for the tune and subsequent sample analyses within that sequence must be set.

Prior to tuning/auto-tuning the mass spec, the parameters may be adjusted within the specifications set by the manufacturer or the analytical method. These generally don't need any adjustment but it may be required based on the current instrument performance. If the tune verification does not pass it may be necessary to clean the source or perform additional maintenance. Any maintenance is documented in the maintenance log.

Table 20-1. Example: Instrumentation List



TestAmerica Edison Instrument List

Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Metals Department					
ICP (ICP5)	Thermo Jarrell Ash	ICAP 6500 DUO View	IC5D20121709	2012	New
ICP (ICP4)	Thermo Jarrell Ash	ICAP 6500 DUO View	ICP-20073407	2009	New
ICP/MS (ICPMS1)	Agilent Technologies	7500CE	JP51201560	2006	New
Heat Exchanger	Agilent Technologies	3370	G57335		
Autosampler	Cetac	G3286A	US0808108A520		
ICP/MS (ICPMS2)	Agilent Technologies	7500CX	JP82802644	2010	New
Heat Exchanger	Agilent Technologies	3370	1C1160265	2006	Used
Autosampler	Cetac	ASX500	021134A520	2006	New
ICP/MS (ICPMS3)	Agilent Technologies	G8403A	JP16121357	2016	New
Heat Exchanger	PolyScience	G3292-80000	2U1570105	2016	New
Autosampler	Agilent Technologies	G8410A	AU16101128	2016	New
Mercury Analyzer 6	Leeman Labs	Hydra II	2008 112-00064-1	2014	New
Mercury Analyzer 7	Leeman Labs	Hydra II	US17159010	2017	New
Hot Block (Hot Block 2)	Environmental Express Limited	SC-154	2391CE1273	2004	New
Hot Block (Hot Block 3)	Environmental Express Limited	SC-150	4298CEC2048	2004	New
Hot Block (Hot Block 4)	Environmental Express Limited	SC-150	4507CEC2115	2006	New
Hot Block (Hot Block 5)	Environmental Express Limited	SC-150	466CEC2183	2006	New
Hot Block (Hot Block 7)	Environmental Express Limited	SC-150	2772CDC1378	2006	New
Hot Block (Hot Block 8)	Environmental Express Limited	SC154	1423CEC1154		
Hot Block (Hot Block 9)	Environmental Express Limited	SC-150	1917CEC1155		

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Hot Block (Hot Block 11) **OUT FOR REPAIR – 11/7/17**	Environmental Express Limited	DigiPrep	4102030316		
Hot Block (Hot Block 12)	Environmental Express Limited	SC-154	3098CEC1508		
Top Loading Balance (Balance #35)	Acculab	VIC-412	18255989	2005	New
Top Loading Balance (Balance #33)	Ohaus	AR5120	F0461200521139	2001	New
Semivolatile GC/MS Department					
GC/MS System (BNAMS2)					
Gas Chromatograph	Agilent Technologies	6890A	CN10447031	TBD	New
MS Detector	Agilent Technologies	5973	US44647039	TBD	New
Autosampler Tower	Agilent Technologies	7683B	US82410944	TBD	New
Autosampler Tray	Agilent Technologies	7683	US85002901	TBD	New
GC/MS System (BNAMS4)					
Gas Chromatograph	Hewlett Packard	5890 Series II	3108A34490	1986	New
MS Detector	Hewlett Packard	5971A	3114A02077	1986	New
Autosampler Tower	Hewlett Packard	7673A	3429A33228	1986	New
Autosampler Tray	Hewlett Packard	7673	3624A42191	1986	New
Controller	Hewlett Packard		2803A11211	1986	New
GC/MS System (BNAMS5)					
Gas Chromatograph	Agilent Technologies	7890A	CN10726100	2005	New
MS Detector	Agilent Technologies	5975C	US35120328	2005	New
Autosampler Tower	Agilent Technologies	7673B	CN72441261	2005	New
Autosampler Tray	Agilent Technologies	7673	CN43830668	2005	New
Controller	Agilent Technologies		CN40427800	2005	New

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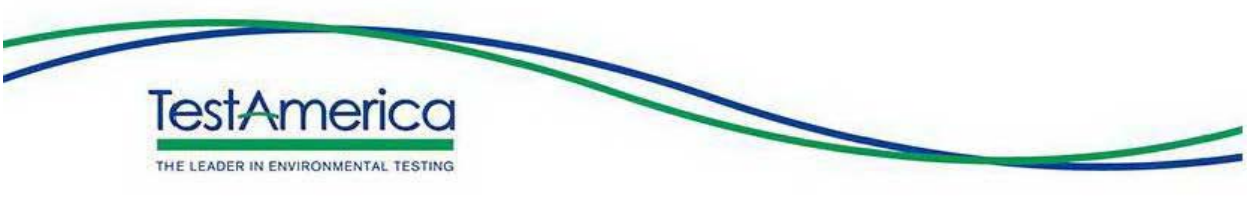
Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
GC/MS System (BNAMS9)					
Gas Chromatograph	Agilent Technologies	6890N	CN10349071	2004	New
MS Detector	Agilent Technologies	5973	US35120328	2004	New
Autosampler Tower	Agilent Technologies	7683	CN34433497	2004	New
Autosampler Tray	Agilent Technologies	7683	CN40327770	2004	New
Controller	Agilent Technologies		CN40427800	2004	New
GC/MS System (BNAMS11)					
Gas Chromatograph	Agilent Technologies	7890A	CN10727109	2007	New
MS Detector	Agilent Technologies	5975C	US71236621	2007	New
Autosampler Tower	Agilent Technologies	7683B	CN72441255	2007	New
Autosampler Tray	Agilent Technologies	7683	CN72544441	2007	New
Controller	Agilent Technologies			2007	New
GC/MS System (BNAMS12)					
Gas Chromatograph	Agilent Technologies	6890A	CN10531011	2012	New
MS Detector	Agilent Technologies	5975C	US52420834	2012	New
Autosampler Tower	Agilent Technologies	7683B	CN61732705	2012	New
Autosampler Tray	Agilent Technologies	7683	CN24322270	2012	New
Controller	Agilent Technologies				
GC/MS System (BNAMS13)					
Gas Chromatograph	Agilent Technologies	6890A	CN10529024	2012	New
MS Detector	Agilent Technologies	5975C	US10503712	2012	New
Autosampler Tower	Agilent Technologies	7683B	CN48320808	2012	New
Autosampler Tray	Agilent Technologies	7683	CN40327583	2012	New



Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Controller	Agilent Technologies			2012	New
GC/MS System (BNAMS14)					
Gas Chromatograph	Agilent Technologies	7890B	CN14393167	2012	New
MS Detector	Agilent Technologies	5975C	US83131020	2012	New
Autosampler Tower	Agilent Technologies	7683B	CN759A2046	2012	New
Autosampler Tray	Agilent Technologies	7683	CN72544431	2012	New
Controller	Agilent Technologies			2012	New
GC/MS System (BNAMS15)	Agilent Technologies				
Gas Chromatograph	Agilent Technologies	9000 Intuvo	CN17010006	2015	New
MS Detector	Agilent Technologies	5977A	US1433L427	2015	New
Autosampler Tower	Agilent Technologies	7963A	CN14410091	2015	New
Autosampler Tray	Agilent Technologies	7963	CN14360040	2015	New
GC/MS System (BNAMS16)					
Gas Chromatograph	Agilent Technologies	6890N	CN10402079	TBD	New
MS Detector	Agilent Technologies	5975	US55132182	TBD	New
Autosampler Tower	Agilent Technologies	7683	CN22025342	TBD	New
Autosampler Tray	Agilent Technologies	G2614A	CN404427800	TBD	New
GC/FID System (BNAGC8)					
Gas Chromatograph	Hewlett-Packard	5890	3121A35833	1986	New
Autosampler Tower	Hewlett-Packard	7673A	2704805765	1986	New
Autosampler Tray	Hewlett-Packard		3131A25914	1986	New
Controller	Hewlett-Packard		2921A03449	1986	New
Manifold	Western Enterprise	Innovator HBAC2-5-4	28452	2004	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Volatiles Department (GC and GC/MS)					
GC/MS System (VOAMS1)					
Gas Chromatograph	Agilent Technologies	6890N	CN10606023	2006	New
MS Detector	Agilent Technologies	5975	US60532504	2006	New
Autosampler	OI	4551A	D60745B342	2006	New
Concentrator	OI	Eclipse 4660	D608466853	2006	New
Spiker	OI	SAM	E54175492	2006	New
GC/MS System (VOAMS2)					
Gas Chromatograph	Hewlett-Packard	7890A	CN10813013	2008	New
MS Detector	Hewlett-Packard	5975C	US80838709	2008	New
Autosampler	OI	4552 (Archon 5100)	14608	2008	New
Concentrator	OI	Eclipse 4660	K41746689OP	2008	New
GC/MS System (VOAMS3)					
Gas Chromatograph	Agilent Technologies	6890N	CN10406105	2004	New
MS Detector	Agilent Technologies	5973 Inert	US35120382	2004	New
Autosampler	EST	Centurion	CENT140051304	2004	New
Concentrator	EST	Encon	478021506	2004	New
Concentrator	EST	Encon	478021506	2004	New
GC/MS System (VOAMS4)					
Gas Chromatograph	Hewlett-Packard	7890A	CN10813014	2008	New
MS Detector	Hewlett-Packard	5975C	US80838712	2008	New
Autosampler	OI	4552	15264	2008	New
Concentrator	OI	2008	D809466076	2008	New
GC/MS System (VOAMS5)					
Gas Chromatograph	Agilent	6890	US10518019	TBD	New
MS Detector	Hewlett-Packard	5973	US44621422	TBD	New
Autosampler	OI	4552 (Archon 5100)	12206	1998	New
Concentrator	OI/EST	Encon	425042704	TBD	New
Concentrator	OI/EST	Encon	425042705	TBD	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
GC/MS System (VOAMS6)					
Gas Chromatograph	Agilent Technologies	6890N	CN10406076	2004	New
MS Detector	Agilent Technologies	5973 Inert	US35120322	2004	New
Autosampler	OI	4551A	D54645B461	2005	New
Concentrator	OI	4660	D548466579	2005	New
Spiker	OI	SAM	C425475656	2004	New
GC/MS System (VOAMS7)					
Gas Chromatograph	Agilent Technologies	6890N	CN10437064	2006	New
MS Detector	Agilent Technologies	5973 Inert	US43110514	2004	New
Autosampler	Teledyne Tekmar	Solatek	US08121007	2008	New
Concentrator	Teledyne Tekmar	Stratum	US08007007	2008	New
GC/MS System (VOAMS8)					
Gas Chromatograph	Hewlett-Packard	6890	US00028879	TBD	New
MS Detector	Hewlett-Packard	5973	US91411758	TBD	New
Autosampler	EST Archon	5100A	13097	TBD	New
Concentrator	EST Encon	4560	389092704E	TBD	New
GC/MS System (VOAMS9)					
Gas Chromatograph	Agilent	6890	CN10517107	TBD	New
MS Detector	Agilent	5973	US44610847	TBD	New
Autosampler	OI	4552	15266	2008	New
Concentrator	OI	4660	D548466579	TBD	New
GC/MS System (VOAMS10)					
Gas Chromatograph	Agilent	6890	CN10419047	TBD	New
MS Detector	Hewlett-Packard	5973	US10461695	TBD	New
Autosampler	OI	4100	D714410066	TBD	New
Concentrator	OI	4760	A714447065	TBD	New
GC/MS System (VOAMS11)					
Gas Chromatograph	Agilent Technologies	6890N	CN10324011	2003	New
MS Detector	Agilent Technologies	5973N	US30965664	2003	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Autosampler	EST Archon	5100A	13970	2003	New
Concentrator	EST	Encon Eclipse	A714447060	2017	New
GC/MS System (VOAMS12)					
Gas Chromatograph	Agilent Technologies	6890N	CN10439051	2005	New
MS Detector	Agilent Technologies	5973 inert	US43110519	2004	New
Autosampler	EST	5100A	14448	2005	New
Concentrator	EST	Encon	430051605	2005	New
Turbo Pump Upgrade	Agilent Technologies	Performance	56115832	2005	New
GC/MS System (VOAMS13)					
Gas Chromatograph	Agilent Technologies	6890N	CN10439052	2005	New
MS Detector	Agilent Technologies	5973 inert	US43110517	2004	New
Autosampler	EST	5100A	14449	2005	New
Concentrator	EST	Encon	431051605	2005	New
Turbo Pump Upgrade	Agilent Technologies	Performance	56069171	2005	New
GC/MS System (VOAMS14)					
Gas Chromatograph	Agilent Technologies	7890B	17293078	2017	New
MS Detector	Agilent Technologies	5977B	US1731M027	2017	New
Autosampler					
Concentrator					
GC/MS System (VOAMS15)					
Gas Chromatograph	Agilent Technologies	7890B	CN17293101	2017	New
MS Detector	Agilent Technologies	5977B	US1731M011	2017	New
Autosampler					
Concentrator					
GC/FID System (VOAGC1)					
Gas Chromatograph	Agilent Technologies	6890N	US10610006	2006	New
Autosampler	OI	4552	14608	2006	New
Concentrator	OI	4660	D607466340	2006	New
Autosampler	OI	4551A	D60745B342	2006	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Concentrator	OI	4660	D607466341	2006	New
Spiker	OI	SAM	E610475713	2006	New
GC/FID System (VOAGC3)					
Gas Chromatograph	Hewlett-Packard	5890 II	3310A49242	1996	New
Autosampler	Dynatech Archon	5100	11780-795	1996	New
Concentrator	OI	4560	J437460274	1996	New
GC/FID System (VOAGC4)					
Gas Chromatograph	Hewlett-Packard	6890	00031073	TBD	New
Headspace Autosampler	Teledyne Tekmar	HT3	US17187006	TBD	New
Headspace Autosampler	Teledyne Tekmar	HT3	US1715201	TBD	New
GC/FID System (VOASCREEN5/6)					
Gas Chromatograph	Hewlett-Packard	5890 II	2921A23492	1993	New
Autosampler	Tekmar	7050	US04156005	2004	New
Headspace Sampler	Tekmar	7000	US04156003	2004	New
Autosampler	Tekmar	7050	US04148014	2004	New
Headspace Sampler	Tekmar	7000	US04163001	2004	New
Top Loading Balance (Balance #22)	Mettler	PB1501	2115517886	1997	New
Precision Balance (Balance #50)	Ohaus	Explorer Pro 413	1125573353	2006	New
Top Loading Balance (Balance #32)	Denver Instruments	P602	126008	2009	New
Drying Oven	Fisher Isotemp Oven	13-246-516G	502N0045	2005	New
Drying Oven	Baxter	DX-1	199012	2000	New
H-Nu PID	H-Nu Systems	PI101	801023	1989	New
Fume Hood	Air Science	PurAir15	P41007	2004	New
GC Semivolatile Department					
Analytical Balance (Balance #30)	A&D	HR200C	12315880		
Ion Chromatograph (IC-B)	Metrohm Peak, Inc.			2005	New
Pump 1	Metrohm Peak, Inc.	818	04187	2005	New
Pump 2	Metrohm Peak, Inc.	818	04197	2005	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Conductivity Detector	Metrohm Peak, Inc.	819	03195	2005	New
Injector and Oven	Metrohm Peak, Inc.	820	04147	2005	New
2-channel interface	Metrohm Peak, Inc.	830	04184	2005	New
Liquid Handling 1	Metrohm Peak, Inc.	833	04154	2005	New
Liquid Handling 12	Metrohm Peak, Inc.	833	04118	2005	New
Autosample	Metrohm Peak, Inc.	838	03198	2005	New
Ion Chromatograph (IC-A)	Metrohm Peak, Inc.			2010	New
Pump 1	Metrohm Peak, Inc.	818	SS4818011006190	2010	New
Pump 2	Metrohm Peak, Inc.	818	SS1818011003192	2010	New
UV-VIS Detector	Metrohm Peak, Inc.	1010 (Bischoff)	SS1153001010101	2010	New
Conductivity Detector	Metrohm Peak, Inc.	819	03181	2005	New
IC Interface	Metrohm Peak, Inc.	830	SS1830002003180	2010	New
Separation Center	Metrohm Peak, Inc.	820	SS1820023003168	2010	New
Sample Processor	Metrohm Peak, Inc.	838	SS1838001009171	2010	New
Filter Pump 1	Emerson		N SA55-NXGTB 4142		New
Filter Pump 2	Emerson	SA55JXgtd-4144	G8ECX	2002	New
Ion Chromatograph (IC-1)	Metrohm USA, Inc.	Compact IC Flex 930.2460		2017	New
Compact Flex Oven/Ses/Deg	Metrohm USA, Inc.	29302460	00103716	2017	New
Conductivity Detector	Metrohm USA, Inc.	28509010			
Dosino	Metrohm USA, Inc.	28000010	00099636		
MSM-A Rotor	Metrohm USA, Inc.	28509010	00102177		
Metrohm Data Management System	Metrohm USA, Inc.	66059321	JB5FKH2		

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
ProfIC Sample Processor Pump	Metrohm USA, Inc.	28580020	000091657		
Ion Chromatograph (IC-2)	Metrohm USA, Inc.	Compact IC Flex 930.2460		2017	New
Compact Flex Oven/Ses/Deg	Metrohm USA, Inc.	29302460	00103714	2017	New
Conductivity Detector	Metrohm USA, Inc.	28509010			
Dosino	Metrohm USA, Inc.	28000010	00099712		
Dosino Invial Dilution	Metrohm USA, Inc.	28000010	00099731		
MSM-A Rotor	Metrohm USA, Inc.	28509010	00102177		
Metrohm Data Management System	Metrohm USA, Inc.	66059321	JB5DKH2		
ProfIC Sample Processor Pump	Metrohm USA, Inc.	28580020	000098576		
GC/FID System (BNAGC1)					
Gas Chromatograph	Agilent Technologies	6890N	US10248079		
Autosampler	Agilent Technologies	G2913A	**CHECK**		
Autosampler	Agilent Technologies	G2913A	US95110886 (Compco)		
Autosampler Tray	Agilent Technologies	G2914A	CN82949935		
GC/FID System (BNAGC2)					
Gas Chromatograph	Agilent Technologies	6890N	US00005410		
Autosampler	Agilent Technologies	G2913A	US00210996		
Autosampler	Agilent Technologies	G2914A	**CHECK**		
Autosampler Tray	Agilent Technologies	G2914A	CN21420543		
GC/FID System (BNAGC3)					
Gas Chromatograph	Agilent Technologies	6890N	US10202132		

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Autosampler	Agilent Technologies	G2913A	CN22025340		
Autosampler	Agilent Technologies	G2914A	US00210996		
Autosampler Tray	Agilent Technologies	G2914A	CN43830663		
GC/FID System (BNAGC4)					
Gas Chromatograph	Agilent Technologies	6890N	US10610005	2006	New
Autosampler	Agilent Technologies	G2913A	CN24428046	2006	New
Autosampler	Agilent Technologies	G2913A	CN43820799	2006	New
Autosampler Tray	Agilent Technologies	G2914A	CN43930714	2006	New
GC/ECD System (PESTGC1)					
Gas Chromatograph	Hewlett-Packard	5890A	2612A07669	1992	New
Autosampler	Hewlett-Packard	G1513A	US72202218	1992	New
Autosampler Tray	Hewlett-Packard	18596C	3401A34202	1992	New
Controller	Hewlett-Packard	G1512A	CN00005085	1992	New
GC/ECD System (PESTGC3)					
Gas Chromatograph	Hewlett-Packard	5890A	3223A42873	1992	New
Autosampler	Hewlett-Packard	18593B	3216A38325	1992	New
Autosampler Tray	Hewlett-Packard	18596B	3120A27740	1992	New
Controller	Hewlett-Packard	18594B	3049A23890	1992	New
GC/ECD System (PESTGC4)					
Gas Chromatograph	Hewlett-Packard	5890A Series II	US00024529	1997	New
Autosampler	Hewlett-Packard	18593B	**Check?**	1997	New
Autosampler Tray	Hewlett-Packard	7673	US13807350	1997	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Controller	Hewlett-Packard	18594B	3227A29129	1997	New
GC/ECD System (PESTGC5)					
Gas Chromatograph	Agilent Technologies	6890N	US10226033	2002	New
Autosampler	Agilent Technologies	G2613A	US83301937	2002	New
Autosampler Tray	Agilent Technologies	G2614A	CN61739524	2002	New
GC/ECD System (PESTGC6)					
Gas Chromatograph	Hewlett-Packard	5890A	2950A26642	1998	New
Autosampler	Hewlett-Packard	18593B	US83301937	1998	New
Autosampler Tray	Hewlett-Packard	18596B	2942A20025	1998	New
Controller	Hewlett-Packard	G1512A	CN00004777	1998	New
GC/ECD System (PESTGC7)					
Gas Chromatograph	Hewlett-Packard	5890A	3029A29927	1998	New
Autosampler	Hewlett-Packard	18593A	3120A28315	1998	New
Autosampler Tray	Hewlett-Packard	18596B	3346A33861	1998	New
Controller	Hewlett-Packard	18594A	626059	1998	New
GC/ECD System (PESTGC8)					
Gas Chromatograph	Agilent Technologies	6890	US00004463	2000	New
Autosampler	Agilent Technologies	G1513A	**Check**	2000	New
Autosampler Tray	Agilent Technologies	18596M	3334A32973	2000	New
Controller	Agilent Technologies	G1512A	3631A05939	2000	New
GC/ECD System (PESTGC9)					
Gas Chromatograph	Agilent Technologies	6890	US00043694	2001	New
Autosampler	Agilent Technologies	G1513A	**Check**	2001	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Autosampler Tray	Agilent Technologies	18596B	3228A29094	2001	New
Controller	Agilent Technologies	G1512A	CN00004150	2001	New
GC/ECD System (PESTGC11)					
Gas Chromatograph	Agilent Technologies	6890	US00008746	2003	New
Autosampler	Agilent Technologies	18593B	3120A28308	2003	New
Autosampler Tray	Agilent Technologies	18596C	3249A30680	2003	New
Controller	Agilent Technologies	G2512A	US72202100	2003	New
Wet Chemistry Department					
UV/VIS Spectrophotometer	HACH	DR2800	1205122	2007	New
UV/VIS Spectrophotometer	HACH	DR2800	1204684	2007	New
UV/VIS Spectrophotometer	HACH	DR2800	1120442	2007	New
Turbidimeter	HACH	HACH 2100N	12050C028810	2006	New
Ion Selective Meter	Orion	720A	006825	1994	New
Ion Selective Meter	Orion	720A+	092904	2007	New
pH Meter	Orion	A211	X16125	2017	New
pH Meter	Orion	A211	X39284	2017	New
pH Meter	Orion	A211	X37844	2017	New
pH Meter	Orion	A211	26256	2017	New
pH Meter	Orion	A211	Y28592	2016	New
Oven	VWR	1320	0402001	2001	New
Oven	VWR	1300U	VWR	2001	New
Oven	VWR	1305U	VWR	2001	New
Oven	Fisher	230G	Fisher	1997	New
Muffle Furnace	Fisher	550-14	901N002	2002	New
Drying Oven	VWR	1320	VWR	2001	New
Analytical Balance (Balance #27)	A&D	HR-200C	12315883	2005	New
Analytical Balance (Balance #29)	A&D	HR-200C	12315872	2005	New
Micro Balance (Balance #100)	Mettler	MX-5	122423439	2006	New
Top Loading Balance (Balance #13)	Sartorius	LC-421	50709085		
Top Loading Balance (Balance #200)	Denver Instruments	P-602	095010		
Analytical Balance (Balance #900)	Ohaus	GA-110	2220		
Top Loading Balance (Balance #25)	Sartorius		3403003		

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Water Bath	Precision	50	9302-112	1995	New
Water Bath	Precision	50	9305-024	1995	New
COD Reactor	Hach	DRB 200	960800014651		
COD Reactor	Hach	DRB 200	13060C0213	2007	New
COD Reactor	Hach	DRB 200	1202323	2007	New
COD Reactor	Hach	DRB 200	1209887	2015	New
Flow Injection Autoanalyzer	Lachat	Quickem 8000	A83000	1997	New
Flow Injection Autoanalyzer	Lachat	8000 Series	8300-1658	2000	New
Total Organic Carbon (TOC) Analyzer	Shimadzu	TOC 5000	31242909	1997	New
Autosampler	Shimadzu	ASI 5000	31816800	1997	New
Solid Sample Module	Shimadzu	SSM-5000A	31303115	1997	New
Total Organic Carbon (TOC) Soil Analyzer #2	Thermo Electron Corp.	Flash EA 1112 Series	20034945	2004	New
Printer	Epson	LQ570	41NE28676	1997	New
Total Organic Carbon (TOC) Analyzer	Shimadzu	TOC_VCSH	H51104335164	2006	New
Autosampler	Shimadzu	ASI-V	H52104301656SA	2006	New
Solid Sample Module	Shimadzu	SSM-500A	H52504300040NK	2006	New
BOD Meter	YSI	5000	97S0534AE	1998	New
BOD Meter1 Rinse Pump Interface Control Box Automax 390 autosampler Software Seed pump Dilution pump Computer Monitor		PBM-BOD/AM39010 PC-1000-475 PC-1085-00 PB-10030 PC-1000-1074 PB-10600 PC-1000-408 PC-1000-443	 MT-1F7-414 MT-1G7-249 MT-1H7-200 MT-1H7-100 MT-1K6-559 MT-1G7-230 MXL7112917 CNK72411GS	2017	New
Incubator	GCA Precision Scientific			1998	New
Hot Plate	Corning		103N0071	2001	New
Hot Plate	Fischer Scientific	PC-400	370301092774	2007	New
Hot Plate	Corning	PC-420	390502148495	2007	New
Hot Plate	Fischer Scientific	PC-620	220897070707	2007	New
Conductivity Meter	Fischer Scientific	Accumetab 30	81209007	2002	New
Vortex Mixer	Thermolyne	M63215	632000855604	2002	New
Dishwasher	Miele Professional	G7783CD	208479	2003	New
Easy-Dist Distillation	Westco		1095	2003	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Easy	Westco		J097	2003	New
Easy	Westco		1063	2007	New
Easy	Westco		1110	2007	New
Automated Discrete Analyzer #1	Konelab	20	S2019177	2003	New
Automated Discrete Analyzer #2	Konelab	20	2519236	2003	New
Computer	Dell		246175	2003	New
PC-Titration Plus Autotitrator	Mantech Assoc., Inc			2004	New
Interface		PC-1000-102/4	MS-0H4-373		
Titra-Rinse 1		PC-1000-408	MS-0G4-198		
Titra-Rinse 2		PC-1000-408	MS-0G4-200		
Buret Module 1		PC-1104-00	MS-0H4-627		
Buret Module 2		PC-1104-00	MS-0H4-625		
Titration Module		PC-1300-475	MS-0B5-657		
Redox Meter	VWR	8005	001149	1997	New
TCLP Extraction Laboratory					
Peristaltic Pump	PC-Titrate	PC-1000-40	MS-OF3-568	2004	New
TCLP Extraction Apparatus/Timer included	Assoc. Design and Mfg. Co.	3740-4 BRE	1320	2006	New
TCLP Extraction1 Apparatus/Timer included	Assoc. Design and Mfg. Co.	3740-12 BRE	1352	1997	New
TCLP Extraction2 Apparatus/Timer included	Assoc. Design and Mfg. Co.	3740-12 BRE	1053	1997	New
TCLP Extraction3 Apparatus/Timer included	Assoc. Design and Mfg. Co.	3740-12 BRE	1249	1997	New
TCLP Extraction4 Apparatus/Timer included	Environmental Express Ltd	LE 1002	3384-12-473	2005	New
TCLP Extraction5 Apparatus/Timer included	Environmental Express Ltd	LE 1002	3384-12-472	2005	New
TCLP Extraction6 Apparatus/Timer included	Assoc. Design and Mfg. Co.	3740-12 BREII	2125	2006	New
TCLP Extraction7 Apparatus/Timer included	Assoc. Design and Mfg. Co.	3740-12 BREII	2126	2006	New
Sample Control Department					
Top Loading Balance (Balance #104)	Denver Instruments	P602	126006		
Oven #1	Fisher	Isotemp 637G	410B01117	2005	New
Oven #2	Fisher	Isotemp 637G	505N0063	2005	New
Oven #3	Fisher	6921			
DI Water System (LOGIN)	Millipore		07348-C	1990	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Organic Prep Department					
Analytical Balance (Balance #28)	A&D	HR200C	12315879		
Analytical Balance (Balance #A1)	Denver Instruments	P214	1050008		
Top Loading Balance (Balance #60)	Denver Instruments	P602	115003		
DI Water System	Barnstead	D11911	1191020210415	1995	New
Microwave Extraction System	MARS Xpress 230/60	907501	MD5095	2012	Inter-company transfer
Microwave Extraction System	MARS Xpress 230/60	907501	MD1952	2009	
Microwave Extraction System	MARS Xpress 230/60	907501	MD4965	2014	
Sonicator (Controller)	Sonic & Material, Inc.	VC750	58783	2012	Inter - company transfer
Sonicator Horn	Sonic & Material, Inc.	CV335	33107206	2012	Inter-company transfer
N-Evap #1	Organomation	112	52792	2004	New
N-Evap #2	Organomation	112	1694	1990	New
N-Evap #3	Organomation	112	59284	2014	New
N-Evap #4	Organomation	112	10203	2014	New
Water Bath #1	Fischer	15-491	605021280	2005	New
Water Bath #2	Fischer	15-491	204272	2007	New
Large Muffle Furnace	Wilt Industries	210	041213	2001	New
Dishwasher #1	Miele Professional	G7783CD	53081646	2003	New
Dishwasher #2	LabConco	4540031	130576299 E	2003	New
Vacuum Pump #1	Emerson Electric MLD	5KH36KN90HX	UNL231171	1990	New
Vortex Mixer	Scientific Industries	6560	2-318564	1995	New
Electric Mixer	Barnstead/Thermlyne		125404091646	1995	New
Mini Stirring Hotplate	VWR	220	33918-604	1995	New
Separatory Funnel Rotator 1	AP & R Machine & Tool		222307	2003	New
Separatory Funnel Rotator 2	AP & R Machine & Tool		222306	2003	New
Separatory Funnel Rotator 3	AP & R Machine & Tool		222305	2003	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Separatory Funnel Rotator 4	AP & R Machine & Tool		222304	2003	New
Separatory Funnel Rotator 5	AP & R Machine & Tool		222303	2003	New
Separatory Funnel Rotator 6	AP & R Machine & Tool		222302	2003	New
Centriguge #1	Sigma	2-5	78646	2001	New
Field Services Department					
pH meter E-036	HACH	Sension1-5170060	10120C210304		New
pH meter E-019	HACH	Sension1-5170060	412000029333	2006	New
pH meter E-035	HACH	Sension1-5170060	08040C310395		
pH meter M-016	Hach	Sension1	050400022762	2005	New
pH meter M-039	Hach	Sension1	08040C410063	2006	New
pH meter M-031	Hach	HQ40D			
pH meter	Hach	Sension1	050600C10445	2005	New
pH meter E-036	HACH	5170060	0C260049		New
pH meter M-042	HACH	5170060	08110C111808		New
pH meter M-010	HACH	5170060	40300004162		New
pH meter E-021	ThermoOrion	230A	017900		New
pH meter E-033	ThermoOrion	230A	017788		New
pH/COND M-059	HACH	HQ40Dmulti	130800092563		New
pH+EC Sensor EP-091	HACH	5059	230		New
pH+ORP+EC Sensor MP-162	HACH	5048	151		New
DO meter M-056	HACH	Sension+DO6	401123		New
DO meter M-058	HACH	Sension+DO6	326101		New
DO meter M-032	HACH	Sension6-5185060	05070C360249	2006	New
DO meter E-037	HACH	Sension6-5185060	10120C260049		
DO meter M-027	Hach	Sension6	050500C60066	2005	New
DO meter M-007	Hach	Sension6	020900001321		New
DO meter	Hach	Sension6			New
DO meter M-015	Hach	Sension6	001200002352	2000	New
DO Meter E-037	HACH	5185000	0C260049		New
DO Meter	Hach	Sension +DO6	348155		New
DO Meter	Hach	Sension +DO6	403037		New
Conductivity Meter E-038	HACH	Sension5-5180060	10120C250073		New
Conductivity Meter M-028	HACH	Sension5-5180060	050500C50288	2005	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Conductivity Meter E-006	HACH	Sension5-5180060	501000002708		New
Conductivity Meter M-018	HACH	Sension5	050300013668		New
Conductivity Meter M-0055	HACH	HQ40D	12080078247		New
Conductivity Meter	HACH	Sension5			New
Conductivity Meter M-014	HACH	Sension5	030500006215		New
Conductivity Meter E-038	HACH	5180000	0C250073		New
Conductivity Meter E-027	HACH	5180060	050500C50193		New
ORP Meter E-039	HACH	Sension1-5170060	10120C210070		New
ORP Meter M-060	HACH	HQ40Dmulti	130100083125		New
ORP Meter E-028	HACH	Sension1-5170060	40800010007		New
ORP Meter E-009	HACH	Sension1-5170060	402000003831		New
ORP Meter M-017	HACH	Sension1	05040002039		New
ORP Meter M-041	HACH	Sension1	08040C410042		New
ORP Meter	HACH	Sension1			New
ORP Meter M-006	HACH	Sension1	04030004238		New
ORP Meter E-039	HACH	5170000	0C210070		New
ORP Meter M-069	HACH	HQ40D	140300101090		New
Turbidity Meter E-056	Lamotte	2020we	584-0311		New
Turbidity Meter M-056	Lamotte	2020we	3458-2313		New
Turbidity Meter M-053	Lamotte	2020we	2404-3012		New
Turbidity Meter E-058	Lamotte	2020we	371-4610		New
Turbidity Meter M-047	Lamotte	2020we	567-0111		New
Turbidity Meter M-048	Lamotte	2020we	639-0411		New
Turbidity Meter	Lamotte	2020we			New
Turbidity Meter M-049	Lamotte	2020we	546-0111		New
Turbidity Meter M-066	Lamotte	2020we	4225-1014		New
Turbidity Meter M-054	Lamotte	2020we	2385-0312		New
Turbidity Meter E-059	Lamotte	2020we	3462-2313		New
Turbidity Meter E-055	Lamotte	2020we	180-3710		New
Turbidity Meter M-050	Lamotte	2020we	640-0411		New
Turbidity Meter EP-057	Lamotte	2020we	369-4610		New
Multi Meter (pH/Cond/ORP) M-064	Hach	HQ40D	131200097322		New
Multi Meter (pH/Cond/ORP) M-062	Hach	HQ40D	131100096885		New
Multi Meter (pH/Cond/ORP) M-068	Hach	HQ40D	140300101093		New
Chlorine Meter CL-007	HACH	Pocket Colorimeter II	040200011290	2006	New
Chlorine Meter CL-002	HACH	Pocket Colorimeter	020100174404	2006	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Chlorine Meter CL-003	HACH	Pocket Colorimeter II	040200011345	2006	New
Chlorine Meter CL-004	HACH	Pocket Colorimeter	961200102549	2006	New
Chlorine Meter CL-006	HACH	Pocket Colorimeter	030400034505		New
Chlorine Meter CL-005	HACH	Pocket Colorimeter	020100174252		New
Chlorine Meter CL-008	HACH	Colorimeter 1200	4796-4900		New
PID	RAE	Min:RAE2000	110-010940		New
PID	RAE	Min:RAE2000	110-010984		New
Peristaltic Pump	Solonist	410	003270		New
Peristaltic Pump	Solonist	410	002642		
Peristaltic Pump	Solonist	410	002634		New
Peristaltic Pump	ISCO	ISCO 150	202F01835		New
Peristaltic Pump	ISCO	ISCO 150	195K01032		New
Peristaltic Pump	ISCO	ISCO 150	N/A		New
Peristaltic Pump	Sigma	N/A	22151		New
Peristaltic Pump	GeoPump	9001280	603003533		New
Composite sampler	ISCO	3700	204G00978		New
Composite sampler	ISCO	3700	210S00481		New
Composite sampler	ISCO	3700	211D00260		New
Composite sampler	ISCO	3700	212L00333		New
Grundfos	Grundfos	MP1/1A106003 P1	10460002		New
Grundfos	Grundfos	MP1/1A106003 P1	11030045		New
Grundfos	Grundfos	MP1/1A106003 P1	7460012		New
Grundfos	Grundfos	MP1/1A106003	98040466		New
Grundfos	Grundfos	MP1/1A106003	51418349		New
Sub Pump	Proactive	N/A	1371		New
Monsoon Control	Proactive	N/A	NA		New
Compressor	QED	3020	18323		New
Compressor	Coleman	CT5090412	D02812339		New
Compressor	Honda/Cambell	N/A	091593L689231VT69 7203AJ		New
Control Pack	QED	MP15	1278		New
Control Pack	QED	MP15	1299		New
Control Pack	QED	MP15	1079		New
Control Pack	QED	MP15	1528		New
Control Pack	QED	MP15	1280		New
Control Box	Grundfos	96765947	H100520040		New
Control Box	Grundfos	81128527	H0303130012		New
Control Box	Grundfos	91126028	H0412210115		New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Control Box	Grundfos	91126028	H0412210120		New
Control Box	Grundfos	SI-MP1115	151131		New
Control Box	Grundfos	SI-MP1115	203718		New
Bladder Pump	QED	MP-SPK-4P	12219		New
Bladder Pump	QED	MP-SPK-4P	10218		New
Bladder Pump	QED	MP-SPK-4P	12794		New
Bladder Pump	QED	MP-SPK-4P	12523		New
Bladder Pump	QED	MP-SPK-4P	11191		New
Bladder Pump	QED	MP-SPK-4P	11192		New
Bladder Pump	QED	MP-SPK-4P	11991		New
Bladder Pump	QED	MP-SPK-4P	11697		New
Bladder Pump	QED	MP-SPK-4P	11714		New
Bladder Pump	QED	MP-SPK-4P	12751		New
Bladder Pump	QED	MP-SPK-4P	11512		New
Bladder Pump	GeoTech	Model D 0.675	18		New
Bladder Pump	GeoTech	Model D 0.675	93		New
Generator	Honda	EU Inverter 2000	EAAS-2126666		New
Generator	Honda	EM 1800	E2CK-1011585		New
Generator	Honda	EM 3000	E2GL-1002925		New
Metal Detector	Fisher	FX-3	10123978		New
Marshaulk	N/A	N/A	N/A		New
Water Level Meter	Solonist	101	236477		New
Water Level Meter	Solonist	101	236505		New
Water Level Meter	Solonist	101	200769		New
Water Level Meter	Solonist	101	58356		New
Water Level Meter	Solonist	N/A	N/A		New
Interphase	Solonist	122	58167		New
Interphase	N/A	N/A	N/A		New
PID	RAE	MiniRae 2000	110-010953		New
PID	RAE	PGM-7615	103958		New
PID	RAE	MiniRae 3000	592-906947		New
YSI Meter	YSI Inc.	556MPS	06F1362 AC		New
Bladder Pump	QED	MP-SPK-4P	12870		New
Bladder Pump	QED	MP-SPK-4P	12175		New
Bladder Pump	QED	MP-SPK-4P	10996		New
Bladder Pump	QED	MP-SPK-4P	12023		New
Bladder Pump	QED	MP-SPK-4P	12752		New
Bladder Pump	QED	MP-SPK-4P	10997		New
Bladder Pump	QED	MP-SPK-4P	10200		New
Bladder Pump	QED	MP-SPK-4P	12087		New
Bladder Pump	QED	MP-SPK-4P	10649		New
Bladder Pump	QED	MP-SPK-4P	12568		New
Bladder Pump	QED	MP-SPK-4P	12654		New
Bladder Pump	Solinst	NA	NA		New
Bladder Pump	Solinst	NA	NA		New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Submersible Pump	Proactive	Monsoon XL	24730		New
Monsoon Control Box	Proactive	LCD Controller	H10867		New
Grundfos Pump	Grundfos	MP1/1A106003	044917629		New
Grundfos Pump	Grundfos	MP1/1A106003	06029591		New
Grundfos Pump	Grundfos	MP1/1A106003	051418361		New
Grundfos Pump	Grundfos	A 1A106003PI	10030064		New
Grundfos Pump	Grundfos	A 1A106003PI	07460012		New
Grundfos Pump	Grundfos	A 1A106003PI	11150009		New
Control Box	Grundfos	BMI/MP1-115V	9517		New
Control Box	Grundfos	SI/MP1-115/230V	203831		New
Control Box	Grundfos	IN2039B11	H1006080040		New
Control Box	Grundfos	IN0853A43	H0303130012		New
Control Box	Grundfos	IN0903A44	H0412210120		New
Control Pack	QED	MP-15	1181		New
Control Pack	QED	MP-15	1537		New
Control Pack	QED	MP-15	1615		New
Control Pack	QED	MP-15	1297		New
Control Pack	QED	MP-15	1060		New
Control Pack	QED	MP-15	1538		New
Control Pack	QED	MP-15	1180		New
Control Pack	QED	MP-15	1300		New
Peristaltic Pump	Solinst	410	002562		New
Peristaltic Pump	Solinst	410	002071		New
Peristaltic Pump	Solinst	410	001979		New
Peristaltic Pump	Solinst				New
Peristaltic Pump	GeoTech	900-1280	J02003143		New
Interface Meter	Solinst	122	59307		New
Interface Meter	Solinst	122	122 008699-1		New
Water Level Meter	Solinst	101	50333		New
Water Level Meter	Solinst	101	200766		New
Water Level Meter	Solinst	101	50331		New
Water Level Meter	Solinst	101	236317		New
Water Level Meter	Solinst	101	35312		New
Water Level Meter	Solinst	101	222854		New
Composite sampler	ISCO	3700 Sampler	212L00327		New
Composite sampler	ISCO	3700 Sampler	205C01380		New
Composite sampler	ISCO	3700 Sampler	205C01376		New
Composite sampler	ISCO	2700 Sampler	04939-054		New
Composite sampler	ISCO	2910 Sampler	197J00505		New
Composite sampler	ISCO	2700 Sampler	06522-094		New
Metal Detector	Chicago Steel Tape	Magna-Trak 102	102066024		New
Metal Detector	Chicago Steel Tape	Magna-Trak 102			New
Fresh Water Pump	NorthStar	10633	2252957		New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Generator	Honda	EB 3000C	EZGP-1145763		New
Generator	Honda	EB 3000C	EZGP-1151238		New
Generator	Honda	EM 3000C	EZGL-1002930		New
Compressor	Industrial Air	CTA5090412.GNE	K13110207A		New
Power Inverter	N Power	NA	120270929		New
PID	PE Photovac	2020	DQ-GD-302		New
Control Box	Grundfos	SI/MP1-115/230V	9909		New
Generator	Troy Bilt	01924	1010594921		New
Composite sampler	ISCO	2710 Sampler	05248-001		New
Mini Interface Meter	Water Mark	H01L/SM01L	01-1096		New
Interface Meter	Testwell Inc.	NA	NA		New
Water Level Meter	Fisher	M-Scope	NA		New
Water Level Meter	Fisher	M-Scope	NA		New
Varistaltic Pump	Manostat	72-310-000	M97005467		New
Utility Pump	TEEL	2P110A	1962		New
Utility Pump	TEEL	2P110B	3021		New
Utility Pump	TEEL	2P110B	0034		New
Utility Pump	TEEL	2P110B	0036		New

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Table 20-2. Example: Schedule of Routine Maintenance

Table 20-2. Example: Schedule of Routine Maintenance		
Instrument	**Procedure**	**Frequency**
Leeman Mercury Analyzer	Check tubing for wear Fill rinse tank with 10% HCl Change dryer tube Fill reductant bottle with 10% Stannous Chloride	Daily Daily As needed Daily
ICP	Check pump tubing Check liquid argon supply Check fluid level in waste container Check filters Clean or replace filters Check torch Check sample spray chamber for debris Clean and align nebulizer Check entrance slit for debris Change printer ribbon Replace pump tubing	Daily Daily Daily Weekly As required Daily Monthly Monthly Monthly As required As required
ICP MS	Change pump tubing Clean torch Check / clean nebulizer Clean cones Check air filters Check multiplier voltages & do cross calibration Replace sample uptake tubing Check rotary pump oil Check oil mist filters Check chiller water level	Weekly or As required Weekly or As required Weekly or As required Weekly or As required Weekly or As required Weekly or As required Weekly or As required Weekly or As required Monthly Monthly
UV-Vis Spectrophotometer	Clean ambient flow cell Precision check/alignment of flow cell Wavelength verification check	As required As required Semi-annually
Auto Analyzers	Clean sampler Check all tubing Clean inside of colorimeter Clean pump well and pump rollers Clean wash fluid receptacle Oil rollers/chains/side rails Clean optics and cells	Daily Daily Daily Quarterly Weekly Weekly Quarterly

Table 20-2. Example: Schedule of Routine Maintenance

Instrument	Procedure	Frequency
Gas Chromatograph/Mass Spectrometer (GC/MS)	Ion gauge tube degassing Pump oil-level check Pump oil changing Analyzer bake-out Analyzer cleaning Resolution adjustment COMPUTER SYSTEM AND PRINTER: Air filter cleaning Change data system air filter Printer head carriage lubrication Paper sprocket cleaning Drive belt lubrication	As required Monthly Annually As required As required As required As required As required As required As required As required
Gas Chromatograph	Compare standard response to previous day or since last initial calibration Check carrier gas flow rate in column Check temp. of detector, inlet, column oven Septum replacement Glass wool replacement Check system for gas leaks with SNOOP Check for loose/frayed wires and insulation Bake injector/column Change/remove sections of guard column Replace connectors/liners Change/replace column(s)	Daily Daily via use of known compound retention Daily As required As required W/cylinder change as required Monthly As Required As Required As Required As Required
Electron Capture Detector (ECD)	Detector wipe test (Ni-63) Detector cleaning	Semi-annually As required
Flame Ionization Detector (FID)	Detector cleaning	As required
Photoionization Detector (PID)	Change O-rings Clean lamp window	As required As required
HPLC	Change guard columns Change lamps Change pump seals Replace tubing Change fuses in power supply Filter all samples Change autosampler rotor/stator	As required As required Semi-annually or as required As required As required Daily As required
Balances	Class “S” traceable weight check Clean pan and check if level Field service	Daily, when used Daily At least Annually
Conductivity Meter	0.01M KCl calibration Conductivity cell cleaning	Daily As required
Turbidimeter	Check light bulb	Daily, when used
Deionized/Distilled Water	Daily conductivity check Check deionizer light Monitor for VOA’s System cleaning Replace cartridge & large mixed bed resins	Daily Daily Daily As required As required

Table 20-2. Example: Schedule of Routine Maintenance

Instrument	Procedure	Frequency
Drying Ovens	Temperature monitoring Temperature adjustments	Daily As required
Refrigerators/ Freezers	Temperature monitoring Temperature adjustment Defrosting/cleaning	Daily As required As required
Vacuum Pumps/ Air Compressor	Drained Belts checked Lubricated	Weekly Monthly Semi-annually
pH/Specific Ion Meter	Calibration/check slope Clean electrode	Daily As required
BOD Incubator	Temperature monitoring Coil and incubator cleaning	Daily Monthly
Centrifuge	Check brushes and bearings	Every 6 months or as needed
Water baths	Temperature monitoring Water replaced	Daily Monthly or as needed

SECTION 21. MEASUREMENT TRACEABILITY

21.1 Overview

Traceability of measurements shall be assured using a system of documentation, calibration, and analysis of reference standards. Laboratory equipment that are peripheral to analysis and whose calibration is not necessarily documented in a test method analysis or by analysis of a reference standard shall be subject to ongoing certifications of accuracy. At a minimum, these must include procedures for checking specifications of ancillary equipment: balances, thermometers, temperature, Deionized (DI) and Reverse Osmosis (RO) water systems, automatic pipettes and other volumetric measuring devices. (Refer to Section 20.3). With the exception of Class A Glassware and Glass microliter syringes, quarterly accuracy checks are performed for all mechanical volumetric devices. Wherever possible, subsidiary or peripheral equipment is checked against standard equipment or standards that are traceable to national or international standards. Class A Glassware and Glass microliter syringes should be routinely inspected for chips, acid etching or deformity (e.g., bent needle). If the Class A glassware or syringe is suspect, the accuracy of the glassware will be assessed prior to use.

21.2 NIST-Traceable Weights and Thermometers

Reference standards of measurement shall be used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

For NIST-traceable weights and thermometers, the laboratory requires that all calibrations be conducted by a calibration laboratory accredited by A2LA, NVLAP (National Voluntary Laboratory Accreditation Program), or another accreditation organization that is a signatory to a MRA (Mutual Recognition Arrangement) of one or more of the following cooperations – ILAC (International Laboratory Accreditation Cooperation) or APLAC (Asia–Pacific Laboratory Accreditation Cooperation). A calibration certificate and scope of accreditation is kept on file at the laboratory.

21.3 Reference Standards / Materials

Reference standards/materials, where commercially available, are traceable to certified reference materials. Commercially prepared reference standards, to the extent available, are purchased from vendors that are accredited to ISO Guide 34 and ISO/IEC Guide 17025. All reference standards from commercial vendors shall be accompanied with a certificate that includes at least the following information:

- Manufacturer
- Analytes or parameters calibrated
- Identification or lot number
- Calibration method
- Concentration with associated uncertainties
- Purity

If a standard cannot be purchased from a vendor that supplies a Certificate of Analysis, the purity of the standard is documented by analysis. The receipt of all reference standards must be documented. Reference standards are labeled with a unique Standard Identification Number

and expiration date. All documentation received with the reference standard is retained as a QC record and references the Standard Identification Number.

All reference, primary and working standards/materials, whether commercially purchased or laboratory prepared, must be checked regularly to ensure that the variability of the standard or material from the 'true' value does not exceed method requirements. The accuracy of calibration standards is checked by comparison with a standard from a second source. In cases where a second standard manufacturer is not available, a vendor certified different lot is acceptable for use as a second source. For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst would be considered a second source. The appropriate Quality Control (QC) criteria for specific standards are defined in laboratory SOPs. In most cases, the analysis of an Initial Calibration Verification (ICV) or LCS (where there is no sample preparation) is used as the second source confirmation. These checks are generally performed as an integral part of the analysis method (e.g. calibration checks, laboratory control samples).

All standards and materials must be stored and handled according to method or manufacturer's requirements in order to prevent contamination or deterioration. Refer to the Corporate Environmental Health & Safety Manual or laboratory SOPs. For safety requirements, please refer to method SOPs and the laboratory Environmental Health and Safety Manual.

Standards and reference materials shall not be used after their expiration dates unless their reliability is verified by the laboratory and their use is approved by the Quality Assurance Manager. The laboratory must have documented contingency procedures for re-verifying expired standards.

21.4 Documentation and Labeling of Standards, Reagents, and Reference Materials

Reagents must be at a minimum the purity required in the test method. The date of reagent receipt and the expiration date are documented. The lots for most of the common solvents and acids are tested for acceptability prior to company-wide purchase. [Refer to TestAmerica's Corporate SOP (CA-Q-S-001), Solvent and Acid Lot Testing and Approval.]

All manufacturer or vendor supplied Certificate of Analysis or Purity must be retained, stored appropriately, and readily available for use and inspection. These records are maintained applicable analytical Departments. Records must be kept of the date of receipt and date of expiration of standards, reagents and reference materials. In addition, records of preparation of laboratory standards, reagents, and reference materials must be retained, stored appropriately, and be readily available for use and inspection. For detailed information on documentation and labeling, please refer to method specific SOPs.

Commercial materials purchased for preparation of calibration solutions, spike solutions, etc.., are usually accompanied with an assay certificate or the purity is noted on the label. If the assay purity is 96% or better, the weight provided by the vendor may be used without correction. If the assay purity is less than 96% a correction will be made to concentrations applied to solutions prepared from the stock commercial material. Blended gas standard cylinders use a nominal concentration if the certified value is within +/-15%, otherwise the certified values is used for the canister concentration.

21.4.1 All standards, reagents, and reference materials must be labeled in an unambiguous manner. Standards are logged into the laboratory's LIMS system, and are assigned a unique identification number. The following information is typically recorded in the electronic database within the LIMS.

- Standard ID
- Description of Standard
- Department
- Preparer's name
- Final volume and number of vials prepared
- Solvent type and lot number
- Preparation Date
- Expiration Date
- Standard source type (stock or daughter)
- Standard type (spike, surrogate, other)
- Parent standard ID (if applicable)
- Parent Standard Analyte Concentration (if applicable)
- Parent Standard Amount used (if applicable)
- Component Analytes
- Final concentration of each analyte
- Comment box (text field)

Records are maintained electronically for standard and reference material preparation. These records show the traceability to purchased stocks or neat compounds. These records also include method of preparation, date of preparation, expiration date and preparer's name or initials. Preparation procedures are provided in the Method SOPs.

21.4.2 All standards, reagents, and reference materials must be clearly labeled with a minimum of the following information:

- Expiration Date (include prep date for reagents)
- Standard ID (***from LIMS***)
- Special Health/Safety warnings if applicable

Records must also be maintained of the date of receipt for commercially purchased items or date of preparation for laboratory prepared items. Special Health/Safety warnings must also be available to the analyst. This information is maintained by the facility Environmental Health and Safety Coordinator.

21.4.3 In addition, the following information may be helpful:

- Date opened (for multi-use containers, if applicable)
- Description of standard (if different from manufacturer's label or if standard was prepared in the laboratory)

- Recommended Storage Conditions
- Concentration (if applicable)
- Initials of analyst preparing standard or opening container

All containers of prepared reagents must include an expiration date and an ID number to trace back to preparation.

Procedures for preparation of reagents can be found in the Method SOPs.

Standard ID numbers must be traceable through associated logbooks, worksheets and preparation/analytical batch records.

All reagents and standards must be stored in accordance to the following priority: 1) with the manufacturer's recommendations; 2) with requirements in the specific analytical methods as specified in the laboratory SOP.

SECTION 22. SAMPLING

22.1 Overview

The laboratory provides sampling services. Sampling procedures are described in the following SOPs as applicable::

- Groundwater Sampling (TestAmerica Edison SOP #s ED-FLD-008 and ED-FLD-009)
- Wastewater Sampling (TestAmerica Edison SOP # ED-FLD-014)
- Potable Sampling
- Waste Sampling
- Soil and Sediment Sampling
- Flow Monitoring (TestAmerica Edison SOP #s ED-FLD-008 and ED-FLD-009)
- Field Parameter Analysis (TestAmerica Edison SOPs ED-FLD-001 thru ED-FLD-007, ED-FLD-010)
- Cleaning and Decontamination of Field Equipment (see individual SOPs listed above and TestAmerica Edison SOP# ED-GEN-013)

22.2 Sampling Containers

The laboratory offers clean sampling containers for use by clients. These containers are obtained from reputable container manufacturers and meet EPA specifications as required. Certificates of cleanliness for bottles and preservatives are provided by the supplier and are maintained at the laboratory. Alternatively, the certificates may be maintained by the supplier and available to the laboratory on-line.

22.2.1 Preservatives

Upon request, preservatives are provided to the client in pre-cleaned sampling containers. In some cases containers may be purchased pre-preserved from the container supplier. Whether prepared by the laboratory or bought pre-preserved, the grades of the preservatives are at a minimum:

- Hydrochloric Acid – Reagent ACS (Certified VOA Free) or equivalent
- Methanol – Purge and Trap grade
- Nitric Acid – Instra-Analyzed or equivalent
- Sodium Bisulfate – ACS Grade or equivalent
- Sodium Hydroxide – Instra-Analyzed or equivalent
- Sulfuric Acid – Instra-Analyzed or equivalent
- Sodium Thiosulfate – ACS Grade or equivalent

22.3 Definition of Holding Time

The date and time of sampling documented on the COC form establishes the day and time zero. As a general rule, when the maximum allowable holding time is expressed in “days” (e.g., 14 days, 28 days), the holding time is based on calendar day measured. Holding times expressed in “hours” (e.g., 6 hours, 24 hours, etc.) are measured from date and time zero. Holding times for analysis include any necessary reanalysis. However, there are some programs that determine holding time compliance based on the date and specific time of analysis compared to the time of sampling regardless of how long the holding time is.

22.4 Sampling Containers, Preservation Requirements, Holding Times

The preservation and holding time criteria specified in the laboratory SOPs are derived from the source documents for the methods. If method required holding times or preservation requirements are not met, the reports will be qualified using a flag, footnote or case narrative. As soon as possible or “ASAP” is an EPA designation for tests for which rapid analysis is advised, but for which neither EPA nor the laboratory have a basis for a holding time.

22.5 Sample Aliquots / Subsampling

Taking a representative sub-sample from a container is necessary to ensure that the analytical results are representative of the sample collected in the field. The size of the sample container, the quantity of sample fitted within the container, and the homogeneity of the sample need consideration when sub-sampling for sample preparation. It is the laboratory’s responsibility to take a representative subsample or aliquot of the sample provided for analysis.

Analysts should handle each sample as if it is potentially dangerous. At a minimum, safety glasses, gloves, and lab coats must be worn when preparing aliquots for analysis.

Guidelines on taking sample aliquots & subsampling are located SOP No. ED-GEN-007 (Subsampling).

SECTION 23. HANDLING OF SAMPLES

Sample management procedures at the laboratory ensure that sample integrity and custody are maintained and documented from sampling/receipt through disposal.

23.1 Chain of Custody (COC)

The COC form is the written documented history of any sample and is initiated when bottles are sent to the field, or at the time of sampling. This form is completed by the sampling personnel and accompanies the samples to the laboratory where it is received and stored under the laboratory's custody. The purpose of the COC form is to provide a legal written record of the handling of samples from the time of collection until they are received at the laboratory. It also serves as the primary written request for analyses from the client to the laboratory. The COC form acts as a purchase order for analytical services when no other contractual agreement is in effect. An example of a COC form may be found in Figure 23-1.

23.1.1 Field Documentation

The information the sampler needs to provide at the time of sampling on the container label is:

- Sample identification
- Date and time
- Preservative

During the sampling process, the COC form is completed and must be legible (see Figure 23-1). This form includes information such as:

- Client name, address, phone number and fax number (if available)
- Project name and/or number
- The sample identification
- Date, time and location of sampling
- Sample collectors name
- The matrix description
- The container description
- The total number of each type of container
- Preservatives used
- Analysis requested
- Requested turnaround time (TAT)
- Any special instructions
- Purchase Order number or billing information (e.g. quote number) if available

- The date and time that each person received or relinquished the sample(s), including their signed name.

When the sampling personnel deliver the samples directly to TestAmerica personnel, the samples are stored in a cooler with ice, as applicable, and remain solely in the possession of the client's field technician until the samples are delivered to the laboratory personnel. The sample collector must assure that each container is in his/her physical possession or in his/her view at all times, or stored in such a place and manner to preclude tampering. The field technician relinquishes the samples in writing on the COC form to the sample control personnel at the laboratory or to a TestAmerica courier. When sampling personnel deliver the samples through a common carrier (Fed-Ex, UPS), the CoC relinquished date/time is completed by the field personnel and samples are released to the carrier. Samples are only considered to be received by lab when personnel at the fixed laboratory facility have physical contact with the samples.

Note: Independent couriers are not required to sign the COC form. The COC is usually kept in the sealed sample cooler. The receipt from the courier is stored in log-in by date; it lists all receipts each date.

23.1.2 Legal / Evidentiary Chain-of-Custody

The laboratory may, upon special request, adhere to legal/evidentiary chain of custody requirements. If TestAmerica agrees to such procedures the samples are identified for legal/evidentiary purposes on the COC, login will complete the custody seal retain the shipping record with the COC, and initiate an internal COC for laboratory use by analysts and a sample disposal record.

23.2 Sample Receipt

Samples are received at the laboratory by designated sample receiving personnel and a unique laboratory project identification number is assigned. Each sample container shall be assigned a unique sample identification number that is cross-referenced to the client identification number such that traceability of test samples is unambiguous and documented. Each sample container is affixed with a durable sample identification label. Sample acceptance, receipt, tracking and storage procedures are summarized in the following sections.

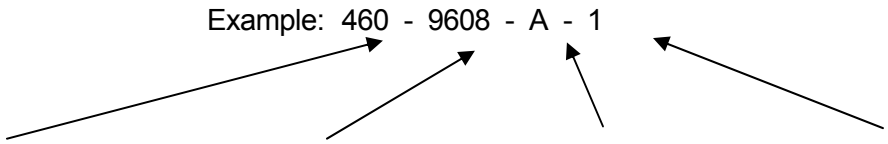
23.2.1 Laboratory Receipt

When samples arrive at the laboratory, sample receiving personnel inspect the coolers and samples. The integrity of each sample must be determined by comparing sample labels or tags with the COC and by visual checks of the container for possible damage. Any non-conformance, irregularity, or compromised sample receipt must be documented on a via the Sample Receipt application within TALS (the laboratory LIMS) and brought to the immediate attention of the client. The COC, shipping documents, documentation of any non-conformance, irregularity, or compromised sample receipt, record of client contact, and resulting instructions become part of the project record.

23.2.1.1 Unique Sample Identification

All samples that are processed through the laboratory receive a unique sample identification to ensure that there can be no confusion regarding the identity of such samples at anytime. This system includes identification for all samples, subsamples and subsequent extracts and/or digestates.

The laboratory assigns a unique identification (e.g., Sample ID) code to each sample container received at the laboratory. This Primary ID is made up of the following information (consisting of 4 components):



The above example states that TestAmerica Edison Laboratory (Location 460). Login ID is 9608 (unique to a particular client/job occurrence). The container code indicates it is the first container ("A") of Sample #1.

If the primary container goes through a prep step that creates a "new" container, then the new container is considered secondary and gets another ID. An example of this being a client sample in a 1-Liter amber bottle is sent through a Liquid/Liquid Extraction and an extraction vial is created from this step. The vial would be a SECONDARY container. The secondary ID has 5 components.

Example: 460 - 9608 - A - 1 - **A** ←——**Secondary Container Occurrence**

Example: 460-9608-A-1-A, would indicate the PRIMARY container listed above that went through a step that created the 1st occurrence of a Secondary container.

With this system, a client sample can literally be tracked throughout the laboratory in every step from receipt to disposal.

23.3 Sample Acceptance Policy

The laboratory has a written sample acceptance policy (Figure 23-2) that clearly outlines the circumstances under which samples shall be accepted or rejected. These include:

- a COC filled out completely;
- samples must be properly labeled;
- proper sample containers with adequate volume for the analysis (Sampling Guide) and necessary QC;
- samples must be preserved according to the requirements of the requested analytical method (Sampling Guide);
- sample holding times must be adhered to (Sampling Guide);

- all samples submitted for water/solid Volatile Organic analyses must have a Trip Blank submitted at the same time;
- the project manager will be notified if any sample is received in damaged condition.

Data from samples which do not meet these criteria are flagged and the nature of the variation from policy is defined.

23.3.1 After inspecting the samples, the sample receiving personnel sign and date the COC form, make any necessary notes of the samples' conditions and store them in appropriate refrigerators or storage locations.

23.3.2 Any deviations from these checks that question the suitability of the sample for analysis, or incomplete documentation as to the tests required will be resolved by consultation with the client. If the sample acceptance policy criteria are not met, the laboratory shall either:

- Retain all correspondence and/or records of communications with the client regarding the disposition of rejected samples, or
- Fully document any decision to proceed with sample analysis that does not meet sample acceptance criteria.

Once sample acceptance is verified, the samples are logged into the LIMS according SOP No. ED-SPM-001.

23.4 Sample Storage

In order to avoid deterioration, contamination or damage to a sample during storage and handling, from the time of receipt until all analyses are complete, samples are stored in refrigerators, freezers or protected locations suitable for the sample matrix. Sample containers designated for metals only analysis are stored un-refrigerated. In addition, samples to be analyzed for volatile organic parameters are stored in separate refrigerators designated for volatile organic parameters only. Samples are never to be stored with reagents, standards or materials that may create contamination.

To ensure the integrity of the samples during storage, refrigerator blanks are maintained in the volatile sample refrigerators and analyzed every two weeks.

Analysts and technicians retrieve the sample container allocated to their analysis from the designated refrigerator and place them on carts, analyze the sample, and return the remaining sample or empty container to the refrigerator from which it originally came. All unused portions of samples, including empty sample containers, are returned to the secure sample control area. All samples are kept in the refrigerators for 30 days after delivery of the final report to the client, which meets or exceeds most sample holding times. After 30 days the samples are disposed of or, upon client request moved to a sample archive area where they are stored for an additional time period agreed upon with the client or dictated by the applicable analytical program (ex. USEPA CLP).

Access to the laboratory is controlled such that sample storage need not be locked at all times unless a project specifically demands it. Samples are accessible to laboratory personnel only. Visitors to the laboratory are prohibited from entering the refrigerator and laboratory areas unless accompanied by an employee of TestAmerica.

23.5 Hazardous Samples and Foreign Soils

To minimize exposure to personnel and to avoid potential accidents, hazardous and foreign soil samples are stored in an isolated area designated for hazardous waste only.

Procedures for the handling and storage of hazardous samples are addressed in the TestAmerica Corporate Safety Manual (TestAmercia Document No. CW-E-M-001) and in TestAmerica Edison SOP No. ED-SPM-001 (Sample Receipt, Login, Identification, and Storage).

Procedures for the acceptance and handling of USDA regulated domestic and foreign soils are detailed in TestAmerica SOP No. ED-SPM-006 (Procedure for Acceptance and Handling of Regulated Domestic and Foreign Soils).

23.6 Sample Shipping

In the event that the laboratory needs to ship samples, the samples are placed in a cooler with enough ice to ensure the samples remain just above freezing and at or below 6.0°C during transit. The samples are carefully surrounded by packing material to avoid breakage (yet maintain appropriate temperature). A trip blank is enclosed for those samples requiring water/solid volatile organic analyses (see Note). The chain-of-custody form is signed by the sample control technician and attached to the shipping paperwork. Samples are generally shipped overnight express or hand-delivered by a TestAmerica courier to maintain sample integrity. All personnel involved with shipping and receiving samples must be trained to maintain the proper chain-of-custody documentation and to keep the samples intact and on ice. The Environmental, Health and Safety Manual contains additional shipping requirements.

Note: If a client does not request trip blank analysis on the COC or other paperwork, the laboratory will not analyze the trip blanks that were supplied. However, in the interest of good client service, the laboratory will advise the client at the time of sample receipt that it was noted that they did not request analysis of the trip blank; and that the laboratory is providing the notification to verify that they are not inadvertently omitting a key part of regulatory compliance testing.

23.7 Sample Disposal

Samples should be retained for a minimum of 30 days after the project report is sent, however, provisions may be made for earlier disposal of samples once the holding time is exceeded. Some samples are required to be held for longer periods based on regulatory or client requirements (e.g., 60 days after project report is sent). The laboratory must follow the longer sample retention requirements where required by regulation or client agreement. Several possibilities for sample disposal exist: the sample may be consumed completely during analysis, the sample may be returned to the customer or location of sampling for disposal, or the sample

may be disposed of in accordance with the laboratory's waste disposal procedures, TestAmerica Edison SOP No. ED-SPM-007 (Disposal of Samples and Associated Laboratory Waste). All procedures in the laboratory Environmental, Health and Safety Manual are followed during disposal. Samples are normally maintained in the laboratory no longer than two months from receipt unless otherwise requested. Unused portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work.

If a sample is part of a known litigation, the affected legal authority, sample data user, and/or submitter of the sample must participate in the decision about the sample's disposal. All documentation and correspondence concerning the disposal decision process must be kept on file. Pertinent information includes the date of disposal, nature of disposal (such as sample depletion, hazardous waste facility disposal, return to client), names of individuals who conducted the arrangements and physically completed the task. The laboratory will remove or deface sample labels prior to disposal unless this is accomplished through the disposal method (e.g., samples are incinerated).

Figure 23-1. Example: Chain of Custody (COC)

CHAIN OF CUSTODY / ANALYSIS REQUEST

TestAmerica Edison
777 New Durham Road
Edison, New Jersey 08817
Phone: (732) 549-3900 Fax: (732) 549-3679

Page ___ of ___

Name (for report and invoice)	Samplers Name (Printed)	Site/Project Identification
Company	P.O. #	State (Location of site): NJ: ☐ NY: ☐ Other:
		Regulatory Program:
Address	Analysis Turnaround Time Standard ☐	ANALYSIS REQUESTED (ENTER "X" BELOW TO INDICATE REQUEST)
City State	Rush Charges Authorized For: 2 Week ☐	LAB USE ONLY Project No:
Phone Fax	1 Week ☐ Other ☐ _____	Job No:

Sample Identification	Date	Time	Matrix	No. of. Cont.									Sample Numbers
Preservation Used: 1 = ICE, 2 = HCl, 3 = H_2SO_4, 4 = HNO_3, 5 = NaOH					Soil:								
6 = Other _____, 7 = Other _____					Water:								

Special Instructions_____ Water Metals Filtered (Yes/No)?_____

Relinquished by	Company	Date / Time	Received by	Company
1)		|	1)	
Relinquished by	Company	Date / Time	Received by	Company
2)		|	2)	
Relinquished by	Company	Date / Time	Received by	Company
3)		|	3)	
Relinquished by	Company	Date / Time	Received by	Company
4)		|	4)	

Laboratory Certifications: New Jersey (12028), New York (11452), Pennsylvania (68-522), Connecticut (PH-0200), Rhode Island (132).

Figure 23-2. Example: Sample Acceptance Policy

All incoming work will be evaluated against the criteria listed below. Where applicable, data from any samples that do not meet the criteria listed below will be noted on the laboratory report defining the nature and substance of the variation. In addition the client will be notified either by telephone, fax or e-mail ASAP after the receipt of the samples.

Per State and/or Federal Regulation, the client is responsible to ensure that samples are shipped in accordance with DOT/IATA requirements, and that radioactive materials may only be delivered to licensed facilities. Any samples containing (or suspected to contain) Source, Byproduct, or Special Nuclear Material as defined by 10 CFR should be delivered directly to facilities licensed to handle such radioactive material. Natural material or ores containing naturally occurring radionuclides may be delivered to any TestAmerica facility or courier as long as the activity concentration of the material does not exceed 270 pCi/g alpha or 2700 pCi/g beta (49 CFR Part 173).

1) Samples must arrive with labels intact with a Chain of Custody filled out completely. The following information must be recorded.
   - Client name, address, phone number and fax number (if available)
   - Project name and/or number
   - The sample identification
   - Date, time and location of sampling
   - The collectors name
   - The matrix description
   - The container description
   - The total number of each type of container
   - Preservatives used
   - Analysis requested
   - Requested turnaround time (TAT)
   - Any special instructions
   - Purchase Order number or billing information (e.g. quote number) if available
   - The date and time that each person received or relinquished the sample(s), including their signed name.
   - The date and time of receipt must be recorded between the last person to relinquish the samples and the person who receives the samples in the lab, and they must be exactly the same.
   - Information must be legible

2) Samples must be properly labeled.
   - Use durable labels (labels provided by TestAmerica are preferred)
   - Include a unique identification number
   - Include sampling date and time & sampler ID
   - Include preservative used.
   - Use indelible ink
   - Information must be legible

3) Proper sample containers with adequate volume for the analysis and necessary QC are required for each analysis requested.

4) Samples must be preserved according to the requirements of the requested analytical method.

5) Most analytical methods require chilling samples to 4° C (other than water samples for metals analysis). For these methods, the criteria are met if the samples are chilled to below 6° C and above freezing (0°C). For methods with other temperature criteria (e.g. some bacteriological methods require ≤ 10 °C), the samples must arrive within ± 2° C of the required temperature or within the method specified range. **Note:** Samples that are hand delivered to the laboratory immediately after collection may not have had time to cool sufficiently. In this case the samples will be considered acceptable as long as there is evidence that the chilling process has begun (arrival on ice).

5i.) Samples that are delivered to the laboratory on the same day they are collected may not meet the requirements of Section 5. In these cases, the samples shall be considered acceptable if the samples were received on ice.

5ii.) If sample analysis is begun within fifteen (15) minutes of collection, thermal preservation is not required.

5iii.) Thermal preservation is not required in the field if the laboratory receives and refrigerates the sample within fifteen (15) minutes of collection.

- Chemical preservation (pH) will be verified prior to analysis and documented, either in sample control or at the analyst's level. The project manager will be notified immediately if there is a discrepancy. If analyses will still be performed, all affected results will be flagged to indicate improper preservation.

- **For Volatile Organic analyses in drinking water (Methods 502.2 or 524.2**). Residual chlorine must be neutralized prior to preservation. If there is prior knowledge that the samples are not chlorinated, state it on the COC and use the VOA vials pre-preserved with HCl. The following are other options for a sampler and laboratory where the presence of chlorine is not known:

  - 1. Test for residual chlorine in the field prior to sampling.
    - If no chlorine is present, the samples are to be preserved using HCl as usual.
    - If chlorine is present, add either ascorbic acid or sodium thiosulfate prior to adding HCl.

  - 2. Use VOA vials pre-preserved with sodium thiosulfate or ascorbic acid and add HCl after filling the VOA vial with the sample.

- **FOR WATER SAMPLES TESTED FOR CYANIDE (by Standard Methods or EPA 335)**
  - In the Field: Samples are to be tested for Sulfide using lead acetate paper prior to the addition of Sodium Hydroxide (NaOH). If sulfide is present, the sample must be treated with Cadmium Chloride and filtered prior to the addition of NaOH.

    - If the sulfide test and treatment is not performed in the field, the lab will test the samples for sulfide using lead acetate paper at the time of receipt and if sulfide is present in the sample, the client will be notified and given the option of retaking the sample and treating in the field per the method requirements or the laboratory can analyze the samples as delivered and qualify the results in the final report.

  - It is the responsibility of the client to notify the laboratory if thiosulfate, sulfite, or thiocyanate are known or suspected to be present in the sample. This notification may be on the chain of custody. The samples may need to be subcontracted to a laboratory that performs a UV digestion. If the lab does not perform the UV digestion on samples that contain these compounds, the results must be qualified in the final report.

- The laboratory must test the sample for oxidizing agents (e.g. Chlorine) prior to analysis and treat according to the methods prior to distillation. (ascorbic acid or sodium arsenite are the preferred choice).

6) Sample Holding Times
   - TestAmerica will make every effort to analyze samples within the regulatory holding time. Samples must be received in the laboratory with enough time to perform the sample analysis. Except for short holding time samples (< 48hr HT) sample must be received with at least 48 hrs (2 working days) remaining on the holding time for us to ensure analysis.

   - Analyses that are designated as "field" analyses (Odor, pH, Dissolved Oxygen, Disinfectant Residual; a.k.a. Residual Chlorine, and Redox Potential) should be analyzed ASAP by the field sampler prior to delivering to the lab (within 15 minutes). However, if the analyses are to be performed in the laboratory, TestAmerica will make every effort to analyze the samples within 24 hours from receipt of the samples in the testing laboratory. Samples for "field" analyses received after 4:00 pm on Friday or on the weekend will be analyzed no later than the next business day after receipt (i.e., Monday, unless Monday is a holiday). Samples will remain refrigerated and sealed until the time of analysis. The actual times of all "field" sample analyses are noted in the final report. Samples analyzed in the laboratory will be qualified on the final report with an 'H' to indicate holding time exceedance.

7) All samples submitted for Volatile Organic analyses must have a Trip Blank submitted at the same time. TestAmerica will supply a blank with the bottle order.

8) The project manager will be notified if any sample is received in damaged condition. TestAmerica will request that a sample be resubmitted for analysis.

9) Recommendations for packing samples for shipment.

   - Pack samples in Ice rather than "Blue" ice packs.

   - Soil samples should be placed in plastic zip-lock bags. The containers often have dirt around the top, do not seal very well and are prone to intrusion from the water which results from melted ice.

   - Water samples are best package when wrapped with bubble-wrap or paper (newspaper, or paper towels) and then placed in plastic zip-lock bags.

   - Fill cooler void spaces with bubble wrap.

Figure 23-3. Example: Cooler Receipt Form

TestAmerica Edison
Receipt Temperature and pH Log

Page ___ of ____

Job Number: _____

Number of Coolers: _____ IR Gun # _____

Cooler Temperatures

	RAW	CORRECTED		RAW	CORRECTED		RAW	CORRECTED
Cooler #1:	°C	°C	Cooler #4:	°C	°C	Cooler #7:	°C	°C
Cooler #2:	°C	°C	Cooler #5:	°C	°C	Cooler #8:	°C	°C
Cooler #3:	°C	°C	Cooler #6:	°C	°C	Cooler #9:	°C	°C

TALS Sample Number	Ammonia (pH<2)	COD (pH<2)	Nitrate Nitrite (pH<2)	Metals* (pH<2)	Hardness (pH<2)	Pest (pH 5-9)	EPH or QAM (pH<2)	Phenols (pH<2)	Sulfide (pH>9)	TKN (pH<2)	TOC (pH<2)	Total Cyanide (pH>12)	Total Phos (pH<2)	Other	Other

If pH adjustments are required record the information below:

Sample No(s). adjusted: _____

Preservative Name/Conc.: _____ Volume of Preservative used (ml): _____

Lot # of Preservative(s): _____ Expiration Date: _____

The appropriate Project Manager and Department Manager should be notified about the samples which were pH adjusted.

** Samples for Metal analysis which are out of compliance must be acidified at least 24 hours prior to analysis.*

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Initials: _____ Date: _____

SECTION 24. ASSURING THE QUALITY OF TEST RESULTS

24.1 Overview

In order to assure our clients of the validity of their data, the laboratory continuously evaluates the quality of the analytical process. The analytical process is controlled not only by instrument calibration as discussed in Section 20, but also by routine process quality control measurements (e.g. Blanks, Laboratory Control Samples (LCS), Matrix Spikes (MS), duplicates (DUP), surrogates, Internal Standards (IS)). These quality control checks are performed as required by the method or regulations to assess precision and accuracy. Quality control samples are to be treated in the exact same manner as the associated field samples being tested. In addition to the routine process quality control samples, Proficiency Testing (PT) Samples (concentrations unknown to laboratory) are analyzed to help ensure laboratory performance.

24.2 Controls

Sample preparation or pre-treatment is commonly required before analysis. Typical preparation steps include homogenization, grinding, solvent extraction, sonication, acid digestion, distillation, reflux, evaporation, drying and ashing. During these pre-treatment steps, samples are arranged into discreet manageable groups referred to as preparation (prep) batches. Prep batches provide a means to control variability in sample treatment. Control samples are added to each prep batch to monitor method performance and are processed through the entire analytical procedure with investigative/field samples.

24.3 Negative Controls

Table 24-1. Example – Negative Controls

Control Type	Details
Method Blank (MB)	are used to assess preparation and analysis for possible contamination during the preparation and processing steps.
	The specific frequency of use for method blanks during the analytical sequence is defined in the specific standard operating procedure for each analysis. Generally it is 1 for each batch of samples; not to exceed 20 environmental samples.
	The method blank is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (e.g., Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The method blank goes through all of the steps of the process (including as necessary: filtration, clean-ups, etc.).
	Reanalyze or qualify associated sample results when the concentration of a targeted analyte in the blank is at or above the reporting limit as established by the method or by regulation, AND is greater than 1/10 of the amount measured in the sample.
Calibration Blanks	are prepared and analyzed along with calibration standards where applicable. They are prepared using the same reagents that are used to prepare the standards. In some analyses the calibration blank may be included in the calibration curve.
Instrument Blanks	are blank reagents or reagent water that may be processed during an analytical sequence in order to assess contamination in the analytical system. In general, instrument blanks are used to differentiate between contamination caused by the analytical system and that caused by the sample handling or sample prep process. Instrument blanks may also be inserted throughout the analytical sequence to minimize the effect of carryover from samples with high analyte content.

Table 24-1. Example – Negative Controls

Control Type	Details
Trip Blank [1]	are required to be submitted by the client with each shipment of samples requiring aqueous and solid volatiles analyses (or as specified in the client's project plan). Additionally, trip blanks may be prepared and analyzed for volatile analysis of air samples, when required by the client. A trip blank may be purchased (certified clean) or is prepared by the laboratory by filling a clean container with pure deionized water that has been purged to remove any volatile compounds. Appropriate preservatives are also added to the container. The trip blank is sent with the bottle order and is intended to reflect the environment that the containers are subjected to throughout shipping and handling and help identify possible sources if contamination is found. The field sampler returns the trip blank in the cooler with the field samples.
Field Blanks [1]	are sometimes used for specific projects by the field samplers. A field blank prepared in the field by filling a clean container with pure reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken. (EPA OSWER)
Equipment Blanks [1]	are also sometimes created in the field for specific projects. An equipment blank is a sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (TNI)
Holding Blanks	also referred to as refrigerator or freezer blanks, are used to monitor the sample storage units for volatile organic compounds during the storage of VOA samples in the laboratory

[1] When known, these field QC samples should not be selected for matrix QC as it does not provide information on the behavior of the target compounds in the field samples. Usually, the client sample ID will provide information to identify the field blanks with labels such as "FB", "EB", or "TB."

Evaluation criteria and corrective action for these controls are defined in the specific standard operating procedure for each analysis.

24.4 Positive Controls

Control samples (e.g., QC indicators) are analyzed with each batch of samples to evaluate data based upon (1) Method Performance (Laboratory Control Sample (LCS) or Blank Spike (BS)), which entails both the preparation and measurement steps; and (2) Matrix Effects (Matrix Spike (MS) or Sample Duplicate (MD, DUP), which evaluates field sampling accuracy, precision, representativeness, interferences, and the effect of the matrix on the method performed. Each regulatory program and each method within those programs specify the control samples that are prepared and/or analyzed with a specific batch

Note that frequency of control samples vary with specific regulatory, methodology and project specific criteria. Complete details on method control samples are as listed in each analytical SOP.

24.4.1 Method Performance Control - Laboratory Control Sample (LCS)

The LCS measures the accuracy of the method in a blank matrix and assesses method performance independent of potential field sample matrix affects in a laboratory batch.

The LCS is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (for example: Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The LCS is spiked with verified known amounts of analytes or is made of a material containing known and verified amounts of analytes, taken through all preparation and analysis steps along with the

field samples. Where there is no preparation taken for an analysis (such as in aqueous volatiles), or when all samples and standards undergo the same preparation and analysis process (such as Phosphorus), a calibration verification standard is reported as the LCS. In some instances where there is no practical clean solid matrix available, aqueous LCS's may be processed for solid matrices; final results may be calculated as mg/kg or ug/kg, assuming 100% solids and a weight equivalent to the aliquot used for the corresponding field samples, to facilitate comparison with the field samples.

Certified pre-made reference material purchased from a NIST/A2LA accredited vendor may also be used for the LCS when the material represents the sample matrix or the analyte is not easily spiked (e.g. solid matrix LCS for metals, TDS, etc.).

The specific frequency of use for LCS during the analytical sequence is defined in the specific standard operating procedure for each analysis. It is generally 1 for each batch of samples; not to exceed 20 environmental samples.

If the mandated or requested test method, or project requirements, do not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample (and Matrix Spike) where applicable (e.g. no spike of pH). However, in cases where the components interfere with accurate assessment (such as simultaneously spiking chlordane, toxaphene and PCBs in Method 608), the test method has an extremely long list of components or components are incompatible, at a minimum, a representative number of the listed components (see below) shall be used to control the test method. The selected components of each spiking mix shall represent all chemistries, elution patterns and masses, permit specified analytes and other client requested components. However, the laboratory shall ensure that all reported components are used in the spike mixture within a two-year time period.

- For methods that have 1-10 target analytes, spike all components.

- For methods that include 11-20 target analytes, spike at least 10 or 80%, whichever is greater.
- For methods with more than 20 target analytes, spike at least 16 components.

- Exception: Due to analyte incompatibility in pesticides, Toxaphene and Chlordane are only spiked at client request based on specific project needs.

- Exception: Due to analyte incompatibility between the various PCB Aroclors, Aroclors 1016 and 1260 are used for spiking as they cover the range of all of the Aroclors. Specific Aroclors may be used by request on a project specific basis.

24.5 Sample Matrix Controls

Table 24-3. Sample Matrix Control

Control Type	Details	
Matrix Spikes (MS)	Use	used to assess the effect sample matrix of the spiked sample has on the precision and accuracy of the results generated by the method used;
	Typical Frequency [1]	At a minimum, with each matrix-specific batch of samples processed, an MS is carried through the complete analytical procedure. Unless specified by the client, samples used for spiking are randomly selected and rotated between different client projects. If the mandated or requested test method does not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample and Matrix Spike. Refer to the method SOP for complete details
	Description	essentially a sample fortified with a known amount of the test analyte(s).
Surrogate	Use	Measures method performance to sample matrix (organics only).
	Typical Frequency [1]	Are added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. The recovery of the surrogates is compared to the acceptance limits for the specific method. Poor surrogate recovery may indicate a problem with sample composition and shall be reported, with data qualifiers, to the client whose sample produced poor recovery.
	Description	Are similar to matrix spikes except the analytes are compounds with properties that mimic the analyte of interest and are unlikely to be found in environment samples.
Duplicates[2]	Use	For a measure of analytical precision, with each matrix-specific batch of samples processed, a matrix duplicate (MD or DUP) sample, matrix spike duplicate (MSD), or LCS duplicate (LCSD) is carried through the complete analytical procedure.
	Typical Frequency [1]	Duplicate samples are usually analyzed with methods that do not require matrix spike analysis.
	Description	Performed by analyzing two aliquots of the same field sample independently or an additional LCS.
Internal Standards	Use	Are spiked into all environmental and quality control samples (including the initial calibration standards) to monitor the qualitative aspect of organic and some inorganic analytical measurements.
	Typical Frequency [1]	All organic and ICP methods as required by the analytical method.
	Description	Used to correct for matrix effects and to help troubleshoot variability in analytical response and are assessed after data acquisition. Possible sources of poor internal standard response are sample matrix, poor analytical technique or instrument performance.

[1] See the specific analytical SOP for type and frequency of sample matrix control samples.

[2] LCSD's are normally not performed except when regulatory agencies or client specifications require them. The recoveries for the spiked duplicate samples must meet the same laboratory established recovery limits as the accuracy QC samples. If an LCSD is analyzed both the LCS and LCSD must meet the same recovery criteria and be included in the final report. The precision measurement is reported as "Relative Percent Difference" (RPD). Poor precision between duplicates (except LCS/LCSD) may indicate non-homogeneous matrix or sampling.

24.6 Acceptance Criteria (Control Limits)

As mandated by the test method and regulation, each individual analyte in the LCS, MS, or Surrogate Spike is evaluated against the control limits published in the test method. Where there are no established acceptance criteria, the laboratory calculates in-house control limits with the use of control charts or, in some cases, utilizes client project specific control limits. When this occurs, the regulatory or project limits will supersede the laboratory's in-house limits.

Note: For methods, analytes and matrices with very limited data (e.g., unusual matrices not analyzed often), interim limits are established using available data or by analogy to similar methods or matrices.

Once control limits have been established, they are verified, reviewed, and updated if necessary on an annual basis unless the method requires more frequent updating. Control limits are established per method (as opposed to per instrument) regardless of the number of instruments utilized.

Laboratory generated % Recovery acceptance (control) limits are generally established by taking $\pm$ 3 Standard Deviations (99% confidence level) from the average recovery of a minimum of 20-30 data points (more points are preferred).

- Regardless of the calculated limit, the limit should be no tighter than the Calibration Verification (ICV/CCV). (Unless the analytical method specifies a tighter limit).

- In-house limits cannot be any wider than those mandated in a regulated analytical method. Client or contract required control limits are evaluated against the laboratory's statistically derived control limits to determine if the data quality objectives (DQOs) can be achieved. If laboratory control limits are not consistent with DQOs, then alternatives must be considered, such as method improvements or use of an alternate analytical method.

- The lowest acceptable recovery limit will be 10% (the analyte must be detectable and identifiable). Exception: The lowest acceptable recovery limit for Benzidine will be 5% and the analyte must be detectable and identifiable.

- The maximum acceptable recovery limit will be 150%.

- The maximum acceptable RPD limit will be 35% for waters and 40% for soils. The minimum RPD limit is 10%.

- If either the high or low end of the control limit changes by $\leq$ 5% from previous, the control chart is visually inspected and, using professional judgment, they may be left unchanged if there is no affect on laboratory ability to meet the existing limits.

24.6.1 The lab must be able to generate a current listing of their control limits and track when the updates are performed. In addition, the laboratory must be able to recreate historical control limits.

24.6.1.1 The QA Department generates and reviews Quality Control Limit Summaries using the TALS Control Chart module. These tables summarize the updated, proposed precision and accuracy acceptability limits for each applicable analysis performed at TestAmerica Edison. Once the QA Department is satisfied that the proposed limits are satisfactory the tables are forwarded to the applicable Department (Technical) Manager for final review. Once the proposed limits have been reviewed they entered into the appropriate TALS Method Limit Group database and approved for use (effectively replacing the existing limits in the database). The Quality Assurance Department maintains an archive of all limits used within the laboratory. Reference TestAmerica

Edison SOP No. ED-GEN-026 (Evaluation of Analytical Accuracy and Precision Through The Use of Control Charts).

24.6.2 A LCS that is within the acceptance criteria establishes that the analytical system is in control and is used to validate the process. Samples that are analyzed with an LCS with recoveries outside of the acceptance limits may be determined as out of control and should be reanalyzed if possible. If reanalysis is not possible, then the results for all affected analytes for samples within the same batch must be qualified when reported. The internal corrective action process (see Section 12) is also initiated if an LCS exceeds the acceptance limits. Sample results may be qualified and reported without reanalysis if:

- The analyte results are below the reporting limit and the LCS is above the upper control limit.
- If the analytical results are above the relevant regulatory limit and the LCS is below the lower control limit.

24.6.3 If the MS/MSDs do not meet acceptance limits, the MS/MSD and the associated spiked sample is reported with a qualifier for those analytes that do not meet limits. If obvious preparation errors are suspected, or if requested by the client, unacceptable MS/MSDs are reprocessed and reanalyzed to prove matrix interference. A more detailed discussion of acceptance criteria and corrective action can be found in the lab's method SOPs and in Section 12.

24.6.4 If a surrogate standard falls outside the acceptance limits, if there is not obvious chromatographic matrix interference, reanalyze the sample to confirm a possible matrix effect. If the recoveries confirm or there was obvious chromatographic interference, results are reported from the original analysis and a qualifier is added. If the reanalysis meets surrogate recovery criteria, the second run is reported (or both are reported if requested by the client). Under certain circumstances, where all of the samples are from the same location and share similar chromatography, the reanalysis may be performed on a single sample rather than all of the samples and if the surrogate meets the recovery criteria in the reanalysis, all of the affected samples would require reanalysis.

24.7 Additional Procedures to Assure Quality Control

The laboratory has written and approved method SOPs to assure the accuracy of the test method including calibration (see Section 20), use of certified reference materials (see Section 21) and use of PT samples (see Section 15).

A discussion regarding MDLs, Limit of Detection (LOD) and Limit of Quantitation (LOQ) can be found in Section 19.

- Use of formulae to reduce data is discussed in the method SOPs and in Section 20.
- Selection of appropriate reagents and standards is included in Section 9 and 21.
- A discussion on selectivity of the test is included in Section 5.
- Constant and consistent test conditions are discussed in Section 18.
- The laboratories sample acceptance policy is included in Section 23.

SECTION 25. REPORTING RESULTS

25.1 Overview

The results of each test are reported accurately, clearly, unambiguously, and objectively in accordance with State and Federal regulations as well as client requirements. Analytical results are issued in a format that is intended to satisfy customer and laboratory accreditation requirements as well as provide the end user with the information needed to properly evaluate the results. Where there is conflict between client requests and laboratory ethics or regulatory requirements, the laboratory's ethical and legal requirements are paramount, and the laboratory will work with the client during project set up to develop an acceptable solution. Refer to Section 7.

A variety of report formats are available to meet specific needs.

In cases where a client asks for simplified reports, there must be a written request from the client. There still must be enough information that would show any analyses that were out of conformance (QC out of limits) and there should be a reference to a full report that is made available to the client. Review of reported data is included in Section 19.

25.2 Test Reports

Analytical results are reported in a format that is satisfactory to the client and meets all requirements of applicable accrediting authorities and agencies. A variety of report formats are available to meet specific needs. The report is printed on laboratory letterhead, reviewed, and signed by the appropriate project manager. At a minimum, the standard laboratory report shall contain the following information:

25.2.1 A report title (e.g. Analytical Report For Samples) with a "sample results" column header.

25.2.2 Each report cover page printed on company letterhead, which includes the laboratory name, address and telephone number.

25.2.3 A unique identification of the report (e.g. work order number) and on each page an identification in order to ensure the page is recognized as part of the report and a clear identification of the end.

Note: Page numbers of report are represented as page # of ##. Where the first number is the page number and the second is the total number of pages.

25.2.4 A copy of the chain of custody (COC).

- Any COCs involved with Subcontracting are included.

25.2.5 The name and address of client and a project name/number, if applicable.

25.2.6 Client project manager or other contact

25.2.7 Description and unambiguous identification of the tested sample(s) including the client identification code.

25.2.8 Date of receipt of sample, date and time of collection, and date(s) of test preparation and performance, and time of preparation or analysis if the required holding time for either activity is less than or equal to 72 hours.

25.2.9 Date reported or date of revision, if applicable.

25.2.10 Method of analysis including method code (EPA, Standard Methods, etc.).

25.2.11 Reporting limit.

25.2.12 Method detection limits (if requested)

25.2.13 Definition of Data qualifiers and reporting acronyms (e.g. ND).

25.2.14 Sample results.

25.2.15 QC data consisting of method blank, surrogate, LCS, and MS/MSD recoveries and control limits.

25.2.16 Condition of samples at receipt including temperature. This may be accomplished in a narrative or by attaching sample login sheets (Refer to Sec. 25.2.4 – Item 3 regarding additional addenda).

25.2.17 A statement expressing the validity of the results, that the source methodology was followed and all results were reviewed for error.

25.2.18 A statement to the effect that the results relate only to the items tested and the sample as received by the laboratory.

25.2.19 A statement that the report shall not be reproduced except in full, without prior express written approval by the laboratory coordinator.

25.2.20 A signature and title of the person(s) accepting responsibility for the content of the report and date of issue. Authorized signatories are qualified Project Managers appointed by the Manager of Project Managers.

25.2.21 When TNI accreditation is required, the lab shall certify that the test results meet all requirements of TNI or provide reasons and/or justification if they do not.

25.2.22 The laboratory includes a cover letter.

25.2.23 Where applicable, a narrative to the report that explains the issue(s) and corrective action(s) taken in the event that a specific accreditation or certification requirement was not met.

25.2.24 When soil samples are analyzed, a specific identification as to whether soils are reported on a “wet weight” or “dry weight” basis.

25.2.25 Appropriate laboratory certification number for the state of origin of the sample, if applicable.

25.2.26 If only part of the report is provided to the client (client requests some results before all of it is complete), it must be clearly indicated on the report (e.g., partial report). A complete report must be sent once all of the work has been completed.

25.2.27 Any non-TestAmerica subcontracted analysis results are provided as a separate report on the official letterhead of the subcontractor. All TestAmerica subcontracting is clearly identified on the report as to which laboratory performed a specific analysis.

25.2.28 A Certification Summary Report, where required, will document that, unless otherwise noted, all analytes tested and reported by the laboratory were covered by the noted certifications.

Note: Refer to the Corporate SOP on Electronic Reporting and Signature Policy (No. CA-I-P-002) for details on internally applying electronic signatures of approval.

25.3 Reporting Level or Report Type

The laboratory offers four levels of quality control reporting. Each level, in addition to its own specific requirements, contains all the information provided in the preceding level. The packages provide the following information in addition to the information described above:

- Level I is a report with the features described in Section 25.2 above.
- Level II (also called 'Results/QA) is a Level I report plus summary information, including results for the method blank reported to the laboratory MDL, percent recovery for laboratory control samples and matrix spike samples, and the RPD values for all MSD and sample duplicate analyses.
- NJDEP Reduced Deliverables Format which contains, at minimum, the elements listed in the current NJDEP Technical Requirements for Site Remediation, N.J.A.C. 7:26E.
- NJDEP Full Deliverables Format (Non-USEPA CLP Methods) which contains, at minimum, the elements listed in the current NJDEP Technical Requirements for Site Remediation, N.J.A.C. 7:26E.
- NJDEP Full Deliverables Format (USEPA CLP Methods) which contains, at minimum, the elements listed in the current NJDEP Technical Requirements for Site Remediation, N.J.A.C. 7:26E.
- NYSDEC ASP 'A' and 'B' Deliverables Format which contain, at minimum, the elements listed in the current *New York State Department of Environmental Conservation Analytical Services Protocol*.

In addition to the various levels of QC packaging, the laboratory also provides reports in diskette deliverable form. Initial reports may be provided to clients by facsimile. Procedures used to ensure client confidentiality are outlined in Section 25.6.

25.3.1 Electronic Data Deliverables (EDDs)

EDDs are routinely offered as part of TestAmerica's services in addition to the test report as described in Section 25.2. When NELAP accreditation is required and both a test report and EDD are provided to the client, the official version of the test report will be the combined information of the report and the EDD. TestAmerica Edison offers a variety of EDD formats including NJ Hazsite Deliverables, Excel, Dbase, GISKEY, and Text Files.

EDD specifications are submitted to the IT department by the PM for review and undergo the contract review process. Once the facility has committed to providing data in a specific electronic format, the coding of the format may need to be performed. This coding is documented and validated. The validation of the code is retained by the IT staff coding the EDD.

EDDs shall be subject to a review to ensure their accuracy and completeness. If EDD generation is automated, review may be reduced to periodic screening if the laboratory can demonstrate that it can routinely generate that EDD without errors. Any revisions to the EDD format must be reviewed until it is demonstrated that it can routinely be generated without errors. If the EDD can be reproduced accurately and if all subsequent EDDs can be produced error-free, each EDD does not necessarily require a review.

25.4 Supplemental Information for Test

The lab identifies any unacceptable QC analyses or any other unusual circumstances or observations such as environmental conditions and any non-standard conditions that may have affected the quality of a result. This is typically in the form of a footnote or a qualifier and/or a narrative explaining the discrepancy in the front of the report.

Numeric results with values outside of the calibration range, either high or low are qualified as 'estimated'.

Where quality system requirements are not met, a statement of compliance/non-compliance with requirements and/or specifications is required, including identification of test results derived from any sample that did not meet TNI sample acceptance requirements such as improper container, holding time, or temperature.

Where applicable, a statement on the estimated uncertainty of measurements; information on uncertainty is needed when a client's instructions so require.

Opinions and Interpretations - The test report contains objective information, and generally does not contain subjective information such as opinions and interpretations. If such information is required by the client, the Laboratory Director will determine if a response can be prepared. If so, the Laboratory Director will designate the appropriate member of the management team to prepare a response. The response will be fully documented, and reviewed by the Laboratory Director, before release to the client. There may be additional fees charged to the client at this time, as this is a non-routine function of the laboratory.

Note: Review of data deliverable packages for submittal to regulatory authorities requires responses to non-conforming data concerning potential impact on data quality. This

necessitates a limited scope of interpretation, and this work is performed by the QA Department. This is the only form of "interpretation" of data that is routinely performed by the laboratory.

When opinions or interpretations are included in the report, the laboratory provides an explanation as to the basis upon which the opinions and interpretations have been made. Opinions and interpretations are clearly noted as such and where applicable, a comment should be added suggesting that the client verify the opinion or interpretation with their regulator.

25.5 Environmental Testing Obtained From Subcontractors

If the laboratory is not able to provide the client the requested analysis, the samples would be subcontracted following the procedures outlined in the Corporate SOP on Subcontracting (SOP No. CA-L-S-002).

Data reported from analyses performed by a subcontractor laboratory are clearly identified as such on the analytical report provided to the client. Results from a subcontract laboratory outside of TestAmerica are reported to the client on the subcontract laboratory's original report stationary and the report includes any accompanying documentation.

25.6 Client Confidentiality

In situations involving the transmission of environmental test results by telephone, facsimile or other electronic means, client confidentiality must be maintained.

TestAmerica will not intentionally divulge to any person (other than the Client or any other person designated by the Client in writing) any information regarding the services provided by TestAmerica or any information disclosed to TestAmerica by the Client. Furthermore, information known to be potentially endangering to national security or an entity's proprietary rights will not be released.

Note: This shall not apply to the extent that the information is required to be disclosed by TestAmerica under the compulsion of legal process. TestAmerica will, to the extent feasible, provide reasonable notice to the client before disclosing the information.

Note: Authorized representatives of an accrediting authority are permitted to make copies of any analyses or records relevant to the accreditation process, and copies may be removed from the laboratory for purposes of assessment.

Report deliverable formats are discussed with each new client. If a client requests that reports be faxed or e-mailed, the reports are to meet all requirements of this document, include cover letter.

25.7 Format of Reports

The format of reports is designed to accommodate each type of environmental test carried out and to minimize the possibility of misunderstanding or misuse.

25.8 Amendments to Test Reports

Corrections, additions, or deletions to reports are only made when justification arises through supplemental documentation. Justification is documented using the laboratory's corrective action system (refer to Section 12).

The revised report is retained on the Archive data server, as is the original report. The revised report is stored in the Archive data server under the sample number followed by "Rev (n)" where 'n' is the revision number. The revised report will have the words "Revision (n)" on the report cover page beneath the report date. Additionally, a section entitled"Revised Report" will appear on the Case Narrative page. A brief explanation of the reasons for the re-issue will be included in this section.

When the report is re-issued, a notation of "report re-issue "is placed on the cover/signature page of the report *or at the top of the narrative page* with a brief explanation of reason for the re-issue and a reference back to the last final report generated. *For Example*: *Report was revised on 11/3/08 to include toluene in sample NQA1504 per client's request. This final report replaces the final report generated on 10/27/08 at 10:47am.*

25.9 Policies on Client Requests for Amendments

25.9.1 Policy on Data Omissions or Reporting Limit Increases

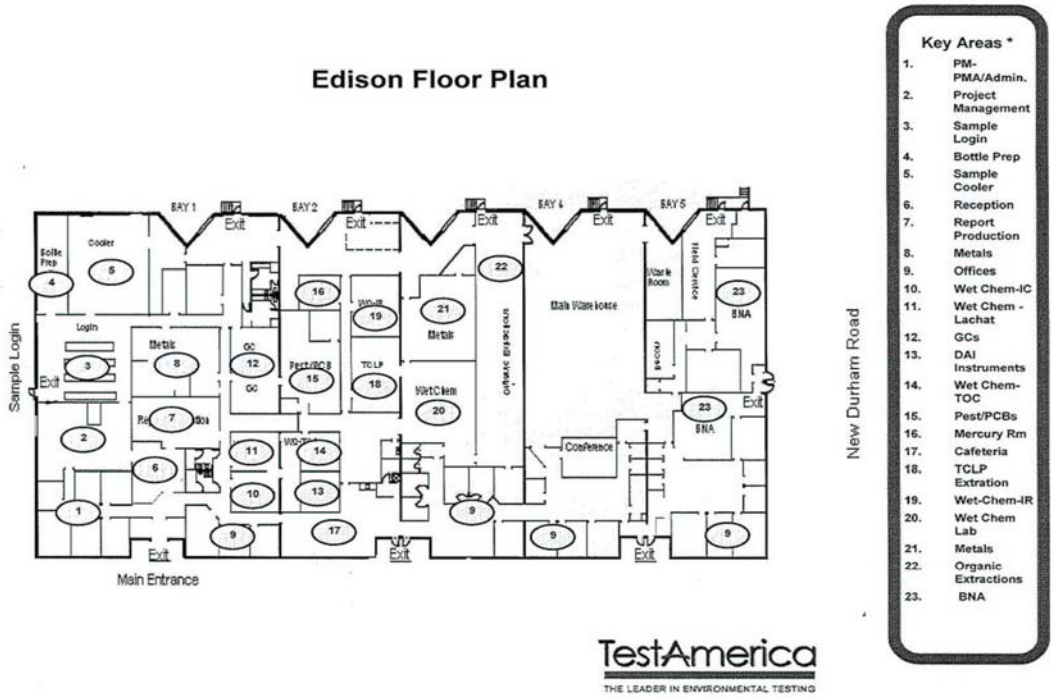
Fundamentally, our policy is simply to not omit previously reported results (including data qualifiers) or to not raise reporting limits and report sample results as ND. This policy has few exceptions. Exceptions are:

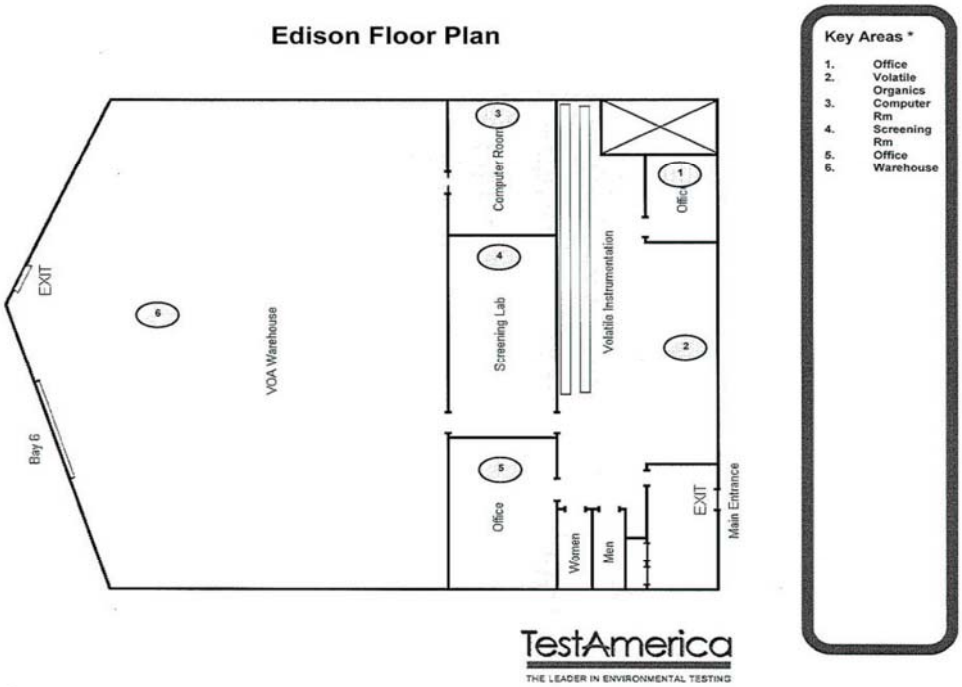
- Laboratory error.
- Sample identification is indeterminate (confusion between COC and sample labels).
- An incorrect analysis (not analyte) was requested (e.g., COC lists 8315 but client wanted 8310). A written request for the change is required.
- Incorrect limits reported based on regulatory requirements.
- The requested change has absolutely *no possible* impact on the interpretation of the analytical results and there is *no possibility* of the change being interpreted as misrepresentation by anyone inside or outside of our company.

25.9.2 Multiple Reports

TestAmerica does not issue multiple reports for the same work order where there is different information on each report (this does not refer to copies of the same report) unless required to meet regulatory needs and approved by QA.

Appendix 1. Laboratory Floor Plan





Appendix 2. Glossary/Acronyms (EL-V1M2 Sec. 3.1)

Glossary:

Acceptance Criteria: Specified limits placed on characteristics of an item, process, or service defined in requirement documents. (ASQC)

Accreditation: The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory.

Accuracy: The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (QAMS)

Analyst: The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.

Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis. (TNI)

Anomaly: A condition or event, other than a deficiency, that may affect the quality of the data, whether in the laboratory's control or not.

Assessment: The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of laboratory accreditation). (TNI)

Audit: A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives. (TNI)

Batch: Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one (1) to twenty (20) environmental samples of the same quality systems matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be twenty-four (24) hours. An **analytical batch** is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various quality system matrices and can exceed twenty (20) samples. (TNI)

Bias: The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value). (TNI)

Blank: A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. (ASQC)

Calibration: A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. (TNI)

1) In calibration of support equipment the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI).

2) In calibration according to methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications.

Calibration Curve: The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (TNI)

Calibration Standard: A substance or reference material used to calibrate an instrument (QAMS)

Certified Reference Material (CRM): A reference material accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute. (TNI)

Chain of Custody (COC) Form: Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; the collector; time of collection; preservation; and requested analyses. (TNI)

Compromised Samples: Those samples which are improperly sampled, insufficiently documented (chain of custody and other sample records and/or labels), improperly preserved, collected in improper containers, or exceeding holding times when delivered to a laboratory. Under normal conditions, compromised samples are not analyzed. If emergency situation require analysis, the results must be appropriately qualified.

Confidential Business Information (CBI): Information that an organization designates as having the potential of providing a competitor with inappropriate insight into its management, operation or products. TNI and its representatives agree to safeguard identified CBI and to maintain all information identified as such in full confidentiality.

Confirmation: Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to Second Column Confirmation; Alternate wavelength; Derivatization; Mass spectral interpretation; Alternative detectors or Additional Cleanup procedures. (TNI)

Conformance: An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements. (ANSI/ASQC E4-1994)
Correction: Actions necessary to correct or repair analysis specific non-conformances. The acceptance criteria for method specific QC and protocols as well as the associated corrective actions. The analyst will most frequently be the one to identify the need for this action as a result of calibration checks and QC sample analysis**.** No significant action is taken to change behavior, process or procedure.

Corrective Action: The action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO 8402)

Data Audit: A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data re of acceptable quality (i.e., that they meet specified acceptance criteria).

Data Reduction: The process of transforming the number of data items by arithmetic or statistical calculations, standard curves, and concentration factors, and collation into a more useable form. (TNI)

Deficiency: An unauthorized deviation from acceptable procedures or practices, or a defect in an item (ASQC), whether in the laboratory's control or not.

Demonstration of Capability: A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision. (TNI)

Document Control: The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly, and controlled to ensure use of the correct version at the location where the prescribed activity if performed. (ASQC)

Duplicate Analyses: The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. (EPA-QAD)

Equipment Blank: Sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures.

External Standard Calibration: Calibrations for methods that do not utilize internal standards to compensate for changes in instrument conditions.

Field Blank: Blank prepared in the field by filing a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken (EPA OSWER)

Field of Accreditation: Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.

Holding Times: The maximum time that samples may be held prior to analyses and still be considered valid or not compromised. (40 CFR Part 136)

Internal Standard: A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical test method. (TNI)

Internal Standard Calibration: Calibrations for methods that utilize internal standards to compensate for changes in instrument conditions.

Instrument Blank: A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. (EPA-QAD)

Instrument Detection Limit (IDL): The minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific instrument. The IDL is associated with the instrumental portion of a specific method only, and sample preparation steps are not considered in its derivation. The IDL is a statistical estimation at a specified confidence interval of the concentration at which the relative uncertainty is $\pm$ 100%. The IDL represents a range where qualitative detection occurs on a specific instrument. Quantitative results are not produced in this range.

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes, taken through all preparation and analysis steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

An LCS shall be prepared at a minimum of 1 per batch of 20 or less samples per matrix type per sample extraction or preparation method except for analytes for which spiking solutions are not available such as total suspended solids, total dissolved solids, total volatile solids, total solids, pH, color, odor, temperature, dissolved oxygen or turbidity. The results of these samples shall be used to determine batch acceptance.

Least Squares Regression (1st Order Curve): The least squares regression is a mathematical calculation of a straight line over two axes. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The regression calculation will generate a correlation coefficient (r) that is a measure of the "goodness of fit" of the regression line to the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r must be greater than or equal to 0.99 for organics and 0.995 for inorganics.

Limit(s) of Detection (LOD) [a.k.a., Method Detection Limit (MDL)]: A laboratory's estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect in their facility. (TNI)

LOD Verification [a.k.a., MDL Verification]: A processed QC sample in the matrix of interest, spiked with the analyte at no more than 3X the LOD for single analyte tests and 4X the LOD for multiple analyte tests and processed through the entire analytical procedure.

Limit(s) of Quantitation (LOQ) [a.k.a., Reporting Limit]: The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. (TNI)

(QS) Matrix: The component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions shall be used:

Aqueous: Any aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine. Includes surface water, groundwater effluents, and TCLP or other extracts.

Drinking Water: Any aqueous sample that has been designated as a potable or potential potable water source.

Saline/Estuarine: Any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.

Non-Aqueous Liquid: Any organic liquid with <15% settleable solids.

Biological Tissue: Any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Solids: Includes soils, sediments, sludges, and other matrices with >15% settleable solids.

Chemical Waste: A product or by-product of an industrial process that results in a matrix not previously defined.

Air & Emissions: Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbent tube, impinger solution, filter, or other device. (TNI)

Matrix Spike (spiked sample or fortified sample): A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test

result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Matrix Spike Duplicate (spiked sample or fortified sample duplicate): A replicate matrix spike prepared and analyzed to obtain a measure of the precision of the recovery for each analyte.

Method Blank: A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.

Method Detection Limit: The minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40 CFR Part 136, Appendix B)

Negative Control: Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results.

Non-conformance: An indication, judgment, or state of not having met the requirements of the relevant specifications, contract, or regulation.

Observation: A record of phenomena that (1) may assist in evaluation of the sample data; (2) may be of importance to the project manager and/or the client, and yet not at the time of the observation have any known effect on quality.

Performance Audit: The routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory.

Positive Control: Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects.

Precision: The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. (TNI)

Preservation: Any conditions under which a sample must be kept in order to maintain chemical and/or biological integrity prior to analysis. (TNI)

Proficiency Testing: A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (TNI)

Proficiency Testing Program: The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories. (TNI)

Proficiency Test Sample (PT): A sample, the composition of which is unknown to the laboratory and is provided to test whether the laboratory can produce analytical results within specified acceptance criteria. (TNI)

Quality Assurance: An integrated system of management activities involving planning, implementation, assessment, reporting and quality improvement to ensure that a process, item or service is of the type of quality needed and expected by the client. (TNI)

Quality Assurance [Project] Plan (QAPP): A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. (EAP-QAD)

Quality Control: The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality. (TNI)

Quality Control Sample: A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control. (TNI)

Quality Manual: A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. (TNI)

Quality System: A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC activities. (TNI)

Raw Data: The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records. (TNI)

Record Retention: The systematic collection, indexing and storing of documented information under secure conditions.

Reference Material: Material or substance one or more properties of which are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (TNI)

Reference Standard: Standard used for the calibration of working measurement standards in a given organization or a given location. (TNI)

Sampling: Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.

Second Order Polynomial Curve (Quadratic): The 2nd order curves are a mathematical calculation of a slightly curved line over two axis. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The 2nd order regression will generate a coefficient of determination (COD or r^2) that is a measure of the "goodness of fit" of the quadratic curvature the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r^2 must be greater than or equal to 0.99.

Selectivity: The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system. (TNI)

Sensitivity: The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (TNI)

Spike: A known mass of target analyte added to a blank, sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.

Standard: The document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies. (TNI)

Standard Operating Procedures (SOPs): A written document which details the method for an operation, analysis, or action, with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks. (TNI)

Storage Blank: A blank matrix stored with field samples of a similar matrix (volatiles only) that measures storage contribution to any source of contamination.

Surrogate: A substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes.

Surrogate compounds must be added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. Poor surrogate recovery may indicate a problem with sample composition and shall be reported to the client whose sample produced poor recovery. (QAMS)

Systems Audit (also Technical Systems Audit): A thorough, systematic, qualitative on-site assessment of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system. (EPA-QAD)

Technical Manager: A member of the staff of an environmental laboratory who exercises actual day-to-day supervision of laboratory operations for the appropriate fields of accreditation and reporting of results

Technology: A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.

Traceability: The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project. (TNI)

Trip Blank: A blank matrix placed in a sealed container at the laboratory that is shipped, held unopened in the field, and returned to the laboratory in the shipping container with the field samples.

Uncertainty: A parameter associated with the result of a measurement that characterizes the dispersion of the value that could reasonably be attributed to the measured value.

Acronyms:

CAR – Corrective Action Report
CCV – Continuing Calibration Verification
CF – Calibration Factor
CFR – Code of Federal Regulations

COC – Chain of Custody
DOC – Demonstration of Capability
DQO – Data Quality Objectives
DUP - Duplicate
EHS – Environment, Health and Safety
EPA – Environmental Protection Agency
GC - Gas Chromatography
GC/MS - Gas Chromatography/Mass Spectrometry
HPLC - High Performance Liquid Chromatography
ICP - Inductively Coupled Plasma Atomic Emission Spectroscopy
ICP/MS – ICP/Mass Spectrometry
ICV – Initial Calibration Verification
IDL – Instrument Detection Limit
IH – Industrial Hygiene
IS – Internal Standard
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
LIMS – Laboratory Information Management System
LOD – Limit of Detection
LOQ – Limit of Quantitation
MDL – Method Detection Limit
MDLCK – MDL Check Standard
MDLV – MDL Verification Check Standard
MRL – Method Reporting Limit Check Standard
MS – Matrix Spike
MSD – Matrix Spike Duplicate
SDS - Safety Data Sheet
NELAP - National Environmental Laboratory Accreditation Program
PT – Performance Testing
TNI – The NELAC Institute
QAM – Quality Assurance Manual
QA/QC – Quality Assurance / Quality Control
QAPP – Quality Assurance Project Plan
RF – Response Factor
RPD – Relative Percent Difference
RSD – Relative Standard Deviation
SD – Standard Deviation
SOP – Standard Operating Procedure
TAT – Turn-Around-Time
VOA – Volatiles
VOC – Volatile Organic Compound

Appendix 3. Laboratory Certifications, Accreditations, Validations

TestAmerica Edison maintains accreditations, certifications, and approvals with numerous state and national entities. Programs vary but may include on-site audits, reciprocal agreements with another entity, performance testing evaluations, review of the QA Manual, Standard Operating Procedures, Method Detection Limits, training records, etc.

. At the time of this QA Manual revision, the TestAmerica Edison laboratory has accreditation/certification/licensing with the following organizations:

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Certifications

Laboratory	Program	Authority	Identification	Expiration Date
TestAmerica Edison	Federal	USDA	NJCA-003-08	06/13/2020
TestAmerica Edison	NELAP	New Jersey	12028	06/30/2018
TestAmerica Edison	NELAP	New York	11452	04/01/2018
TestAmerica Edison	NELAP	Pennsylvania	68-00522	02/28/2018
TestAmerica Edison	State Program	Connecticut	PH-0200	09/30/2018
TestAmerica Edison	State Program	DE Haz. Subst. Cleanup Act (HSCA)	N/A	12/31/2017
TestAmerica Edison	State Program	Rhode Island	LAO00132	12/30/2017

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* Certification Valid - Laboratory is Pending Renewal with the Program Authority

For more information, or to contact a local TestAmerica representative nearest you, please visit our website at www.testamericainc.com

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The certificates and accredited parameter lists are available for each State/Program at www.testamericainc.com under Analytical Services Search – Certifications.

Quality Assurance Manual Cover Page

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Title Page:

Quality Assurance Manual
Approval Signatures

Laboratory Director – Mark Acierno	12/19/2017 Date
Quality Manager - Carl Armbruster	12/19/2017 Date
Technical Manager, Organics – Sylvanus Klusey	12/19/2017 Date.
Technical Manager, Inorganics – Donald Evans	12/19/2017 Date

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REFERENCED CORPORATE SOPs AND POLICIES

SOP / Policy Reference	Title
CA-I-P-002	Electronic Reporting and Signature Policy
CA-L-P-002	Contract Compliance Policy
CW-L-S-004	Subcontracting
CA-Q-M-002	Corporate Quality Management Plan
CA-Q-S-001	Solvent and Acid Lot Testing and Approval
CA-Q-S-002	Acceptable Manual Integration Practices
CA-Q-S-006	Detection Limits
CA-Q-S-009	Root Cause Analysis
CA-T-P-001	Qualified Products List
CW-E-M-001	Corporate Environmental Health & Safety Manual
CW-F-P-002	Company-Wide Authorization Matrix
CW-F-P-004	Procurement and Contracts Policy
CW-F-S-007	Capital Expenditure, Controlled Purchase Requests and Fixed Asset Capitalization
CW-L-P-004	Ethics Policy
CW-L-S-002	Internal Investigation
CW-Q-S-001	Corporate Document Control and Archiving
CW-Q-S-002	Writing a Standard Operating Procedure (SOPs)
CW-Q-S-003	Internal Auditing
CW-Q-S-004	Management Systems Review
CW-Q-S-005	Data Recall Process
CA-C-S-001	Work Sharing Process

REFERENCED LABORATORY SOPs

SOP Reference	Title
ED-GEN-002	Document Control
ED-GEN-026	Evaluation of Analytical Accuracy and Precision Through The Use of Control Charts
ED-GEN-010	Calibration of Analytical Balances
ED-GEN-003	Control of Non-Conformances and Corrective Action
ED-GEN-024	Record Storage and Retention
ED-GEN-022	Training
ED-GEN-001	Data Management and Handling Procedures
ED-GEN-021	Data Review
ED-SPM-001	Login
ED-RP-001	Reports Production
ED-GEN-014	Thermometer Calibration

SOP Reference	Title
ED-GEN-011	Calibration and Use of Lab Pipettes
ED-FLD-008, -009	Groundwater Sampling and Flow Monitoring
ED-FLD-014	Wastewater Sampling
ED-FLD-001 thru -010	Field Analytical Parameters
ED-GEN-007	Subsampling
ED-SPM-007	Disposal of Samples and Associated Laboratory Waste
ED-SPM-006	Procedure for Acceptance and Handling of Regulated Domestic and Foreign Soils

SECTION 3. INTRODUCTION, SCOPE AND APPLICABILITY

3.1 Introduction and Compliance References

TestAmerica Edison's Quality Assurance Manual (QAM) is a document prepared to define the overall policies, organization objectives and functional responsibilities for achieving TestAmerica's data quality goals. The laboratory maintains a local perspective in its scope of services and client relations and maintains a national perspective in terms of quality.

The QAM has been prepared to assure compliance with The NELAC Institute (TNI) Standard, dated 2009, Volume 1 Modules 2 and 4. In addition, the policies and procedures outlined in this manual are compliant with TestAmerica's Corporate Quality Management Plan (CQMP) and the various accreditation and certification programs listed in Appendix 3. The CQMP provides a summary of TestAmerica's quality and data integrity system. It contains requirements and general guidelines under which all TestAmerica facilities shall conduct their operations.

The QAM has been prepared to be consistent with the requirements of the following documents:

- ANSI/ASQC, E4-1994, "Specifications and Guidelines for Quality Management Systems for Environmental Data Collection and Environmental Technology Programs" (American National Standard, January 5, 1995, or most recent version)
- "EPA Requirements for Quality Management Programs" (QA/R-2) (EPA/240/B-01/002, May 31, 2006).
- EPA 600/4-88/039, *Methods for the Determination of Organic Compounds in Drinking Water,* EPA, Revised July 1991.
- EPA 600/R-95/131, *Methods for the Determination of Organic Compounds in Drinking Water,* Supplement III, EPA, August 1995.
- EPA 600/4-79-019, *Handbook for Analytical Quality Control in Water and Wastewater Laboratories,* EPA, March 1979.
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008; Final Update V, August 2015.*
- Federal Register, 40 CFR Parts 136, 141, 172, 173, 178, 179 and 261.
- *Manual for the Certification of Laboratories Analyzing Drinking Water (EPA 815-R-05-004, January 2005) (DW labs only)*
- *Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.*
- APHA, *Standard Methods for* the Examination of Water and Wastewater, 18th Edition, 19th, 20th, 21st, and on-line Editions.
- Nuclear Regulatory Commission (NRC) Quality Assurance Requirements.
- Marine Protection, Research, and Sanctuaries Act (MPRSA).
- Toxic Substances Control Act (TSCA).

3.2 Terms and Definitions

A Quality Assurance Program is a company-wide system designed to ensure that data produced by the laboratory conforms to the standards set by state and/or federal regulations. The program functions at the management level through company goals and management policies, and at the analytical level through Standard Operating Procedures (SOPs) and quality control. The TestAmerica program is designed to minimize systematic error, encourage constructive, documented problem solving, and provide a framework for continuous improvement within the organization.

Refer to Appendix 2 for the Glossary/Acronyms.

3.3 Scope / Fields of Testing

The laboratory analyzes a broad range of environmental and industrial samples every month. Sample matrices vary among air, drinking water, effluent water, groundwater, hazardous waste, sludge and soils. The Quality Assurance Program contains specific procedures and methods to test samples of differing matrices for chemical, physical and biological parameters. The Program also contains guidelines on maintaining documentation of analytical processes, reviewing results, servicing clients and tracking samples through the laboratory. The technical and service requirements of all analytical requests are thoroughly evaluated before commitments are made to accept the work. Measurements are made using published reference methods or methods developed and validated by the laboratory.

The methods covered by this manual include the most frequently requested methodologies needed to provide analytical services in the United States and its territories. The specific list of test methods used by the laboratory can be found TestAmerica Edison Work Instruction No. EDS-WI-009 (Analytical Capabilities). The approach of this manual is to define the minimum level of quality assurance and quality control necessary to meet these requirements. All methods performed by the laboratory shall meet these criteria as appropriate. In some instances, quality assurance project plans (QAPPs), project specific data quality objectives (DQOs) or local regulations may require criteria other than those contained in this manual. In these cases, the laboratory will abide by the requested criteria following review and acceptance of the requirements by the Laboratory Director and the Quality Assurance (QA) Manager. In some cases, QAPPs and DQOs may specify less stringent requirements. The Laboratory Director and the QA Manager must determine if it is in the lab's best interest to follow the less stringent requirements.

3.4 Management of the Manual

3.4.1 Review Process

The template on which this manual is based is reviewed annually by Corporate Quality Management Personnel to assure that it remains in compliance with Section 3.1. This manual itself is reviewed every two years by senior laboratory management to assure that it reflects current practices and meets the requirements of the laboratory's clients and regulators as well as the CQMP. Occasionally, the manual may need changes in order to meet new or changing regulations and operations. The QA Manager will review the changes in the normal course of business and incorporate changes into revised sections of the document. All updates will be reviewed by the senior laboratory management staff. The laboratory updates and approves such changes according to our Document Control & Updating procedures (refer to SOP No. ED-GEN-002, Document Control).

SECTION 4. MANAGEMENT REQUIREMENTS

4.1 Overview

TestAmerica Edison is a local operating unit of TestAmerica Laboratories, Inc.. The organizational structure, responsibilities and authorities of the corporate staff of TestAmerica Laboratories, Inc. are presented in the CQMP. The laboratory has day-to-day independent operational authority overseen by corporate officers (e.g., President and Chief Executive Officer (CEO), Chief Operating Officer (COO), Executive Vice President (VP) Operations, Corporate Quality, etc.). The laboratory operational and support staff work under the direction of the Laboratory Director. The organizational structure for both Corporate & TestAmerica Edison is presented in Figure 4-1.

4.2 Roles and Responsibilities

In order for the Quality Assurance Program to function properly, all members of the staff must clearly understand and meet their individual responsibilities as they relate to the quality program. The following descriptions briefly define each role in its relationship to the Quality Assurance Program.

4.2.1 Additional Requirements for Laboratories

The responsibility for quality resides with every employee of the laboratory. All employees have access to the QAM, are trained to this manual, and are responsible for upholding the standards therein. Each person carries out his/her daily tasks in a manner consistent with the goals and in accordance with the procedures in this manual and the laboratory's SOPs. Role descriptions for Corporate personnel are defined in the CQMP. This manual is specific to the operations of TestAmerica's Edison laboratory.

4.2.2 President and Chief Executive Officer (CEO)

The President and CEO is a member of the Board of Directors and is ultimately responsible for the quality and performance of all TestAmerica facilities. The President and CEO establishes

the overall quality standard and data integrity program for the Analytical Business, providing the necessary leadership and resources to assure that the standard and integrity program are met.

4.2.3 Chief Operation Officer (COO)

The COO reports directly to the President and CEO of TestAmerica. The COO~~VPO~~ oversees the operations of all TestAmerica laboratories and the EMLab P&K business unit. The VP's of Operations report directly to COO

4.2.4 Vice President of Operations

Each VP of Operations reports directly to the Executive VP of Operations and is a part of the Executive Committee. Each VP of Operations is responsible for the overall administrative and operational management of their respective laboratories. The VP's responsibilities include allocation of personnel and resources, long-term planning, goal setting, and achieving the financial, business, and quality objectives of TestAmerica. The VP's ensure timely compliance with Corporate Management directives, policies, and management systems reviews. The VP's are also responsible for restricting any laboratory from performing analyses that cannot be consistently and successfully performed to meet the standards set forth in this manual.

4.2.5 Vice President of Quality and Environmental Health and Safety (VP-QA/EHS)

The Vice President (VP) of QA/EHS reports directly to the President and CEO. With the aid of the Executive Committee, Laboratory Directors, Quality Directors, Safety Manager, EH&S Coordinators and QA Managers, the VP-QA/EHS has the responsibility for the establishment, general overview and Corporate maintenance of the Quality Assurance and EH&S Programs within TestAmerica. Additional responsibilities include:

- Review of QA/QC and EHS aspects of Corporate SOPs & Policies, national projects and expansions or changes in services.
- Work with various organizations outside of TestAmerica to further the development of quality standards and represent TestAmerica at various trade meetings.
- Preparation of a monthly report that includes quality metrics across the analytical laboratories and a summary of any quality related initiatives and issues.
- Preparation of a monthly report that includes EH&S metrics across the analytical laboratories and a summary of any EH&S related initiatives and issues.
- Work with various organizations outside of TestAmerica to further the development of quality standards and represent TestAmerica at various trade meetings.
- With the assistance of the Corporate Senior Management Teams and the EHS Director~~s~~, development and implementation of the TestAmerica Environmental, Health and Safety Program.

4.2.6 Vice President of Client Service

The VP of Client Services leads the Client Service Organization (CSO) and is responsible for client satisfaction, driving operational excellence and improving client responsiveness. The VP provides direction to the Client Service Directors, Programs Managers and Project Managers.

4.2.7 Quality Assessment Director

The Quality Assessment Director reports to the VP-QA/EHS. The Quality Assessment Director has QA oversight of laboratories; responsible for the internal audit system, schedule and procedure; monitors laboratory internal audit findings; identifies common laboratory weaknesses; and monitors corrective action closures. Together with the Quality Compliance Director, the Quality Systems Director, and the VP-QA/EHS, the Quality Assessment Director has the responsibility for the establishment, general overview and maintenance of the Analytical Quality Assurance Program within TestAmerica.

4.2.8 Quality Compliance Director

The Quality Compliance Director reports to the VP-QA/EHS. The Quality Compliance Director has QA oversight of laboratories; monitors and communicates DoD / DoE requirements; develops corporate tools for ensuring and improving compliance; develops corporate assessment tools; identifies common laboratory weaknesses; and monitors corrective action closures. Together with the Quality Assessment Director, Quality Systems Director and the VP-QA/EHS, the Quality Compliance Director has the responsibility for the establishment, general overview and maintenance of the Analytical Quality Assurance Program within TestAmerica.

4.2.9 Quality Systems Director

The Quality Systems Director reports to the VP-QA/EHS. The Quality Systems Director has QA oversight of laboratories; develops quality policies, procedures and management tools; monitors and communicates regulatory and certification requirements; identifies common laboratory weaknesses; and monitors corrective action closures. Together with the Quality Assessment Director, Quality Compliance Director and the VP-QA/EHS, the Quality Systems Director has the responsibility for the establishment, general overview and maintenance of the Analytical Quality Assurance Program within TestAmerica.

4.2.10 Quality Information Manager

The Quality Information Manager is responsible for managing all company official documents (e.g., Policies, Procedures, Work Instructions), the company's accreditation database, intranet websites, external laboratory subcontracting, regulatory limits for clients on the company's TotalAccess website; internal and external client support for various company groups (e.g., Client Services, EH&S, Legal, IT, Sales) for both quality and operational functions. The Quality Information Manager reports to the VP-QA/EHS; and works alongside the Quality Assessment, Quality Compliance and Quality System Directors and EHS Managers to support both the Analytical Quality Assurance and EHS Programs within TestAmerica.

4.2.11 Technical Services Director

The Technical Services Director is responsible for establishing, implementing and communicating TestAmerica's Analytical Business's Technical Policies, SOPs, and Manuals. Other responsibilities include conducting technical assessments as required, acting as a

technical resource in national contracts review, coordinating new technologies, establishing best practices, advising staff on technology advances, innovations, and applications.

4.2.12 Ethics and Compliance Officers (ECOs)

TestAmerica has designated two senior members of the Corporate staff to fulfill the role of Ethics and Compliance Officer (ECO) – Corporate Counsel & VP of Human Resources and the VP-QA/EHS. Each ECO acts as a back-up to the other ECO and both are involved when data investigations occur. Each ECO has a direct line of communication to the entire senior Corporate and lab management staff.

The ECOs ensure that the organization distributes the data integrity and ethical practices policies to all employees and ensures annual trainings and orientation of new hires to the ethics program and its policies. The ECO is responsible for establishing a mechanism to foster employee reporting of incidents of illegal, unethical, or improper practices in a safe and confidential environment.

The ECOs monitor and audit procedures to determine compliance with policies and to make recommendations for policy enhancements to the President and CEO, VPOs, Laboratory Director or other appropriate individuals within the laboratory. The ECO will assist the laboratory QA Manager in the coordination of internal auditing of ethical policy related activities and processes within the laboratory, in conjunction with the laboratories regular internal auditing function.

The ECOs will also participate in investigations of alleged violations of policies and work with the appropriate internal departments to investigate misconduct, remedy the situation, and prevent recurrence of any such activity.

4.2.13 Chief Information Officer (CIO)

The CIO is responsible for establishing, implementing and communicating TestAmerica's Information Technology (IT) Policies, SOPs and Manuals. Other responsibilities include coordinating new technologies, development of electronic communication tools such as TestAmerica's intranet and internet sites, ensuring data security and documentation of software, ensuring compliance with the NELAC standard, and assistance in establishing, updating, and maintaining Laboratory Information Management Systems (LIMS) at the various TestAmerica facilities.

4.2.14 Environmental Health and Safety Managers (Corporate)

The EHS Managers report directly to the VP-QA/EHS. The EHS Managers are responsible for the development and implementation of the TestAmerica Environmental, Health and Safety program. Responsibilities include:

- Consolidation and tracking all safety and health-related information and reports for the company, and managing compliance activities for TestAmerica locations.
- Coordination/preparation of the corporate Environmental, Health and Safety Manual Template that is used by each laboratory to prepare its own laboratory-specific Safety Manual/ CHP.

- Preparation of information and training materials for laboratory EHS Coordinators.
- Assistance in the internal and external coordination of employee exposure and medical monitoring programs to insure compliance with applicable safety and health regulations.
- Serving as Department of Transportation (D.O.T.) focal point and providing technical assistance to location management.
- Serving as Hazardous Waste Management main contact and providing technical assistance to location management.

4.2.15 Laboratory Director/Lead Technical Manager

TestAmerica Edison's Laboratory Director is responsible for the overall quality, safety, financial, technical, human resource and service performance of the whole laboratory and reports to their respective VPO. The Laboratory Director provides the resources necessary to implement and maintain an effective and comprehensive Quality Assurance and Data Integrity Program.

Specific responsibilities include, but are not limited to:

- Serves as lead Technical Manager for all fields of testing.
- Ensures that all analysts and supervisors have the appropriate education and training to properly carry out the duties assigned to them and ensures that this training has been documented.
- Ensures that personnel are free from any commercial, financial and other undue pressures which might adversely affect the quality of their work.
- Ensures TestAmerica's human resource policies are adhered to and maintained.
- Ensures that sufficient numbers of qualified personnel are employed to supervise and perform the work of the laboratory.
- Ensures that appropriate corrective actions are taken to address analyses identified as requiring such actions by internal and external performance or procedural audits. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs may be temporarily suspended by the Laboratory Director.
- Monitors standards of performance in quality control and quality assurance.
- Monitors the validity of analyses performed and data generated in the lab to assure reliable data.
- Reviews and approves all SOPs prior to their implementation and ensures all approved SOPs are implemented and adhered to.
- Interfaces with Project Management and Customer Service to forecast receipts, provide quality analytical data to clients and meet on-time delivery dates.
- Ensures that the facility has appropriate Information Technology resources and that they are used effectively to support operational requirements.
- Actively participates in the process of sharing and adopting best practices within TestAmerica. Provides technical assistance to other TestAmerica laboratories as needed to improve productivity and customer service.

- Ensures client specific reporting and quality control requirements are met.
- Captains the management team, consisting of the QA Manager, the Operations Manager, the Laboratory Client Services Manager, the Client Services Manager, the Service Center Manager, the Environmental, Health and Safety Manager and the Support Services Manager as direct reports.

4.2.16 Quality Assurance (QA) Manager

The QA Manager has responsibility and authority to ensure the continuous implementation of the quality system.

The QA Manager reports directly to the Laboratory Director their Corporate Quality Director. This position is able to evaluate data objectively and perform assessments without outside (e.g., managerial) influence. Corporate QA may be used as a resource in dealing with regulatory requirements, certifications and other quality assurance related items. The QA Manager directs the activities of the QA officers to accomplish specific responsibilities, which include, but are not limited to:

- Serves as the focal point for QA/QC in the laboratory.
- Having functions independent from laboratory operations for which he/she has quality assurance oversight.
- Maintaining and updating the QAM.
- Monitoring and evaluating laboratory certifications; scheduling proficiency testing samples.
- Monitoring and communicating regulatory changes that may affect the laboratory to management.
- Training and advising the laboratory staff on quality assurance/quality control procedures that are pertinent to their daily activities.
- Have documented training and/or experience in QA/QC procedures and the laboratory's Quality System.
- Having a general knowledge of the analytical test methods for which data audit/review is performed (and/or having the means of getting this information when needed).
- Arranging for or conducting internal audits on quality systems and the technical operation.
- The laboratory QA Manager will maintain records of all ethics-related training, including the type and proof of attendance.
- Maintain, improve, and evaluate the corrective action database and the corrective and preventive action systems.
- Notifying laboratory management of deficiencies in the quality system and ensuring corrective action is taken. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs shall be investigated following procedures outlined in Section 12 and if deemed necessary may be temporarily suspended during the investigation.

- Objectively monitor standards of performance in quality control and quality assurance without outside (e.g., managerial) influence.
- Coordinating of document control of SOPs, MDLs, control limits, and miscellaneous forms and information.
- Review a percentage of all final data reports for internal consistency. Review of Chain of Custody (COC), correspondence with the analytical request, batch QC status, completeness of any corrective action statements, 5% of calculations, format, holding time, sensibility and completeness of the project file contents.
- Review of external audit reports and data validation requests.
- Follow-up with audits to ensure client QAPP requirements are met.
- Establishment of reporting schedule and preparation of various quality reports for the Laboratory Director, clients and/or Corporate QA.
- Development of suggestions and recommendations to improve quality systems.
- Research of current state and federal requirements and guidelines.
- Captains the QA team to enable communication and to distribute duties and responsibilities.

- Ensuring Communication & monitoring standards of performance to ensure that systems are in place to produce the level of quality as defined in this document.
- Notifying laboratory management of deficiencies in the quality system and ensuring corrective action is taken. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs are temporarily suspended following the procedures outlined in Section 12.
- Evaluation of the thoroughness and effectiveness of training.
- Compliance with ISO 17025. (where applicable)

4.2.17 Quality Assurance (QA) Specialist

The Quality Assurance (QA) Specialist is responsible for performing data audits, special audits, assisting with external and systems audits, overseeing the maintenance of QC records, certifications, Standard Operating Procedures (SOPs), training records, DOCs, arranging and managing PT samples. Additional responsibilities may include assisting with systematic problems within the laboratory, assisting in reviewing and/or writing of Quality Assurance Project Plans, and technical and QC specifications in contracts and other functions in support of the QA Manager's responsibilities as assigned.

- Assist QA Manager in conducting QA training courses, including ethics training.
- Performs data audits.
- Assist in performing special audits as deemed necessary by data audits, client inquiries, etc.
- Assisting in, conducting and responding to external audits conducted by clients and regulatory agencies.

- Assisting in reviewing and/or writing of Quality Assurance Project Plans, and technical and QC specifications in contracts.
- Maintaining all necessary laboratory certifications.
- Arranging and managing PT samples.
- Reviewing laboratory SOPs. Writing SOPs as needed.
- Maintaining historical indices of all technical records including SOPs, QC records, laboratory data, etc.
- Ensuring maintenance of records archives.
- Assisting in and monitoring laboratory's method compliance.
- Ensuring maintenance of DOCs for all analysts.
- Ensuring maintenance of training records for all employees.
- Assisting in identification of systematic problems within laboratories.
- Recommends resolutions for ongoing or recurring nonconformance.
- Providing statistical feedback to Departments on error rates, and assisting in identifying systematic improvements to minimize errors.
- Assists in tracking of customer complaints, providing statistical feedback to the laboratory, and assisting in identifying improvements.
- Overseeing and reviewing MDL studies.
- Ensuring control charts are generated; oversees and approves setting of control limits.
- Assists in monitoring new regulations and communicating them to the laboratory.

4.2.18 Operations/Technical Manager(s)

The Organics and Inorganics Operations/Technical Managers report directly to the Laboratory Director (throughout this text the term 'Technical Manager' refers to these individuals).. He/she is accountable for all analyses and analysts under their experienced supervision The scope of responsibility ranges from the new-hire process and existing technology through the ongoing training and development programs for existing analysts and new instrumentation. Specific responsibilities include, but are not limited to:

- Exercises day-to-day supervision of laboratory operations for the appropriate field of accreditation and reporting of results. Coordinating, writing, and reviewing preparation of all test methods, i. e., SOPs, with regard to quality, integrity, regulatory and optimum and efficient production techniques, and subsequent analyst training and interpretation of the SOPs for implementation and unusual project samples. He/she insures that the SOPs are properly managed and adhered to at the bench. He/she develops standard costing of SOPs to include supplies, labor, overhead, and capacity (design vs. demonstrated versus first-run yield) utilization.
- Reviewing and approving, with input from the QA Manager, proposals from marketing, in accordance with an established procedure for the review of requests and contracts. This

procedure addresses the adequate definition of methods to be used for analysis and any limitations, the laboratory's capability and resources, the client's expectations. Differences are resolved before the contract is signed and work begins. A system documenting any significant changes is maintained, as well as pertinent discussions with the client regarding their requirements or the results of the analyses during the performance of the contract. All work subcontracted by the laboratory must be approved by the client. Any deviations from the contract must be disclosed to the client. Once the work has begun, any amendments to the contract must be discussed with the client and so documented.

- Monitoring the validity of the analyses performed and data generated in the laboratory. This activity begins with reviewing and supporting all new business contracts, insuring data quality, analyzing internal and external non-conformances to identify root cause issues and implementing the resulting corrective and preventive actions, facilitating the data review process (training, development, and accountability at the bench), and providing technical and troubleshooting expertise on routine and unusual or complex problems.
- Providing training and development programs to applicable laboratory staff as new hires and, subsequently, on a scheduled basis. Training includes instruction on calculations, instrumentation management to include troubleshooting and preventive maintenance.
- Enhancing efficiency and improving quality through technical advances and improved LIMS utilization. Capital forecasting and instrument life cycle planning for second generation methods and instruments as well as asset inventory management.
- Coordinating sample management from "cradle to grave," insuring that no time is lost in locating samples.
- Scheduling all QA/QC-related requirements for compliance, e.g., MDLs, etc..
- Captains department personnel to communicate quality, technical, personnel, and instrumental issues for a consistent team approach.
- Coordinates audit responses with the QA Manager.

4.2.19 Department Manager(s)

The Department Managers manage and direct the analytical production sections of the laboratory and act as Technical Manager of their department. He/She reports directly to either the Organics or Inorganics Operations/Technical Manager (as applicable). He/She assists the Operations/Technical Manager in determining the most efficient instrument utilization. More specifically, he/she:

- Evaluates the level of internal/external non-conformances for all departments.
- Continuously evaluates production capacity and improves capacity utilization.
- Continuously evaluates turnaround time and addresses any problems that may hinder meeting the required and committed turnaround time from the various departments.
- Develops and improves the training of all analysts in cooperation with the Operations/Technical Manager and QA Manager and in compliance with regulatory requirements.
- Ensures that scheduled instrument maintenance is completed.
- Is responsible for efficient utilization of supplies.

- Constantly monitors and modifies the processing of samples through the departments.
- Fully supports the quality system and, if called upon in the absence of the QA Manager, serves as his substitute in the interim.

4.2.20 Environmental, Health and Safety Manager

The Environmental, Health and Safety Manager reports directly to the VP of Quality, Environmental, Heath and Safety. The duties of this position consist of:

- Supervises the Environmental, Health and Safety/Facilities Team.
- Conduct ongoing, necessary safety training and conduct new employee safety orientation.
- Assist in developing and maintaining the Chemical Hygiene/Safety Manual.
- Administer dispersal of all Material Safety Data Sheet (MSDS) information.
- Perform regular chemical hygiene and housekeeping instruction.
- Give instruction on proper labeling and practice.
- Serve as chairman of the laboratory safety committee.
- Provide and train personnel on protective equipment.
- Oversee the inspection and maintenance of general safety equipment – fire extinguishers, safety showers, eyewash fountains, etc. and ensure prompt repairs as needed.
- Supervise and schedule fire drills and emergency evacuation drills.
- Determine what initial and subsequent exposure monitoring, if necessary to determine potential employee exposure to chemicals used in the laboratory.
- When determined necessary, conduct exposure monitoring assessments.
- Determine when a complaint of possible over-exposure is “reasonable” and should be referred for medical consultation.
- Assist in the internal and external coordination of the medical consultation/monitoring program conducted by TestAmerica’s medical consultants.
- Staying current with the hazardous waste regulations.
- Continuing training on hazardous waste issues.
- Reviewing and updating annually the Hazardous Waste Contingency Plan in the Environmental Health & Safety Manual.
- Auditing the staff with regard to compliance with the Hazardous Waste Contingency Plan.
- Contacting the hazardous waste subcontractors for review of procedures and opportunities for minimization of waste.

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4.2.21 EH&S/Facilities Coordinator

The EH&S/Facilities Coordinator reports directly to the Laboratory Director with a dotted line to the Environmental, Health and Safety Manager. The duties of this position consist of:

- Monitors laboratory for unsafe conditions or acts to keep lab in compliance with the Chemical Hygiene Plan, EH&S Procedures, and company policies.
- Ensures the proper personal protective equipment is available and personnel are properly trained in its use.
- Assists the Environmental, Health and Safety Manager in the investigation of accidents, incidents, and near misses and identifies and eliminates root cause.
- Conducts monthly facility inspections for compliance with health, safety and environmental regulations and procedures. Completes and forwards monthly inspection report to safety committee and laboratory management for corrective actions.
- Conducts safety equipment checks to ensure proper working order and sufficient inventory.
- Plans and tracks completion of monthly general awareness training sessions and compliance training, including new employee EH&S orientation.
- Coordinates emergency response team to provide prompt medical attention and stabilize emergency situation. After emergency is over, assists in determining appropriate clean up procedures.
- Conducts the monthly EH&S committee meeting.
- Participates in monthly EH&S conference call.
- Reviews and maintains MSDS's for laboratory materials.
- Coordinates the management and disposal of laboratory wastes.
- Assists in the preparation and maintenance of the laboratory Integrated Contingency Plan.
- Monitors air quality in facility, including monitoring fume hoods for proper operation and ventilation.
- Maintains overall building facilities and equipment as well as administers prevention maintenance measures.
- Contacts outside contractors as necessary to repair/maintain items outside the realm of reasonable maintenance.
- Performs miscellaneous errands, buying parts for labs, janitorial supplies.
- Oversees storage facilities, files and outside storage.

4.2.22 Laboratory Analysts and Technicians

Laboratory analysts and technicians are responsible for conducting analysis and performing all tasks assigned to them by the group leader or supervisor. The responsibilities of the analysts are listed below:

- Perform analyses by adhering to analytical and quality control protocols prescribed by current SOPs, this QA Manual, and project-specific plans honestly, accurately, timely, safely, and in the most cost-effective manner.
- Document standard and sample preparation, instrument calibration and maintenance, data calculations, sample matrix effects, and any observed non-conformance on worklists, benchsheets, lab notebooks and/or the Non-Conformance Database.
- Report all non-conformance situations, instrument problems, matrix problems and QC failures, which might affect the reliability of the data, to their supervisor, the Technical Manager, and/or the QA Manager or member of QA staff.
- Perform 100% review of the data generated prior to entering and submitting for secondary level review.
- Suggest method improvements to their supervisor, the Technical Manager, and the QA Manager. These improvements, if approved, will be incorporated. Ideas for the optimum performance of their assigned area, for example, through the proper cleaning and maintenance of the assigned instruments and equipment, are encouraged.
- Work cohesively as a team in their department to achieve the goals of accurate results, optimum turnaround time, cost effectiveness, cleanliness, complete documentation, and personal knowledge of environmental analysis.
- Adhere to all environmental, health and safety protocols and attend safety meetings as required.
- Attend and participate in all staff meetings.

4.2.23 Sample Control Manager

The Sample Control Manager reports to the Inorganics Operation Manager. The responsibilities are outlined below:

- Direct the logging of incoming samples into the LIMS.
- Ensure the verification of data entry from login.
- Manages the preparation and shipment of bottle kits to clients.
- Oversees the responsibilities of all Sample Control Technicians.
- Supervises the storage and disposal of all samples.

4.2.24 Senior Client Services Director

The Senior Client Services Director reports to the Vice President of Operations and Client Services with a dotted line to the laboratory director and serves as the primary interface between the laboratory and the Sales and Marketing staff. Responsibilities include:

- Laboratory's primary client representative.
- Ensures client complaints are handled professionally, and resolved in a timely manner.
- Compiles and interprets receipts forecast to show near term business trends.

- Manages a minimal list of projects/programs for key client accounts. (Note: sufficient time is needed to manage the PM group and the CSM must not be overwhelmed with project management.)
- Prepares proposals for new business opportunities.
- Compiles and interprets Bid Activity Report.
- Compiles and interprets receipts forecast to show near term business trends.
- Prepares proposals for new business opportunities.
- Provides general sales support to Account Executives for business development activities started in the field.
- Develops and maintains business materials and organized information resource files that include project descriptions, resumes, original proposals, boilerplates, and company qualifications materials.

4.2.25 Manager of Project Managers

The Manager of Project Managers reports to the Senior Client Services Director and serves as the interface between the laboratory's technical Departments and the laboratory's clients. The staff consists of the Project Management team. With the overall goal of total client satisfaction, the functions of this position are outlined below:

- Technical training and growth of the Project Management team.
- Technical liaison for the Project Management team.
- Human resource management of the Project Management team.
- Responsible for ensuring that clients receive the proper sampling supplies, as appropriate.
- Accountable for response to client inquiries concerning sample status.
- Responsible for assistance to clients regarding the resolution of problems concerning COC.
- Ensuring that client specifications, when known, are met by communicating project and quality assurance requirements to the laboratory.
- Notifying the supervisors of incoming projects and sample delivery schedules.
- Accountable to clients for communicating sample progress in daily status meeting with agreed-upon due dates.
- Responsible for discussing with client any project-related problems, resolving service issues, and coordinating technical details with the laboratory staff.
- Responsible for staff familiarization with specific quotes, sample log-in review, and final report completeness.
- Monitor the status of all data package projects in-house to ensure timely and accurate delivery of reports.
- Inform clients of data package-related problems and resolve service issues.
- Coordinate requests for sample containers and other services (data packages).

4.2.26 Project Manager (PM)

The Project Managers report directly to the Director of Project Management and serve as liaisons between the laboratory and its clients. The Project Manager's responsibilities include:

- Ensure client specifications are met by communicating project and quality assurance requirements to the laboratory.
- Notify laboratory personnel of incoming projects and sample delivery schedules.
- Monitor the status of all projects in-house to ensure timely delivery of reports.
- Inform clients of project-related problems, resolving service issues and coordinating technical issues with the laboratory staff.
- Accountable for response to client inquiries concerning sample status.
- Responsible for assistance to clients regarding the resolution of problems concerning COC.
- Ensuring that client specifications, when known, are met by communicating project and quality assurance requirements to the laboratory.
- Notifying the supervisors of incoming projects and sample delivery schedules.
- Coordinate client requests for sample containers and other services.
- Schedule sample pick-ups from client offices or project sites and notifying the laboratory staff of incoming samples.
- Coordinate subcontract work.
- Respond to client inquiries concerning sample status.
- Generates final laboratory reports and has signature authority for those reports (as designated and approved by the Laboratory Director).
- Performs final completeness review of data packages prior to release to client.

4.2.27 Project Management Assistant

The Project Management Assistant coordinates and monitors scheduling, timely completion and maintenance of project documentation files and completion of project set up and final report review, invoicing, and EDD's. Assists the Project Manager in servicing the client's needs. Specific responsibilities include:

- Reviews login confirmation reports for accuracy and corrects as needed.
- Generates diskettes for electronic data deliverables (EDD's) for electronic delivery to clients.
- Enters data that was subcontracted to other laboratories.
- Monitors report due dates for timely delivery.
- Assists Project Manager in changing compound lists, TAT, deliverables and other client specific requirements in the LIMs project and/or job database.

- Invoices completed data packages and generates credit or debit invoices to ensure proper payment.

4.2.28 Service Center Manager

The Service Center Manager (SCM) manages the service center and acts as a liaison between the laboratory and the local client base. The SCM is in charge of maintaining the Service Center facility, managing service center couriers, samplers and other personnel, and working with sales to develop, maintain and grow the client base in the area.

- Local area primary client representative for service center location.
- May head project start up meetings to ensure project objectives are successfully met and hands off project detail to assigned Project Manager(s).
- Works with the Quality Assurance Manager and Account Executives (AE) to evaluate and establish project requirements for the service center area.
- Ensures client complaints are handled professionally, and resolved in a timely manner.
- Is in charge of scheduling service center couriers and samplers, preparing bottle orders for delivery, scheduling sample pick ups and shipping samples to the designated laboratory for analysis.
- May manage a minimal list of projects/programs for key client accounts.
- Maintains the facilities at the service center and is responsible for all EH&S policies of TestAmerica at the service center.
- Responsible for all company vehicles that operate out of the service center.
- Provides general sales support to AEs for business development activities started in the field.

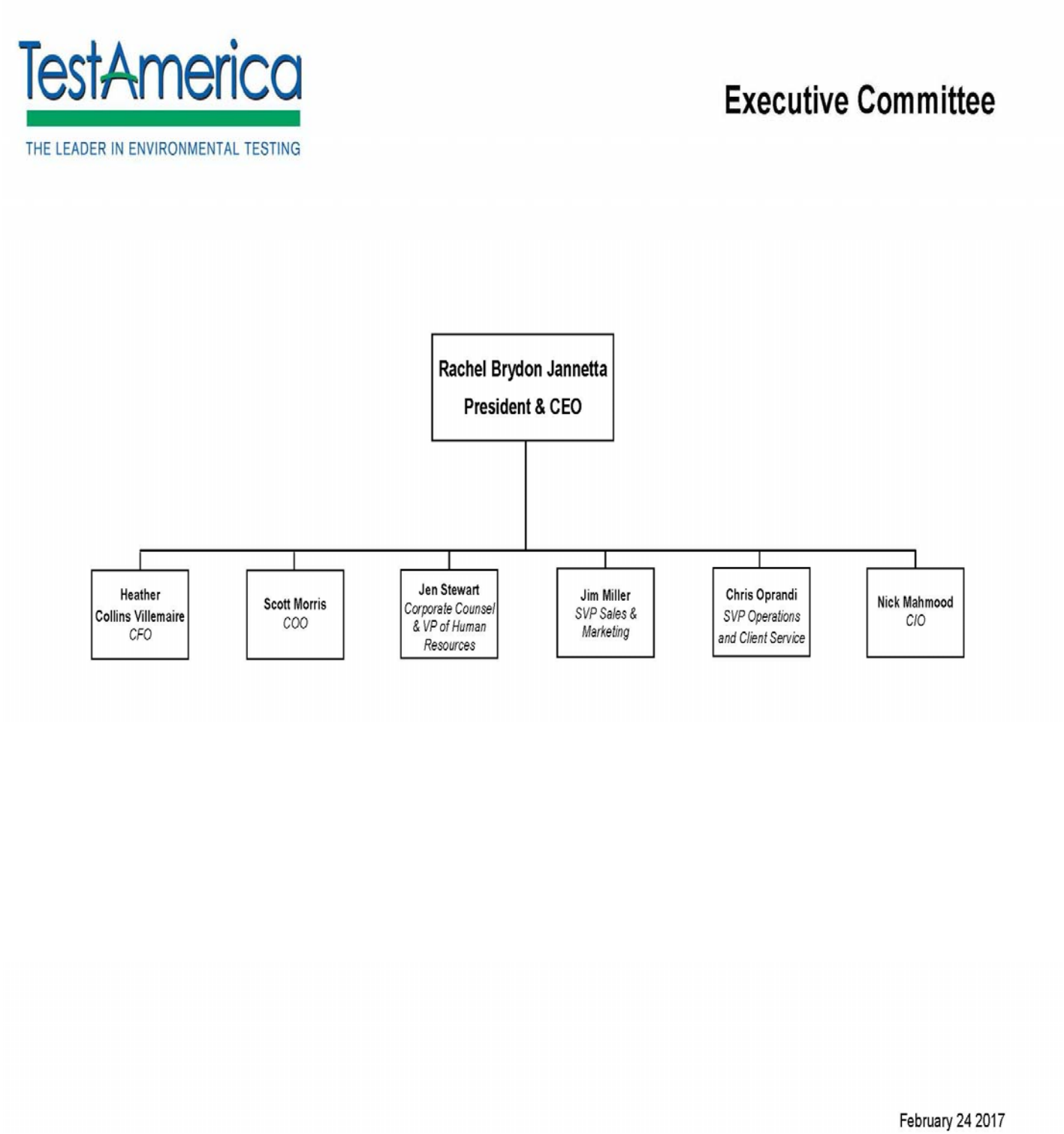
4.3 Deputies

The following table defines who assumes the responsibilities of key personnel in their absence:

Key Personnel	Deputy
Mark Acierno Laboratory Director	In the event of absence the Laboratory Director's responsibilities are shared by the Laboratory Operations Manager, the Quality Assurance Manager and the Client Services Manager, as appropriate
Carl Armbruster Quality Assurance Manager	Emmylou Digiacomo Quality Assurance Specialist Mark Acierno Laboratory Director
Sylvanus Klusey Organic Technical Manager	Donald Evans Inorganic Technical Manager

Key Personnel	Deputy
Donald Evans Inorganic Technical Manager	Sylvanus Klusey Organic Technical Manager
VOA, SVOA & Organic Prep Technical Managers	Sylvanus Klusey Organic Technical Manager
Wet Chemistry, Metals and Sample Control Managers	Donald Evans Inorganic Technical Manager
Dan Helfrich EH&S Manager	Edward Roche EH&S Coordinator
Mark Nemec Client Services Manager	Kristyn Tempe Project Manager
Kate Harrelson South Jersey/King of Prussia Service Center Manager	Alonzo Hall, Sample Control Tech. South Jersey Service Center Jeffery Keehn, Sample Control Tech. King of Prussia Service Center
John Kates Fields Services Manager	Stephen Schulze Thomas Lesinski Field Specialists – Edison Rick Toogood Dustin Miller Field Specialists – South Jersey

Figure 4-1. Corporate and Laboratory Organization Charts



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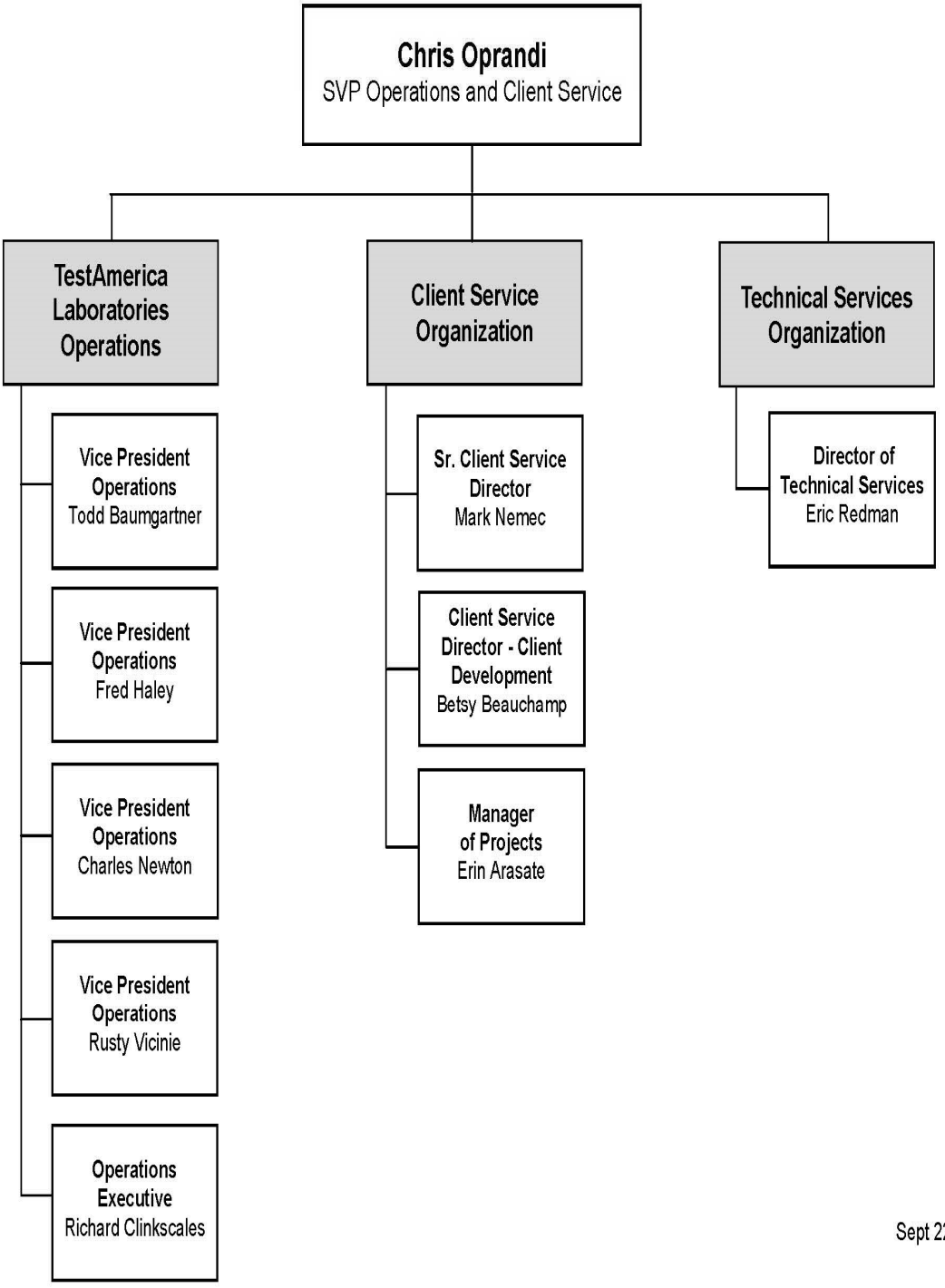

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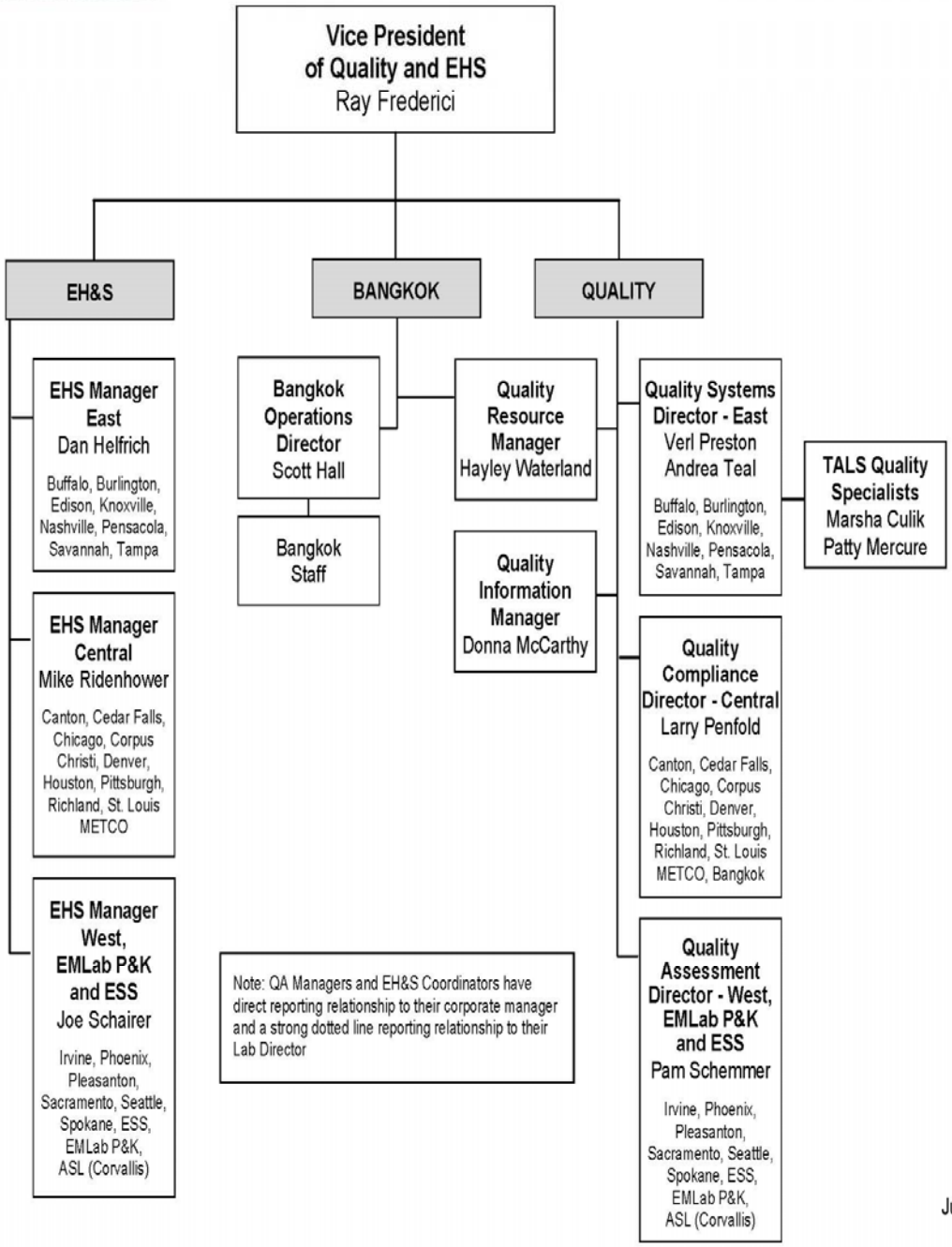

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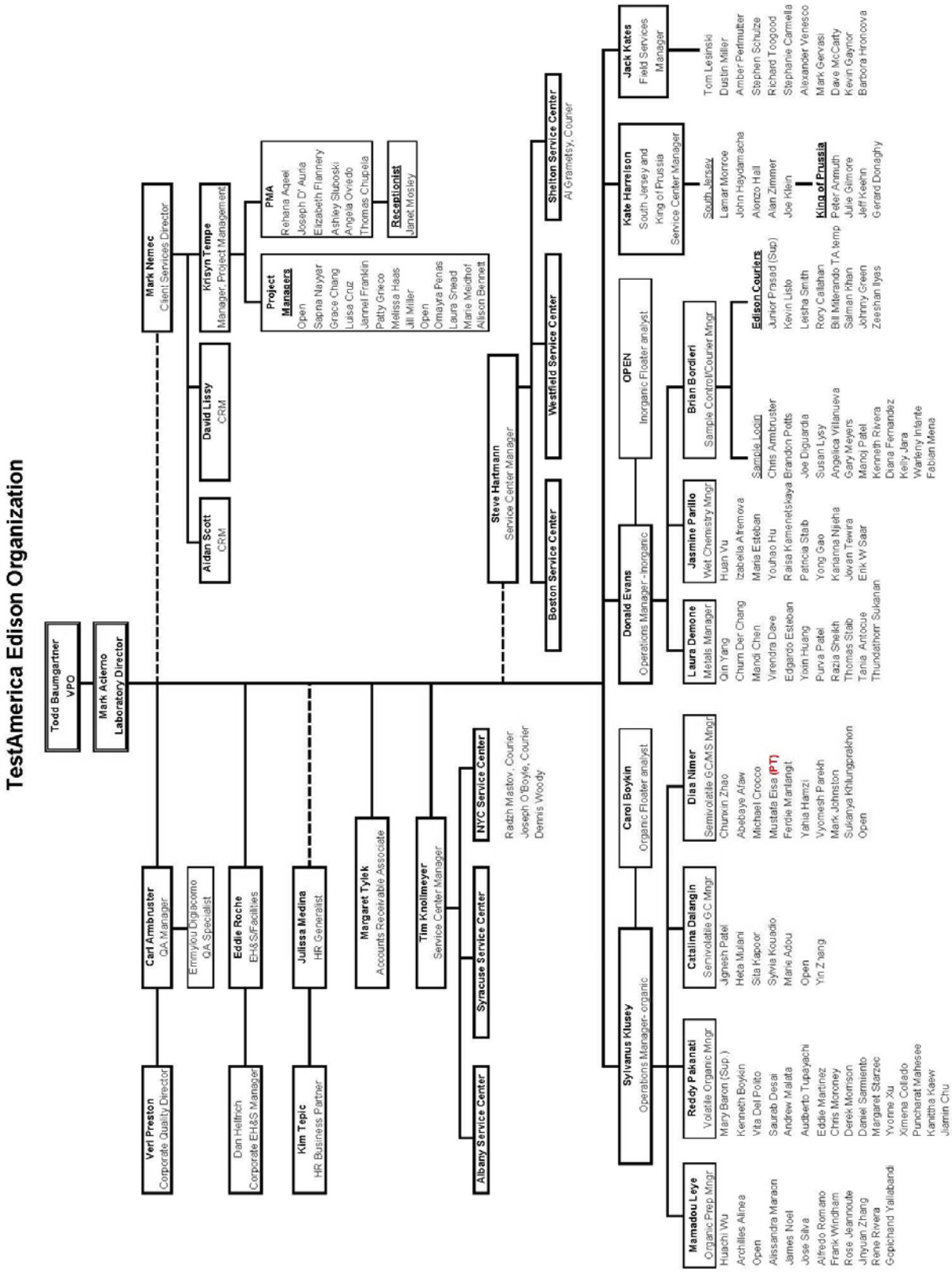

Rev. 04 Dec 2017

SECTION 5. QUALITY SYSTEM

5.1 Quality Policy Statement

It is TestAmerica's Policy to:

- ❖ Provide data of known quality to its clients by adhering to approved methodologies, regulatory requirements and the QA/QC protocols.
- ❖ Effectively manage all aspects of the laboratory and business operations by the highest ethical standards.
- ❖ Continually improve systems and provide support to quality improvement efforts in laboratory, administrative and managerial activities. TestAmerica recognizes that the implementation of a quality assurance program requires management's commitment and support as well as the involvement of the entire staff.
- ❖ Provide clients with the highest level of professionalism and the best service practices in the industry.
- ❖ To comply with the ISO/IEC 17025:2005(E) International Standard, the 2009 TNI Standard and to continually improve the effectiveness of the management system.

Every staff member at the laboratory plays an integral part in quality assurance and is held responsible and accountable for the quality of their work. It is, therefore, required that all laboratory personnel are trained and agree to comply with applicable procedures and requirements established by this document.

5.2 Ethics and Data Integrity

TestAmerica is committed to ensuring the integrity of its data and meeting the quality needs of its clients. The elements of TestAmerica's Ethics and Data Integrity Program include:

- An Ethics Policy (Corporate Policy No. CW-L-P-004) and Employee Ethics Statements.
- Ethics and Compliance Officers (ECOs).
- A Training Program.
- Self-governance through disciplinary action for violations.
- A Confidential mechanism for anonymously reporting alleged misconduct and a means for conducting internal investigations of all alleged misconduct. (Corporate SOP No. CW-L-S-002).
- Procedures and guidance for recalling data if necessary (Corporate SOP No. CA-Q-S-005).
- Effective external and internal monitoring system that includes procedures for internal audits (Section 15).
- Produce results, which are accurate and include QA/QC information that meets client pre-defined Data Quality Objectives (DQOs).
- Present services in a confidential, honest and forthright manner.

- Provide employees with guidelines and an understanding of the Ethical and Quality Standards of our Industry.
- Operate our facilities in a manner that protects the environment and the health and safety of employees and the public.
- Obey all pertinent federal, state and local laws and regulations and encourage other members of our industry to do the same.
- Educate clients as to the extent and kinds of services available.
- Assert competency only for work for which adequate personnel and equipment are available and for which adequate preparation has been made.
- Promote the status of environmental laboratories, their employees, and the value of services rendered by them.

5.3 Quality System Documentation

The laboratory's Quality System is communicated through a variety of documents.

- Quality Assurance Manual – Each laboratory has a lab-specific quality assurance manual.
- Corporate SOPs and Policies – Corporate SOPs and Policies are developed for use by all relevant laboratories. They are incorporated into the laboratory's normal SOP distribution, training and tracking system. Corporate SOPs may be general or technical.
- Work Instructions – A subset of procedural steps, tasks or forms associated with an operation of a management system (e.g., checklists, preformatted bench sheets, forms).
- Laboratory SOPs – General and Technical
- Laboratory QA/QC Policy Memorandums

5.3.1 Order of Precedence

In the event of a conflict or discrepancy between policies, the order of precedence is as follows:

- Corporate Quality Management Plan (CQMP)
- Corporate SOPs and Policies
- Laboratory QA/QC Policy Memorandum
- Laboratory Quality Assurance Manual (QAM)
- Laboratory SOPs and Policies
- Other (Work Instructions (WI), memos, flow charts, etc.)

NOTE: The laboratory has the responsibility and authority to operate in compliance with regulatory requirements of the jurisdiction in which the work is performed. Where the CQMP conflicts with those regulatory requirements, the regulatory requirements of the jurisdiction shall hold primacy. The laboratory's QAM shall take precedence over the CQMP in those cases.

5.4 QA/QC Objectives for the Measurement of Data

Quality Assurance (QA) and Quality Control (QC) are activities undertaken to achieve the goal of producing data that accurately characterize the sites or materials that have been sampled. Quality Assurance is generally understood to be more comprehensive than Quality Control. Quality Assurance can be defined as the integrated system of activities that ensures that a product or service meets defined standards.

Quality Control is generally understood to be limited to the analyses of samples and to be synonymous with the term *"analytical quality control"*. QC refers to the routine application of statistically based procedures to evaluate and control the accuracy of results from analytical measurements. The QC program includes procedures for estimating and controlling precision and bias and for determining reporting limits.

Request for Proposals (RFPs) and Quality Assurance Project Plans (QAPP) provide a mechanism for the client and the laboratory to discuss the data quality objectives in order to ensure that analytical services closely correspond to client needs. The client is responsible for developing the QAPP. In order to ensure the ability of the laboratory to meet the Data Quality Objectives (DQOs) specified in the QAPP, clients are advised to allow time for the laboratory to review the QAPP before being finalized. Additionally, the laboratory will provide support to the client for developing the sections of the QAPP that concern laboratory activities.

Historically, laboratories have described their QC objectives in terms of precision, accuracy, representativeness, comparability, completeness, selectivity and sensitivity (PARCCSS).

5.4.1 Precision

The laboratory objective for precision is to meet the performance for precision demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Precision is defined as the degree of reproducibility of measurements under a given set of analytical conditions (exclusive of field sampling variability). Precision is documented on the basis of replicate analysis, usually duplicate or matrix spike (MS) duplicate samples.

5.4.2 Accuracy

The laboratory objective for accuracy is to meet the performance for accuracy demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Accuracy is defined as the degree of bias in a measurement system. Accuracy may be documented through the use of laboratory control samples (LCS) and/or MS. A statement of accuracy is expressed as an interval of acceptance recovery about the mean recovery.

5.4.3 Representativeness

The laboratory objective for representativeness is to provide data which is representative of the sampled medium. Representativeness is defined as the degree to which data represent a characteristic of a population or set of samples and is a measurement of both analytical and field sampling precision. The representativeness of the analytical data is a function of the procedures used in procuring and processing the samples. The representativeness can be documented by the relative percent difference between separately procured, but otherwise identical samples or sample aliquots.

The representativeness of the data from the sampling sites depends on both the sampling procedures and the analytical procedures. The laboratory may provide guidance to the client regarding proper sampling and handling methods in order to assure the integrity of the samples.

5.4.4 Comparability

The comparability objective is to provide analytical data for which the accuracy, precision, representativeness and reporting limit statistics are similar to these quality indicators generated by other laboratories for similar samples, and data generated by the laboratory over time.

The comparability objective is documented by inter-laboratory studies carried out by regulatory agencies or carried out for specific projects or contracts, by comparison of periodically generated statements of accuracy, precision and reporting limits with those of other laboratories.

5.4.5 Completeness

The completeness objective for data is 90% (or as specified by a particular project), expressed as the ratio of the valid data to the total data over the course of the project. Data will be considered valid if they are adequate for their intended use. Data usability will be defined in a QAPP, project scope or regulatory requirement. Data validation is the process for reviewing data to determine its usability and completeness. If the completeness objective is not met, actions will be taken internally and with the data user to improve performance. This may take the form of an audit to evaluate the methodology and procedures as possible sources for the difficulty or may result in a recommendation to use a different method.

5.4.6 Selectivity

Selectivity is defined as: The capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. Target analytes are separated from non-target constituents and subsequently identified/detected through one or more of the following, depending on the analytical method: extractions (separation), digestions (separation), interelement corrections (separation), use of matrix modifiers (separation), specific retention times (separation and identification), confirmations with different columns or detectors (separation and identification), specific wavelengths (identification), specific mass spectra (identification), specific electrodes (separation and identification), etc..

5.4.7 Sensitivity

Sensitivity refers to the amount of analyte necessary to produce a detector response that can be reliably detected (Method Detection Limit) or quantified (Reporting Limit).

5.5 Criteria for Quality Indicators

The laboratory maintains Quality Control Limits within the Method Limit Group tables in TALS (the laboratory's LIMS) that summarize the precision and accuracy acceptability limits for performed analyses. This summary includes an effective date, is updated each time new limits are generated and are managed by the laboratory's QA department. Unless otherwise noted, limits within these tables are laboratory generated. Some acceptability limits are derived from US EPA methods when they are required. Where US EPA method limits are not required, the laboratory has developed limits from evaluation of data from similar matrices. Criteria for development of control limits is contained in Section 24.

5.6 Statistical Quality Control

Statistically-derived precision and accuracy limits are required by selected methods (such as SW-846) and programs [such as the Ohio Voluntary Action Plan (VAP)]. The laboratory routinely utilizes statistically-derived limits to evaluate method performance and determine when corrective action is appropriate. The analysts are instructed to use the current limits in the laboratory (dated and approved by the Technical Manager and QA Manager) and entered into the Laboratory Information Management System (LIMS). The Quality Assurance Department maintains an archive of all limits used within the Method Limit Group tables in TALS (LIMS). If a method defines the QC limits, the method limits are used.

If a method requires the generation of historical limits, the lab develops such limits from recent data in the QC database of the LIMS following the guidelines described in Section 24. All calculations and limits are documented and dated when approved and effective. On occasion, a client requests contract-specified limits for a specific project.

Current QC limits are entered and maintained in the LIMS analyte database. As sample results and the related QC are entered into LIMS, the sample QC values are compared with the limits in LIMS to determine if they are within the acceptable range. The analyst then evaluates if the sample needs to be rerun or re-extracted/rerun or if a comment should be added to the report explaining the reason for the QC outlier.

5.6.1 QC Charts

The QA Manager generates QC charts using the TALS Control Chart program as detailed in SOP No. ED-GEN-026 (Evaluation of Analytical Accuracy and Precision Through The Use of Control Charts). In addition to their use in generating lab specific spike recovery limits and in the evaluation of MDL studies, these charts are used to determine if adjustments need to be made or for corrective actions to methods. All such findings are documented and kept on file in the QA Department.

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5.7 Quality System Metrics

In addition to the QC parameters discussed above, the entire Quality System is evaluated on a monthly basis through the use of specific metrics (refer to Section 16). These metrics are used to drive continuous improvement in the laboratory's Quality System.

SECTION 6. DOCUMENT CONTROL

6.1 Overview

The QA Department is responsible for the control of documents used in the laboratory to ensure that approved, up-to-date documents are in circulation and out-of-date (obsolete) documents are archived or destroyed. The following documents, at a minimum, must be controlled:

- Laboratory Quality Assurance Manual
- Laboratory Standard Operating Procedures (SOP)
- Laboratory Policies
- Work Instructions and Forms
- Corporate Policies and Procedures distributed outside the intranet

Corporate Quality posts Corporate Manuals, SOPs, Policies, Work Instructions, White Papers and Training Materials on the company intranet site. These Corporate documents are only considered controlled when they are read on the intranet site. Printed copies are considered uncontrolled unless the laboratory physically distributes them as controlled documents. A detailed description of the procedure for issuing, authorizing, controlling, distributing, and archiving Corporate documents is found in Corporate SOP No. CW-Q-S-001, Corporate Document Control and Archiving. The laboratory's internal document control procedure is defined in SOP No. ED-GEN-002 (Document Control).

The laboratory QA Department also maintains access to various references and document sources integral to the operation of the laboratory. This includes reference methods and regulations. Instrument manuals (hard or electronic copies) are also maintained by the laboratory.

The laboratory maintains control of records for raw analytical data and supporting records such as audit reports and responses, logbooks, standard logs, training files, MDL studies, Proficiency Testing (PT) studies, certifications and related correspondence, and corrective action reports (CARs). Raw analytical data consists of bound logbooks, instrument printouts, any other notes, magnetic media, electronic data and final reports.

6.2 Document Approval and Issue

The pertinent elements of a document control system for each document include a unique document title and number, pagination, the total number of pages of the item or an 'end of document' page, the effective date, revision number and the laboratory's name. The QA personnel are responsible for the maintenance of this system.

Controlled documents are authorized by the QA Department. In order to develop a new document, a Department (Technical) Manager submits an electronic draft to the QA Department

for suggestions and approval before use. Upon approval, QA personnel add the identifying version information to the document and retains that document as the official document on file. That document is then provided to all applicable operational units (may include electronic access). Controlled documents are identified as such and records of their distribution are kept by the QA Department. Document control may be achieved by either electronic or hardcopy distribution.

The QA Department maintains a list of the official versions of controlled documents.

Quality System Policies and Procedures will be reviewed at a minimum of every two years and revised as appropriate. Changes to documents occur when a procedural change warrants.

6.3 Procedures for Document Control Policy

For changes to the QA Manual, refer to SOP No. ED-GEN-002 (Document Control) Uncontrolled copies must not be used within the laboratory. Previous revisions and back-up data are stored by the QA Department. Electronic copies are stored on the Public server in the QA folder for the applicable revision.

For changes to SOPs, refer to SOP No. CW-Q-S-002, Writing a Standard Operating Procedure SOP or list your labs SOP on this topic. The SOP identified above also defines the process of changes to SOPs.

Forms, worksheets, work instructions and information are organized by department in the QA office. There is a table of contents. Electronic versions are kept on a hard drive in the QA Department; hard copies are kept in QA files. The procedure for the care of these documents is in SOP ED-GEN-002 (Document Control).

6.4 Obsolete Documents

All invalid or obsolete documents are removed, or otherwise prevented from unintended use. The laboratory has specific procedures as described above to accomplish this. In general, obsolete documents are collected from employees according to distribution lists and are marked obsolete on the cover or destroyed. At least one copy of the obsolete document is archived according to SOP No. ED-GEN-002 (Document Control).

SECTION 7. SERVICE TO THE CLIENT

7.1 Overview

The laboratory has established procedures for the review of work requests and contracts, oral or written. The procedures include evaluation of the laboratory's capability and resources to meet the contract's requirements within the requested time period. All requirements, including the methods to be used, must be adequately defined, documented and understood. For many environmental sampling and analysis programs, testing design is site or program specific and does not necessarily "fit" into a standard laboratory service or product. It is the laboratory's intent to provide both standard and customized environmental laboratory services to our clients.

A thorough review of technical and QC requirements contained in contracts is performed to ensure project success. The appropriateness of requested methods, and the lab's capability to perform them must be established. Projects, proposals and contracts are reviewed for adequately defined requirements and the laboratory's capability to meet those requirements. Alternate test methods that are capable of meeting the clients' requirements may be proposed by the lab. A review of the lab's capability to analyze non-routine analytes is also part of this review process.

All projects, proposals and contracts are reviewed for the client's requirements in terms of compound lists, test methodology requested, sensitivity (detection and reporting levels), accuracy, and precision requirements (% Recovery and RPD). The reviewer ensures that the laboratory's test methods are suitable to achieve these requirements and that the laboratory holds the appropriate certifications and approvals to perform the work. The laboratory and any potential subcontract laboratories must be certified, as required, for all proposed tests.

The laboratory must determine if it has the necessary physical, personnel and information resources to meet the contract, and if the personnel have the expertise needed to perform the testing requested. Each proposal is checked for its impact on the capacity of the laboratory's equipment and personnel. As part of the review, the proposed turnaround time will be checked for feasibility.

Electronic or hard copy deliverable requirements are evaluated against the laboratory's capacity for production of the documentation.

If the laboratory cannot provide all services but intends to subcontract such services, whether to another TestAmerica facility or to an outside firm, this will be documented and discussed with the client prior to contract approval. (Refer to Section 8 for Subcontracting Procedures.)

The laboratory informs the client of the results of the review if it indicates any potential conflict, deficiency, lack of accreditation, or inability of the lab to complete the work satisfactorily. Any discrepancy between the client's requirements and the laboratory's capability to meet those requirements is resolved in writing before acceptance of the contract. It is necessary that the contract be acceptable to both the laboratory and the client. Amendments initiated by the client and/or TestAmerica, are documented in writing.

All contracts, QAPPs, Sampling and Analysis Plans (SAPs), contract amendments, and documented communications become part of the project record.

The same contract review process used for the initial review is repeated when there are amendments to the original contract by the client, and the participating personnel are informed of the changes.

7.2 Review Sequence and Key Personnel

Appropriate personnel will review the work request at each stage of evaluation.

For routine projects and other simple tasks, a review by the Project Manager (PM) is considered adequate. The PM confirms that the laboratory has any required certifications, that it can meet the clients' data quality and reporting requirements and that the lab has the capacity to meet the

clients turn around needs. It is recommended that, where there is a sales person assigned to the account, an attempt should be made to contact that sales person to inform them of the incoming samples.

For new, complex or large projects, the proposed contract is given to the Client Relations Manager (CRM) or CRM Proposal Team, who will decide which lab will receive the work based on the scope of work and other requirements, including certification, testing methodology, and available capacity to perform the work. The contract review process is outlined in TestAmerica's Corporate SOP No. CA-L-P-002**,** Contract Compliance Policy.
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This review encompasses all facets of the operation. The scope of work is distributed to the appropriate personnel, as needed based on scope of contract, to evaluate all of the requirements shown above (not necessarily in the order below).

- Contract Administrator
- VP of Operations
- The Laboratory Client Services Manager
- The Laboratory Project Manager
- Laboratory and/or Corporate Technical Managers / Directors
- Laboratory and/or Corporate Information Technology Managers/Directors
- Account Executives
- Laboratory and/or Corporate Quality
- Laboratory and/or Corporate Environmental Health and Safety Managers/Directors
- The Laboratory Director reviews the formal laboratory quote and makes final acceptance for their facility.

The Sales Director, Contract Administrator, Account Executive or Proposal Coordinator then submits the final proposal to the client.

In the event that one of the above personnel is not available to review the contract, his or her back-up will fulfill the review requirements.

The Contracts Administrator maintains copies of all signed contracts**.** The applicable Project Manager maintains local copies of signed contracts.

7.3 Documentation

Appropriate records are maintained for every contract or work request. All stages of the contract review process are documented and include records of any significant changes. These records are maintained in the project file by the Project Manager and/or Key Account Executive. The contract will be distributed to and maintained by the appropriate sales/marketing personnel and the Account Executive. A copy of the contract and formal quote will be filed with the laboratory PM and the Laboratory Director.

Records are maintained of pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract. The PM keeps a phone log of conversations with the client.

7.3.1 Project-Specific Quality Planning

Communication of contract specific technical and QC criteria is an essential activity in ensuring the success of site specific testing programs. To achieve this goal, a PM is assigned to each client. It is the PM's responsibility to ensure that project-specific technical and QC requirements are effectively evaluated and communicated to the laboratory personnel before and during the project. QA department involvement may be needed to assist in the evaluation of custom QC requirements.

PM's are the primary client contact and they ensure resources are available to meet project requirements. Although PM's do not have direct reports or staff in production, they coordinate opportunities and work with laboratory management and supervisory staff to ensure available resources are sufficient to perform work for the client's project. Project management is positioned between the client and laboratory resources.

Prior to work on a new project, the dissemination of project information and/or project opening meetings may occur to discuss schedules and unique aspects of the project. Items to be discussed may include the project technical profile, turnaround times, holding times, methods, analyte lists, reporting limits, deliverables, sample hazards, or other special requirements. The PM introduces new projects to the laboratory staff through project kick-off meetings or to the supervisory staff during production meetings. These meetings provide direction to the laboratory staff in order to maximize production and client satisfaction, while maintaining quality. In addition, project notes may be associated with each sample batch as a reminder upon sample receipt and analytical processing.

During the project, any change that may occur within an active project is agreed upon between the client/regulatory agency and the PM/laboratory. These changes (e.g., use of a non-standard method or modification of a method) and approvals must be documented prior to implementation. Documentation pertains to any document, e.g., letter, e-mail, variance, contract addendum, which has been signed by both parties.

Such changes are also communicated to the laboratory during production meetings. Such changes are updated to the project notes and are introduced to the managers at these meetings. The laboratory staff is then introduced to the modified requirements via the PM or the individual laboratory Department (Technical) Manager. After the modification is implemented into the laboratory process, documentation of the modification is made in the case narrative of the data report(s).

The laboratory strongly encourages client visits to the laboratory and for formal/informal information sharing session with employees in order to effectively communicate ongoing client needs as well as project specific details for customized testing programs.

7.4 Special Services

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. It is the laboratory's goal to meet all client requirements in addition to statutory and regulatory requirements. The laboratory has procedures to ensure confidentiality to clients (Section 15 and 25).

The laboratory's standard procedures for reporting data are described in Section 25. Special services are also available and provided upon request. These services include:

- Reasonable access for our clients or their representatives to the relevant areas of the laboratory for the witnessing of tests performed for the client.
- Assist client-specified third party data validators as specified in the client's contract.
- Supplemental information pertaining to the analysis of their samples. Note: An additional charge may apply for additional data/information that was not requested prior to the time of sample analysis or previously agreed upon.

7.5 Client Communication

Project managers are the primary communication link to the clients. They shall inform their clients of any delays in project completion as well as any non-conformances in either sample receipt or sample analysis. Project management will maintain ongoing client communication throughout the entire client project.

Technical Managers are available to discuss any technical questions or concerns that the client may have.

7.6 Reporting

The laboratory works with our clients to produce any special communication reports required by the contract.

7.7 Client Surveys

The laboratory assesses both positive and negative client feedback. The results are used to improve overall laboratory quality and client service. TestAmerica's Sales and Marketing teams periodically develops lab and client specific surveys to assess client satisfaction.

SECTION 8. SUBCONTRACTING OF TESTS

8.1 Overview

For the purpose of this quality manual, the phrase subcontract laboratory refers to a laboratory external to the TestAmerica laboratories. The phrase "work sharing" refers to internal transfers of samples between the TestAmerica laboratories. The term outsourcing refers to the act of subcontracting tests.

When contracting with our clients, the laboratory makes commitments regarding the services to be performed and the data quality for the results to be generated. When the need arises to outsource testing for our clients because project scope, changes in laboratory capabilities, capacity or unforeseen circumstances, we must be assured that the subcontractors or work sharing laboratories understand the requirements and will meet the same commitments we have made to the client. Refer to TestAmerica's Corporate SOP's on Subcontracting Procedures CW-L-S-004 and the Work Sharing Process (CA-C-S-001).

When outsourcing analytical services, the laboratory will assure, to the extent necessary, that the subcontract or work sharing laboratory maintains a program consistent with the requirements of this document, the requirements specified in TNI/ISO 17025 and/or the client's Quality Assurance Project Plan (QAPP). All QC guidelines specific to the client's analytical program are transmitted to the subcontractor and agreed upon before sending the samples to the subcontract facility. Additionally, work requiring accreditation will be placed with an appropriately accredited laboratory. The laboratory performing the subcontracted work will be identified in the final report, as will non-TNI accredited work where required.

Project Managers (PMs), Client Service Managers (CSM) or Account Executives (AE) for the Export Lab (TestAmerica laboratory that transfers samples to another laboratory) are responsible for obtaining client approval prior to subcontracting any samples. The laboratory will advise the client of a subcontract arrangement in writing and when possible approval from the client shall be retained in the project folder. Standard TestAmerica Terms & Conditions include the flexibility to subcontract samples within the TestAmerica laboratories. Therefore, additional advance notification to clients for intra-laboratory subcontracting is not necessary unless specifically required by a client contract.

Note: In addition to the client, some regulating agencies (e.g., USDA) or contracts require notification prior to placing such work.

8.2 Qualifying and Monitoring Subcontractors

Whenever a PM, Account Executive (AE) or Client Service Manager (CSM) becomes aware of a client requirement or laboratory need where samples must be outsourced to another laboratory, the other laboratory(s) shall be selected based on the following:

- Subcontractors specified by the client - In these circumstances, the client assumes responsibility for the quality of the data generated from the use of a subcontractor.
- Subcontractors reviewed by TestAmerica – Firms which have been reviewed by the company and are known to meet standards for accreditations (e.g., State, TNI and

DoD/DOE); technical specifications; legal and financial information.

A listing of vendors is available on the TestAmerica intranet site.

All TestAmerica laboratories are pre-qualified for work sharing provided they hold the appropriate accreditations, can adhere to the project/program requirements, and the client approved sending samples to that laboratory. The client must provide acknowledgement that the samples can be sent to that facility (an e-mail is sufficient documentation or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented). The originating laboratory is responsible for communicating all technical, quality, and deliverable requirements as well as other contract needs. (Corporate SOP No. CA-C-S-001, Work Sharing Process).

8.2.1 When the potential sub-contract laboratory has not been previously approved, Account Executives or PMs may nominate a laboratory as a subcontractor based on need. The decision to nominate a laboratory must be approved by the Client Relations Manager (CRM) or Laboratory Director. The CRM or Laboratory Director requests that the QA Manager or PM begin the process of approving the subcontract laboratory as outlined in Corporate SOP No. CW-L-S-004, Subcontracting Procedures.

Once the appropriate accreditation and legal information is received by the laboratory, it is evaluated for acceptability (where applicable) and forwarded to the Corporate Quality Information Manager (QIM) for review. After the Corporate QIM reviews the documents for completeness, the information is forwarded to the Finance Department for formal signature and contracting with the laboratory. The approved vendor will be added to the approved subcontractor list on the intranet site and the finance group is concurrently notified for JD Edwards.

The client will assume responsibility for the quality of the data generated from the use of a subcontractor they have requested the lab to use. The qualified subcontractors on the intranet site are known to meet minimal standards. TestAmerica does not certify laboratories. The subcontractors on our approved list can only be recommended to the extent that we would use them.

8.3 Oversight and Reporting

8.3.1 The status and performance of qualified subcontractors will be monitored by the Corporate Quality department. Any problems identified will be brought to the attention of TestAmerica's Corporate Finance, Legal and Corporate Quality personnel.

- Complaints shall be investigated. Documentation of the complaint, investigation and corrective action will be maintained in the subcontractor's file on the intranet site. Complaints are posted using the Vendor Performance Report.
- Information shall be updated on the intranet when new information is received from the subcontracted laboratories.
- Subcontractors in good standing will be retained on the intranet listing. CSO personnel will notify all TestAmerica laboratories, Corporate Quality and Corporate Contracts if any laboratory requires removal from the intranet site. This notification will be posted on the intranet site and e-mailed to all CSO Personnel, Laboratory Directors, QA Managers and

Sales Personnel.

Prior to initially sending samples to the subcontracted laboratory, the PM confirms their certification status to determine if it's current and scope-inclusive. The information is documented within the project records.

8.3.2 For continued use of a subcontractor, verification of certification is placed upon the subcontractor for the defined project. Samples are subcontracted under Chain of Custody with the program defined as 'Accreditation Required' and the following statement for verification upon sample receipt:

Note: Since laboratory accreditations are subject to change, TestAmerica Laboratories, Inc. places the ownership of method, analyte & accreditation compliance upon our subcontract laboratories. This sample shipment is forwarded under Chain of Custody. If the laboratory does not currently maintain accreditation in the State of Origin listed above for analytes/tests/matrix being analyzed, the samples must be shipped back to the TestAmerica laboratory or other instructions will be provided. Any changes to accreditation status should be brought to TestAmerica Laboratories, Inc. attention immediately. If all requested accreditations are current to date, return the signed Chain of Custody attesting to said compliance to TestAmerica Laboratories, Inc.

For TestAmerica laboratories, certifications can be viewed on the company's TotalAccess Database.

8.3.3 All subcontracted samples must be accompanied by a TestAmerica Chain of Custody (COC). A copy of the original COC sent by the client must be available in TALS for all samples workshared within TestAmerica. Client COCs are only forwarded to external subcontractors when samples are shipped directly from the project site to the subcontractor lab. Under routine circumstances, client COCs are not provided to external subcontractors.

Through communication with the subcontracted laboratory, the PM monitors the status of the subcontracted analyses, facilitates successful execution of the work, and ensures the timeliness and completeness of the analytical report.

Non-TNI accredited work must be identified in the subcontractor's report as appropriate. If TNI accreditation is not required, the report does not need to include this information.

Reports submitted from subcontractor laboratories are not altered and are included in their original form in the final project report. This clearly identifies the data as being produced by a subcontractor facility. If subcontract laboratory data is incorporated into the laboratories EDD (i.e., imported), the report must explicitly indicate which lab produced the data for which methods and samples.

Note: The results submitted by a TestAmerica work sharing laboratory may be transferred electronically and the results reported by the TestAmerica work sharing lab are identified on the final report. The report must explicitly indicate which lab produced the data for which methods and samples. The final report must include a copy of the completed COC for all work sharing reports.

8.4 Contingency Planning

The full qualification of a subcontractor may be waived to meet emergency needs; however, this decision & justification must be documented in the project files, and the 'Purchase Order Terms And Conditions For Subcontracted Laboratory Services' must be sent with the samples and COC.

In the event this provision is utilized, the laboratory (e.g., PM) will be required to verify and document the applicable accreditations of the subcontractor. All other quality and accreditation requirements will still be applicable, but the subcontractor need not have signed a subcontract with TestAmerica at this time.

The use of any emergency subcontractor will require the PM to complete a JDE New Vendor Add Form in order to process payment to the vendor and add them to TALS. This form requires the user to define the subcontractor's category/s of testing and the reason for testing.

SECTION 9. PURCHASING SERVICES AND SUPPLIES

9.1 Overview

Evaluation and selection of suppliers and vendors is performed, in part, on the basis of the quality of their products, their ability to meet the demand for their products on a continuous and short term basis, the overall quality of their services, their past history, and competitive pricing. This is achieved through evaluation of objective evidence of quality furnished by the supplier, which can include certificates of analysis, recommendations, and proof of historical compliance with similar programs for other clients. To ensure that quality critical consumables and equipment conform to specified requirements, which may affect quality, all purchases from specific vendors are approved by a member of the supervisory or management staff. Capital expenditures are made in accordance with TestAmerica's Capital Expenditure, Controlled Purchase Requests and Fixed Asset Capitalization, SOP No. CW-F-S-007.

Contracts will be signed in accordance with TestAmerica's Company-Wide Authorization Matrix Policy, Policy No. CW-F-P-002. Request for Proposals (RFP's) will be issued where more information is required from the potential vendors than just price. Process details are available in TestAmerica's Corporate Procurement and Contracts Policy (Policy No. CW-F-P-004). RFP's allow TestAmerica to determine if a vendor is capable of meeting requirements such as supplying all of the TestAmerica facilities, meeting required quality standards and adhering to necessary ethical and environmental standards. The RFP process also allows potential vendors to outline any additional capabilities they may offer.

9.2 Glassware

Glassware used for volumetric measurements must be Class A or verified for accuracy according to laboratory procedure. Pyrex (or equivalent) glass should be used where possible. For safety purposes, thick-wall glassware should be used where available.

9.3 Reagents, Standards & Supplies

Purchasing guidelines for equipment, consumables, and reagents must meet the requirements of the specific method and testing procedures for which they are being purchased. Solvents and acids are pre-tested in accordance with TestAmerica's Corporate SOP on Solvent & Acid Lot

Testing & Approval, SOP No. CA-Q-S-001. Approval information for the solvents and acids tested under SOP CA-Q-S-001 is stored on the TestAmerica SharePoint, under Solvent Approvals. A master list of all tested materials, as well as the certificates of analysis for the materials, is stored in the same location.

9.3.1 Purchasing

Chemical reagents, solvents, glassware, and general supplies are ordered as needed to maintain sufficient quantities on hand. Materials used in the analytical process must be of a known quality. The wide variety of materials and reagents available makes it advisable to specify recommendations for the name, brand, and grade of materials to be used in any determination. This information is contained in the method SOP. The analyst may check the item out of the on-site consignment system that contains items approved for laboratory use.

If an item is not available from the on-site consignment, the analyst must provide the master item number (from the master item list that has been approved by the Technical Manager), item description, package size, catalogue page number, and the quantity needed. If an item being ordered is not the exact item requested, approval must be obtained from the Technical Manager prior to placing the order. The Department (Technical) Manager or the Laboratory Operations Manager places the order.

9.3.2 Receiving

It is the responsibility of the purchasing manager to receive the shipment. It is the responsibility of the analyst who ordered the materials to document the date materials were received. Once the ordered reagents or materials are received, the analyst compares the information on the label or packaging to the original order to ensure that the purchase meets the quality level specified. This is documented through the addition of the received date and initials to the information present on the daily order log.

The purchasing manager verifies the lot numbers of received solvents and acids against the pre-approval lists. If a received material is listed as unapproved, or is not listed, it is sequestered and returned to the vendor. Alternatively, the laboratory may test the material for the intended use, and if it is acceptable, document the approval on the approval list. Records of any testing performed locally are maintained on the shared “public” folder on the computer network.

Materials may not be released for use in the laboratory until they have been inspected, verified as suitable for use, and the inspection/verification has been documented.

Safety Data Sheets (SDSs) are available online through the Company’s intranet website. Anyone may review these for relevant information on the safe handling and emergency precautions of on-site chemicals.

9.3.3 Specifications

Methods in use in the laboratory specify the grade of reagent that must be used in the procedure. If the quality of the reagent is not specified, analytical reagent grade will be used. It

is the responsibility of the analyst to check the procedure carefully for the suitability of grade of reagent.

Chemicals must not be used past the manufacturer's expiration date and must not be used past the expiration time noted in a method SOP. If expiration dates are not provided, the laboratory may contact the manufacturer to determine an expiration date.

The laboratory assumes a five year expiration date on inorganic dry chemicals and solvents unless noted otherwise by the manufacturer or by the reference source method. Chemicals/solvents should not be used past the manufacturer's or SOPs expiration date unless 'verified' (refer to item 3 listed below).

- An expiration date **cannot** be extended if the dry chemical/solvent is discolored or appears otherwise physically degraded, the dry chemical/solvent must be discarded.
- Expiration dates can be extended if the dry chemical/solvent is found to be satisfactory based on acceptable performance of quality control samples (Continuing Calibration Verification (CCV), Blanks, Laboratory Control Sample (LCS), etc.).
- If the dry chemical/solvent is used for the preparation of standards, the expiration dates can be extended 6 months if the dry chemical/solvent is compared to an unexpired independent source in performing the method and the performance of the dry chemical/solvent is found to be satisfactory. The comparison must show that the dry chemical/solvent meets CCV limits. The comparison studies are maintained in the analytical Department.

Wherever possible, standards must be traceable to national or international standards of measurement or to national or international reference materials. Records to that effect are available to the user.

Compressed gases in use are checked for pressure and secure positioning daily. To prevent a tank from going to dryness, or introducing potential impurities, the pressure should be closely watched as it decreases to approximately 15% of the original reading, at which point it should be replaced. For example, a standard sized laboratory gas cylinder containing 3,000 psig of gas should be replaced when it drops to approximately 500 psig. The quality of the gases must meet method or manufacturer specification or be of a grade that does not cause any analytical interference.

Water used in the preparation of standards or reagents must have a specific conductivity of less than 1- µmho/cm (or specific resistivity of greater than 1.0 megohm-cm) at 25°C. The specific conductivity is checked and recorded daily. If the water's specific conductivity is greater than the specified limit, the Facility Manager and appropriate Technical Managers must be notified immediately in order to notify all departments, decide on cessation (based on intended use) of activities, and make arrangements for correction.

The laboratory may purchase reagent grade (or other similar quality) water for use in the laboratory. This water must be certified "clean" by the supplier for all target analytes or otherwise verified by the laboratory prior to use. This verification is documented.

Standard lots are verified before first time use if the laboratory switches manufacturers or has historically had a problem with the type of standard.

Purchased bottleware used for sampling must be certified clean and the certificates must be maintained. If uncertified sampling bottleware is purchased, all lots must be verified clean prior to use. This verification must be maintained.

Records of manufacturer's certification and traceability statements are maintained in files or binders in each laboratory section. These records include date of receipt, lot number (when applicable), and expiration date (when applicable). Incorporation of the item into the record indicates that the analyst has compared the new certificate with the previous one for the same purpose and that no difference is noted, unless approved and so documented by the Technical Manager or QA Manager.

9.3.4 Storage

Reagent and chemical storage is important from the aspects of both integrity and safety. Light-sensitive reagents may be stored in brown-glass containers. Storage conditions are per the Corporate Environmental Health & Safety Manual (Corp. Doc. No. CW-E-M-001) and method SOPs or manufacturer instructions.

9.4 Purchase of Equipment / Instruments / Software

When a new piece of equipment is needed, either for additional capacity or for replacing inoperable equipment, the analyst or supervisor makes a supply request to the Technical Manager and/or the Laboratory Director. If they agree with the request, the procedures outlined in TestAmerica's Corporate Policy No. CA-T-P-001, Qualified Products List, are followed. A decision is made as to which piece of equipment can best satisfy the requirements. The appropriate written requests are completed and purchasing places the order.

Upon receipt of a new or used piece of equipment, a unique identification name is assigned and provided to the QA Department for inclusion on the laboratory master equipment list. IT must also be notified so that they can synchronize the instrument for back-ups. Its capability is assessed to determine if it is adequate or not for the specific application. For instruments, a calibration curve is generated, followed by MDLs, Demonstration of Capabilities (DOCs), and other relevant criteria (refer to Section 19). For software, its operation must be deemed reliable and evidence of instrument verification must be retained by the IT Department or QA Department. Software certificates supplied by the vendors are filed with the LIMS Administrator. The manufacturer's operation manual is retained at the bench.

9.5 Services

Service to analytical instruments (except analytical balances) is performed on an as needed basis. Routine preventative maintenance is discussed in Section 20. The need for service is determined by analysts and/or Technical Managers. The service providers that perform the services are approved by the Technical Manager and/or the Laboratory Operations Managers.

Analytical balances are serviced and calibrated annually in accordance with TestAmerica Edison SOP ED-GEN-010 (Calibration of Analytical Balances). The calibration and maintenance services are performed on-site, and the balances are returned to use immediately following successful calibration. When the calibration certificates are received (usually within two weeks of the service), they are reviewed, and documentation of the review is filed with the certificates. If the calibration was unsuccessful, the balance is immediately removed from service and segregated pending either further maintenance or disposal.

Calibration services for support equipment such as thermometers, weight sets, autopipettors, etc, are obtained from vendors with current and valid ISO 17025 accreditation for calibration of the specific piece of equipment. Prior to utilizing the vendor's services, the vendor's accreditation status is verified. Once the equipment has been calibrated, the calibration certificates are reviewed by the QA department, and documentation of the review is filed with the calibration certificates. The equipment is then returned to service within the laboratory

9.6 Suppliers

TestAmerica selects vendors through a competitive proposal / bid process, strategic business alliances or negotiated vendor partnerships (contracts). This process is defined in the Procurement & Contracts Policy (Policy No. CW-F-P-004). The level of control used in the selection process is dependent on the anticipated spending amount and the potential impact on TestAmerica business. Vendors that provide test and measuring equipment, solvents, standards, certified containers, instrument related service contracts or subcontract laboratory services shall be subject to more rigorous controls than vendors that provide off-the-shelf items of defined quality that meet the end use requirements. The JD Edwards purchasing system includes all suppliers/vendors that have been approved for use.

Evaluation of suppliers is accomplished by ensuring the supplier ships the product or material ordered and that the material is of the appropriate quality. This is documented by signing off on packing slips or other supply receipt documents. The purchasing documents contain the data that adequately describe the services and supplies ordered.

Any issues of vendor performance are to be reported immediately by the laboratory staff to the Corporate Purchasing Group by completing a Vendor Performance Report.

The Corporate Purchasing Group will work through the appropriate channels to gather the information required to clearly identify the problem and will contact the vendor to report the problem and to make any necessary arrangements for exchange, return authorization, credit, etc.

As deemed appropriate, the Vendor Performance Reports will be summarized and reviewed to determine corrective action necessary, or service improvements required by vendors

The laboratory has access to a listing of all approved suppliers of critical consumables, supplies and services. This information is provided through the JD Edwards purchasing system.

9.6.1 New Vendor Procedure

TestAmerica employees who wish to request the addition of a new vendor must complete a J.D. Edwards Vendor Add Request Form.

New vendors are evaluated based upon criteria appropriate to the products or services provided as well as their ability to provide those products and services at a competitive cost. Vendors are also evaluated to determine if there are ethical reasons or potential conflicts of interest with TestAmerica employees that would make it prohibitive to do business with them as well as their financial stability. The QA Department and/or the Technical Services Director are consulted with vendor and product selection that have an impact on quality.

SECTION 10. COMPLAINTS

10.1 Overview

The laboratory considers an effective client complaint handling processes to be of significant business and strategic value. Listening to and documenting client concerns captures 'client knowledge' that enables our operations to continually improve processes and client satisfaction. An effective client complaint handling process also provides assurance to the data user that the laboratory will stand behind its data, service obligations and products.

A client complaint is any expression of dissatisfaction with any aspect of our business services (e.g., communications, responsiveness, data, reports, invoicing and other functions) expressed by any party, whether received verbally or in written form. Client inquiries, complaints or noted discrepancies are documented, communicated to management, and addressed promptly and thoroughly.

The laboratory has procedures for addressing both external and internal complaints with the goal of providing satisfactory resolution to complaints in a timely and professional manner.

The nature of the complaint is identified, documented and investigated, and an appropriate action is determined and taken. In cases where a client complaint indicates that an established policy or procedure was not followed, the QA Department must evaluate whether a special audit must be conducted to assist in resolving the issue. A written confirmation or letter to the client, outlining the issue and response taken is recommended as part of the overall action taken.

The process of complaint resolution and documentation utilizes the procedures outlined in Section 12 (Corrective Actions) and is documented following TestAmerica Edison SOP No. ED-GEN-003 (Control of Non-Conformances and Corrective Action).

10.2 External Complaints

An employee that receives a complaint initiates the complaint resolution process by first documenting the complaint according to TestAmerica Edison SOP No. ED-GEN-003 (Control of Non-Conformances and Corrective Action).

Complaints fall into two categories: correctable and non-correctable. An example of a correctable complaint would be one where a report re-issue would resolve the complaint. An example of a non-correctable complaint would be one where a client complains that their data was repeatedly late. Non-correctable complaints should be reviewed for preventive action measures to reduce the likelihood of future occurrence and mitigation of client impact.

The general steps in the complaint handling process are:

- Receiving and Documenting Complaints
- Complaint Investigation and Service Recovery
- Process Improvement

The laboratory shall inform the initiator of the complaint of the results of the investigation and the corrective action taken, if any.

10.3 Internal Complaints

Internal complaints include, but are not limited to: errors and non-conformances, training issues, internal audit findings, and deviations from methods. Corrective actions may be initiated by any staff member who observes a nonconformance and shall follow the procedures outlined in Section 12. In addition, Corporate Management, Sales and Marketing and IT may initiate a complaint by contacting the laboratory or through the corrective action system described in Section 12.

10.4 Management Review

The number and nature of client complaints is reported by the QA Manager to the laboratory and Quality Director in the QA Monthly report. Monitoring and addressing the overall level and nature of client complaints and the effectiveness of the solutions is part of the Annual Management Review (Section 16).

SECTION 11. CONTROL OF NON-CONFORMING WORK

11.1 Overview

When data discrepancies are discovered or deviations and departures from laboratory SOPs, policies and/or client requests have occurred, corrective action is taken immediately. First, the laboratory evaluates the significance of the nonconforming work. Then, a corrective action plan is initiated based on the outcome of the evaluation. If it is determined that the nonconforming work is an isolated incident, the plan could be as simple as adding a qualifier to the final results and/or making a notation in the case narrative. If it is determined that the nonconforming work is a systematic or improper practices issue, the corrective action plan could include a more in depth investigation and a possible suspension of an analytical method. In all cases, the actions taken are documented using the laboratory's corrective action system (refer to Section 12).

Due to the frequently unique nature of environmental samples, sometimes departures from documented policies and procedures are needed. When an analyst encounters such a situation, the problem is presented to the Department (Technical) Manager for resolution. The

manager may elect to discuss it with the Lab Director and/or QA Manager or have a representative contact the client to decide on a logical course of action. Once an approach is agreed upon, the analyst documents it using the laboratories corrective action system described in Section 12. This information can then be supplied to the client in the form of a footnote or a case narrative with the report.

Project Management may encounter situations where a client may request that a special procedure be applied to a sample that is not standard lab practice. Based on a technical evaluation, the lab may accept or opt to reject the request based on technical or ethical merit. An example might be the need to report a compound that the lab does not normally report. The lab would not have validated the method for this compound following the procedures in Section 19. The client may request that the compound be reported based only on the calibration. Such a request would need to be approved by the Laboratory Director and QA Manager, documented and included in the project folder. Deviations **must** also be noted on the final report with a statement that the compound is not reported in compliance with TNI (or the analytical method) requirements and the reason. Data being reported to a non-TNI state would need to note the change made to how the method is normally run.

11.2 Responsibilities and Authorities

Under certain circumstances, the Laboratory Director, a Technical Manager, or a member of the QA team may authorize departures from documented procedures or policies. The departures may be a result of procedural changes due to the nature of the sample; a one-time procedure for a client; QC failures with insufficient sample to reanalyze, etc.. In most cases, the client will be informed of the departure prior to the reporting of the data. Any departures must be well documented using the laboratory's corrective action procedures. This information may also be documented in logbooks and/or data review checklists as appropriate**.** Any impacted data must be referenced in a case narrative and/or flagged with an appropriate data qualifier.

Any misrepresentation or possible misrepresentation of analytical data discovered by any laboratory staff member must be reported to facility Senior Management within 24-hours. The Senior Management staff is comprised of the Laboratory Director, the QA Manager, and the Technical Managers. The reporting of issues involving alleged violations of the company's Data Integrity or Manual Integration procedures must be conveyed to an ECO (e.g., the VP-QA/EHS) and the laboratory's Quality Director within 24 hours of discovery.

Whether an inaccurate result was reported due to calculation or quantitation errors, data entry errors, improper practices, or failure to follow SOPs, the data must be evaluated to determine the possible effect.

The Laboratory Director, QA Manager, ECOs, VP of Operations and the Quality Directors have the authority and responsibility to halt work, withhold final reports, or suspend an analysis for due cause as well as authorize the resumption of work.

11.3 Evaluation of Significance and Actions Taken

For each nonconforming issue reported, an evaluation of its significance and the level of management involvement needed is made. This includes reviewing its impact on the final data,

whether or not it is an isolated or systematic issue, and how it relates to any special client requirements.

Corporate SOP entitled Data Recalls (CW-Q-S-005) is the procedure to be followed when it is discovered that erroneous or biased data may have been reported to clients or regulatory agencies.

Corporate SOP entitled Internal Investigations (CW-L-S-002) is the procedure to be followed for investigation and correction of situations involved alleged incidents of misconduct or violation of the company's ethics policy.

Laboratory level decisions are documented and approved using the laboratory's standard nonconformance/corrective action reporting in lieu of the data recall determination form contained in TestAmerica's Corporate SOP No. CW-Q-S-005.

11.4 Prevention of Nonconforming Work

If it is determined that the nonconforming work could recur, further corrective actions must be made following the laboratory's corrective action system. On a monthly basis, the QA Department evaluates non-conformances to determine if any nonconforming work has been repeated multiple times. If so, the laboratory's corrective action process may be followed.

11.5 Method Suspension / Restriction (Stop Work Procedures)

In some cases, it may be necessary to suspend/restrict the use of a method or target compound which constitutes significant risk and/or liability to the laboratory. Suspension/restriction procedures can be initiated by any of the persons noted in Section 11.2, Paragraph 5.

Prior to suspension/restriction, confidentiality will be respected, and the problem with the required corrective and preventive action will be stated in writing and presented to the Laboratory Director.

The Laboratory Director shall arrange for the appropriate personnel to meet with the QA Manager as needed. This meeting shall be held to confirm that there is a problem, that suspension/restriction of the method is required and will be concluded with a discussion of the steps necessary to bring the method/target or test fully back on line. In some cases, that may not be necessary if all appropriate personnel have already agreed there is a problem and there is agreement on the steps needed to bring the method, target or test fully back on line. The QA Manager will also initiate a corrective action report as described in Section 12 if one has not already been started. A copy of any meeting notes and agreed upon steps should be faxed or e-mailed by the laboratory to the appropriate VP of Operations and member of Corporate QA. This fax/e-mail acts as notification of the incident.

After suspension/restriction, the lab will hold all reports to clients pending review. No faxing, mailing or distributing through electronic means may occur. The report must not be posted for viewing on the internet. It is the responsibility of the Laboratory Director to hold all reporting and to notify all relevant laboratory personnel regarding the suspension/restriction (e.g., Project Management, Log-in, etc…). Clients will NOT generally be notified at this time. Analysis may proceed in some instances depending on the non-conformance issue.

Within 72 hours, the QA Manager will determine if compliance is now met and reports can be released, OR determine the plan of action to bring work into compliance, and release work. A team, with all principals involved (Laboratory Director, Laboratory Operations Managers, QA Manager, Department Technical Manager) can devise a start-up plan to cover all steps from client notification through compliance and release of reports. Project Management and the Directors of Client Services and Sales and Marketing must be notified if clients must be notified or if the suspension/restriction affects the laboratory's ability to accept work. The QA Manager must approve start-up or elimination of any restrictions after all corrective action is complete. This approval is given by final signature on the completed corrective action report.

SECTION 12. CORRECTIVE ACTION

12.1 Overview

A major component of TestAmerica's Quality Assurance (QA) Program is the problem investigation and feedback mechanism designed to keep the laboratory staff informed on quality related issues and to provide insight to problem resolution. When nonconforming work or departures from policies and procedures in the quality system or technical operations are identified, the corrective action procedure provides a systematic approach to assess the issues, restore the laboratory's system integrity, and prevent reoccurrence. Corrective actions are documented using TestAmerica's Incident and Corrective Action Tracker (iCAT) (refer to Figure 12-1).

12.2 General

Problems within the quality system or within analytical operations may be discovered in a variety of ways, such as QC sample failures, internal or external audits, proficiency testing (PT) performance, client complaints, staff observation, etc..

The purpose of a corrective action system is to:

- Identify non-conformance events and assign responsibility(s) for investigating.
- Resolve non-conformance events and assign responsibility for any required corrective action.
- Identify systematic problems before they become serious.
- Identify and track client complaints and provide resolution.

12.2.1 Non-Conformance Memo (NCM) - is used to document the following types of corrective actions:

- Deviations from an established procedure or SOP
- QC outside of limits (non-matrix related)
- Isolated reporting / calculation errors
- Client complaints
- Discrepancies in materials / goods received vs. manufacturer packing slips.

12.2.2 Corrective Action Report (CAR) - is used to document the following types of corrective actions:

- Questionable trends that are found in the review of NCMs.
- Issues found while reviewing NCMs that warrant further investigation.
- Internal and external audit findings
- Failed or unacceptable PT results.
- Corrective actions that cross multiple departments in the laboratory.
- Systematic reporting / calculation errors
- Client complaints
- Data recall investigations
- Identified poor process or method performance trends
- Excessive revised reports

This will provide background documentation to enable root cause analysis and preventive action.

12.3 Closed Loop Corrective Action Process

Any employee in the company can initiate a corrective action. There are four main components to a closed-loop corrective action process once an issue has been identified: Cause Analysis, Selection and Implementation of Corrective Actions (both short and long term), Monitoring of the Corrective Actions, and Follow-up.

12.3.1 Cause Analysis

- Upon discovery of a non-conformance event, the event must be defined and documented. A CAR must be initiated, someone is assigned to investigate the issue and the event is investigated for cause. Table 12-1 provides some general guidelines on determining responsibility for assessment.
- The cause analysis step is the key to the process as a long term corrective action cannot be determined until the cause is determined.
- If the cause is not readily obvious, the Technical Manager, Laboratory Director, or QA Manager (or QA designee) is consulted.

12.3.2 Selection and Implementation of Corrective Actions

- Where corrective action is needed, the laboratory shall identify potential corrective actions. The action(s) most likely to eliminate the problem and prevent recurrence are selected and implemented. Responsibility for implementation is assigned.
- Corrective actions shall be to a degree appropriate to the magnitude of the problem identified through the cause analysis.
- Whatever corrective action is determined to be appropriate, the laboratory shall document and implement the changes. The CAR is used for this documentation.

12.3.3 Root Cause Analysis

Root Cause Analysis is a class of problem solving (investigative) methods aimed at identifying the basic or causal factor(s) that underlie variation in performance or the occurrence of a significant failure. The root cause may be buried under seemingly innocuous events, many steps preceding the perceived failure. At first glance, the immediate response is typically directed at a symptom and not the cause. Typically, root cause analysis would be best with three or more incidents to triangulate a weakness. Corporate SOP Root Cause Analysis (No. CA-Q-S-009) describes the procedure.

Systematically analyze and document the root causes of the more significant problems that are reported. Identify, track, and implement the corrective actions required to reduce the likelihood of recurrence of significant incidents. Trend the root cause data from these incidents to identify root causes that, when corrected, can lead to dramatic improvements in performance by eliminating entire classes of problems.

Identify the one event associated with problem and ask why this event occurred. Brainstorm the root causes of failures; for example, by asking why events occurred or conditions existed; and then why the cause occurred 5 consecutive times until you get to the root cause. For each of these sub events or causes, ask why it occurred. Repeat the process for the other events associated with the incident.

Root cause analysis does not mean the investigation is over. Look at technique, or other systems outside the normal indicators. Often creative thinking will find root causes that ordinarily would be missed, and continue to plague the laboratory or operation.

12.3.4 Monitoring of the Corrective Actions

- The Technical Manager and QA Manager are responsible to ensure that the corrective action taken was effective.
- Ineffective actions are documented and re-evaluated until acceptable resolution is achieved. Technical Managers are accountable to the Laboratory Director to ensure final acceptable resolution is achieved and documented appropriately.
- Each CAR is entered into a the iCAT database for tracking purposes and a monthly summary of all corrective actions is printed out for review to aid in ensuring that the corrective actions have taken effect.
- TestAmerica laboratories began using the Incident/Corrective Action Tracker (iCAT) database developed by the company in 2015. (Previously, a local Excel database served this purpose.) An incident is an event triggering the need for one or more corrective actions as distinct from a corrective action, a potential deficiency stemming from an incident that requires investigation and possibly fixing. The database is independent of TALS, available to all local and corporate managers, and capable of notifying and tracking multiple corrective actions per event, dates, and personnel. iCAT allows associated document upload, categorization (such as, external/internal audit, client service concerns, data quality issues, proficiency testing, etc.), and trend analysis. Refer to Figure 12-1.
- The QA Manager reviews monthly CARs for trends. Highlights are included in the QA monthly report (refer to Section 16). If a significant trend develops that adversely affects quality, an audit of the area is performed and corrective action implemented.

- Any out-of-control situations that are not addressed acceptably at the laboratory level may be reported to the Corporate Quality Director by the QA Manager, indicating the nature of the out-of-control situation and problems encountered in solving the situation.

12.3.5 Follow-up Audits

- Follow-up audits may be initiated by the QA Manager and shall be performed as soon as possible when the identification of a nonconformance casts doubt on the laboratory's compliance with its own policies and procedures, or on its compliance with state or federal requirements.
- These audits often follow the implementation of the corrective actions to verify effectiveness. An additional audit would only be necessary when a critical issue or risk to business is discovered.

(Also refer to Section 15.1.4, Special Audits.)

12.4 Technical Corrective Actions

In addition to providing acceptance criteria and specific protocols for technical corrective actions in the method SOPs, the laboratory has general procedures to be followed to determine when departures from the documented policies and procedures and quality control have occurred (refer to Section 11). The documentation of these procedures is through the use of a CAR.

Table 12-1 includes examples of general technical corrective actions. For specific criteria and corrective actions, refer to the analytical methods or specific method SOPs. The laboratory may also maintain Work Instructions on these items that are available upon request.

Table 12-1 provides some general guidelines for identifying the individual(s) responsible for assessing each QC type and initiating corrective action. The table also provides general guidance on how a data set should be treated if associated QC measurements are unacceptable. Specific procedures are included in Method SOPs, Work Instructions, QAM Sections 19 and 20. All corrective actions are reviewed monthly, at a minimum, by the QA Manager and highlights are included in the QA monthly report.

To the extent possible, samples shall be reported only if all quality control measures are acceptable. If the deficiency does not impair the usability of the results, data will be reported with an appropriate data qualifier and/or the deficiency will be noted in the case narrative. Where sample results may be impaired, the Project Manager is notified and appropriate corrective action (e.g., reanalysis) is taken and documented**.**

12.5 Basic Corrections

When mistakes occur in records, each mistake shall be crossed-out, [not obliterated (e.g. no white-out)], and the correct value entered alongside. All such corrections shall be initialed (or signed) and dated by the person making the correction. In the case of records stored electronically, the original “uncorrected” file must be maintained intact and a second “corrected” file is created.

This same process applies to adding additional information to a record. All additions made later than the initial must also be initialed (or signed) and dated.

When corrections are due to reasons other than obvious transcription errors, the reason for the corrections (or additions) shall also be documented.

Figure 12-1.
Example - Corrective Action Report

TestAmerica Edison - Quality Assurance

Corrective Action 8698

Incident 3098: WS0717 PT Failures
Incident Status: Closed
Response Due to Client: Sunday, Oct 8, 2017

Created By:	Carl Armbruster	Created On:	Friday, Sep 8, 2017
Laboratory Function:	Other Lab Functions	Date Follow-up Due:	
Corrective Action Type:	PT and/or Double Blind Failures	Date Follow-up Done:	
Department:	Metals	Response Due to QA:	Sunday, Oct 8, 2017
Finding Number:	1	Planned Closure Date:	Sunday, Oct 8, 2017
Is Repeat Finding?:	No	Date Closed:	Monday, Oct 16, 2017
Finding Reference:			
Assigned To/Lead:	Laura Demone		
Priority:	2 (High Importance)		
Follow-up Assigned To:			
C.A. Status:	Closed		

Issue Requiring Corrective Action:

Rec'd evaluation of 'Not Acceptable for Arsenic by EPA 200.8: Assigned value: 8.17 ug/l Reported result: 10.9 ug/l Acceptance limits: 5.72 - 10.6 ug/l. Rec'd evaluation of 'Not Acceptable for Iron by EPA 200.7: Assigned value: 304 ug/l Reported result: 218 ug/l Acceptance limits: 258 - 349 ug/l. Investigate and submit correction action plan along with completed PT corrective action checklist (attached to this iCAT item).

Investigation/Response:

Drinking water PT 460-137368 sample 12 (PT study WS0717) failed low for iron by EPA 200.7 and failed high for arsenic by EPA 200.8.

Root Cause:

PT sample results as well as instrument and batch QC samples were checked for any anomalies or issues that may have contributed to the failures. For EPA 200.7, the calibration curve and blanks look very good for iron, and QC recoveries are within the acceptable range. For EPA 200.8, the same is true, the arsenic curve and all blanks are very good and all QC recoveries are also within the acceptable range for this method. The only issue noticed in the evaluation of the 200.8 data is that the serial dilution result for arsenic went down with higher dilution. For example,. the serial dilution at 5x was 9.62 ug/L (this is high but within the acceptance limits for arsenic) and at 10x the result was 8.12 ug/L, which is essentially the assigned value of arsenic. Perhaps there was an interference (both copper and zinc needed dilution for this sample) that caused high bias for the arsenic that was removed by the dilution of the sample.

Corrective Action Plan:

As per an older corrective action response, when laboratory sample is logged in for both an ICP and an ICP-MS method, the final data is compared before reporting, and this of course is also true for PT samples. The iron result on the ICP-MS for EPA 200.8 was 301 ug/L but since iron was not logged in as a reportable analyte for this method, this data was not compared to the ICP result. The same is true for arsenic, this analyte was not reported via Method 200.7 so the data was not compared either, (the arsenic result via method 200.7 was 9.98 ug/L, which is high but within the acceptable range) Had these results been compared, the discrepancies would certainly have been noticed and investigated further. Going forward, all data will be compared between the two methods, even when only one method is actually needed for reporting purposes, and all QC data will be examined more carefully to check for possible interferences. In addition, part of the issue is simply that the metals PT samples are either started early but then not reviewed/ compared until close to the due date or they are not started until well after they are received. If there were more time to carefully review data and compare results, it is much more likely that any issues would be caught and resolved. With all future PT studies, metals samples will be digested, analyzed and reviewed within two weeks of login to TALS and if all data is acceptable, results will also be submitted in this time frame. Phenova sent a QC sample (Trace Metals QC Lot #9066-04) with the rapid response PT sample for drinking water by EPA 200.7 and 200.8 with a certified value of 933 ug/L for iron and acceptance limits of 790-1070 ug/L, and a certified value of 21.1 ug/L for arsenic and acceptance limits of 14.8-27.4 ug/L. This sample (460-140875-2) was digested and analyzed with the rapid response PT sample and we got an iron result of 1020 ug/L which is within the acceptable recovery range. We also ran this rapid response QC sample on the ICP-MS for method 200.8 arsenic and we got a result of 23.2 ug/L (this is on A468012, not identified since it is not logged in for this method in TALS) which is within the acceptable range. We also carefully checked QC recoveries on the ICP/ ICPMS and ran the samples on the ICPMS and compared the results from the two instruments as usual, so we feel confident with the rapid response results as reported. Going forward for drinking water by method 200.8, analysts have been reminded to matrix match the standards with the samples (eg, rinse water, internal standard, calibration standards all use 2% HNO3 to match non-digested drinking waters). According to the batch notes this was done in the initial run of the PT.

Corrective Action Documents (3)

iCAT3098_PT corrective action narrative checklist_WS0717_Fe_460-137368.pdf	Con4AanA4.LONG_DATE_STRING 6:58 AM
iCAT3098_PT corrective action narrative checklist_WS0717_As_460-137368.pdf	Con58AanA58.LONG_DATE_STRING 7:3 AM
iCAT3098_PT corrective action QC sample Iron_140875-2.pdf	Con29PanP29.LONG_DATE_STRING 12:32 PM

For QA Use Only

QA Comments	Follow Up
Enter a QA Comment	*Enter Follow Up*

Notifications

Location QA (notification required)

Name	Title
Carl Armbruster	Quality Assurance Manager
Emmylou DiGiacomo	Quality Assurance Specialist
Hayley Waterland	

Additional Notifications

Name	Title
Mark Acierno	Laboratory Director
Laura Demone	Department Manager I
Donald Evans	Operations Manager

Table 12-1. Example – General Corrective Action Procedures

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Initial Instrument Blank *(Analyst)*	- Instrument response < MDL.	- Prepare another blank. - If same response, determine cause of contamination: reagents, environment, instrument equipment failure, etc..
Initial Calibration Standards *(Analyst, Technical Manager(s))*	- Correlation coefficient > 0.99 or standard concentration value. - % Recovery within acceptance range. - See details in Method SOP.	- Reanalyze standards. - If still unacceptable, remake standards and recalibrate instrument.
Independent Calibration Verification (Second Source) *(Analyst, Technical Manager(s))*	- % Recovery within control limits.	- Remake and reanalyze standard. - If still unacceptable, then remake calibration standards or use new primary standards and recalibrate instrument.
Continuing Calibration Standards *(Analyst, Data Reviewer)*	% Recovery within control limits.	- Reanalyze standard. - If still unacceptable, then recalibrate and rerun affected samples.
Matrix Spike / Matrix Spike Duplicate (MS/MSD) *(Analyst, Data Reviewer)*	- % Recovery within limits documented in TALS Method Limit Groups.	- If the acceptance criteria for duplicates or matrix spikes are not met because of matrix interferences, the acceptance of the analytical batch is determined by the validity of the LCS. - If the LCS is within acceptable limits the batch is acceptable. - The results of the duplicates, matrix spikes and the LCS are reported with the data set. - For matrix spike or duplicate results outside criteria the data for that sample shall be reported with qualifiers.

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Laboratory Control Sample (LCS) *(Analyst, Data Reviewer)*	- % Recovery within limits specified in TALS Method Limit Groups.	- Batch must be re-prepared and re-analyzed. This includes any allowable marginal exceedance. When not using marginal exceedances, the following exceptions apply: 1) when the acceptance criteria for the positive control are exceeded high (i.e., high bias) and there are associated samples that are non-detects, then those non-detects may be reported with data qualifying codes; 2) when the acceptance criteria for the positive control are exceeded low (i.e., low bias), those sample results may be reported if they exceed a maximum regulatory limit/decision level with data qualifying codes. **Note:** If there is insufficient sample or the holding time cannot be met, contact client and report with flags.
Surrogates *(Analyst, Data Reviewer)*	- % Recovery within limits of method or within three standard deviations of the historical mean.	- Individual sample must be repeated. Place comment in LIMS. - Surrogate results outside criteria shall be reported with qualifiers.
Method Blank (MB) *(Analyst, Data Reviewer)*	< Reporting Limit [1]	- Reanalyze blank. - If still positive, determine source of contamination. If necessary, reprocess (i.e. digest or extract) entire sample batch. Report blank results. - Qualify the result(s) if the concentration of a targeted analyte in the MB is at or above the reporting limit AND is > 1/10 of the amount measured in the sample.
Proficiency Testing (PT) Samples *(QA Manager, Technical Manager(s))*	- Criteria supplied by PT Supplier.	- Any failures or warnings must be investigated for cause. Failures may result in the need to repeat a PT sample to show the problem is corrected.
Internal / External Audits *(QA Manager, Technical Manager(s), Laboratory Director)*	- Defined in Quality System documentation such as SOPs, QAM, etc..	- Non-conformances must be investigated through CAR system and necessary corrections must be made.

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Reporting / Calculation Errors (Depends on issue – possible individuals include: Analysts, Data Reviewers, Project Managers, Technical Managers, QA Manager, Corporate QA, Corporate Management)	- SOP CW-Q-S-005, Data Recall	- Corrective action is determined by type of error. Follow the procedures in SOP CW-L-S-002 or TestAmerica Edison's Corrective Action SOP (ED-GEN-003),
Client Complaints *(Project Managers, Lab Director/Manager, Sales and Marketing)*	-	- Corrective action is determined by the type of complaint. For example, a complaint regarding an incorrect address on a report will result in the report being corrected and then follow-up must be performed on the reasons the address was incorrect (e.g., database needs to be updated).
QA Monthly Report (Refer to Section 16 for an example) (QA Manager, Lab Director/Manager, *Technical Manager(s)*)	- QAM, SOPs.	- Corrective action is determined by the type of issue. For example, CARs for the month are reviewed and possible trends are investigated.
Health and Safety Violation (Safety Officer, Lab Director/Manager, *Technical Manager(s)*)	- Environmental Health and Safety (EHS) Manual.	- Non-conformance is investigated and corrected through CAR system.

Note:

1. See specific method SOPs for blank acceptance criteria. Concentrations up to five times the reporting limit will be allowed for the ubiquitous laboratory and reagent contaminants: methylene chloride, toluene, acetone, 2-butanone and phthalate.. This allowance presumes that the detection limit is significantly below any regulatory limit to which the data are to be compared and that blank subtraction will not occur.

SECTION 13. PREVENTIVE ACTION / IMPROVEMENT

13.1 Overview

The laboratory's preventive action programs improve or eliminate potential causes of nonconforming product and/or nonconformance to the quality system. This preventive action process is a proactive and continuous process of improvement activities that can be initiated through feedback from clients, employees, business providers, and affiliates. The QA Department has the overall responsibility to ensure that the preventive action process is in place, and that relevant information on actions is submitted for management review.

Dedicating resources to an effective preventive action system emphasizes the laboratory's commitment to its Quality Program. It is beneficial to identify and address negative trends before they develop into complaints, problems and corrective actions. Additionally, the laboratory continually strives to improve customer service and client satisfaction through continuous improvements to laboratory systems.

Opportunities for improvement may be discovered through any of the following:

- review of the monthly QA Metrics Report,
- trending NCMs,
- review of control charts and QC results,
- trending proficiency testing (PT) results,
- performance of management system reviews,
- trending client complaints,
- review of processing operations, or
- staff observations.

The monthly Management Systems Metrics Report shows performance indicators in all areas of the laboratory and quality system. These areas include revised reports, corrective actions, audit findings, internal auditing and data authenticity audits, client complaints, PT samples, holding time violations, SOPs, ethics training, etc. The metrics report is reviewed monthly be the laboratory management, Corporate QA and TestAmerica's Executive Committee. These metrics are used ~~to~~ in evaluating the management and quality system performance on an ongoing basis and provide a tool for identifying areas for improvement.

Items identified as continuous improvement opportunities to the management system may be issued as goals from the annual management systems review, recommendations from internal audits, white papers, Lesson Learned, Technical Services audit report, Technical Best Practices, or as Corporate or management initiatives.

The laboratory's corrective action process is integral to implementation of preventive actions. A critical piece of the corrective action process is the implementation of actions to prevent further occurrence of a non-compliance event. Historical review of corrective action and non-conformances provides a valuable mechanism for identifying preventive action opportunities.

13.1.1 The following elements are part of a preventive action/process improvement system:

- Identification of an opportunity for preventive action or process improvement.
- Process for the preventive action or improvement.
- Define the measurements of the effectiveness of the process once undertaken.
- Execution of the preventive action or improvement.
- Evaluation of the plan using the defined measurements.
- Verification of the effectiveness of the preventive action or improvement.
- Close-Out by documenting any permanent changes to the Quality System as a result of the Preventive Action or Process Improvement. Documentation of Preventive Action/process Improvement is incorporated into the monthly QA reports, corrective action process and management review.

13.1.2 Any Preventive Actions/Process Improvement undertaken or attempted shall be taken into account during the annual Management Systems Review (Section 16). A highly detailed report is not required; however, a summary of successes and failures within the preventive action program is sufficient to provide management with a measurement for evaluation.

13.2 Management of Change

The Management of Change process is designed to manage significant events and changes that occur within the laboratory. Through these various tracking indicators, the potential risks inherent with a new event or change are identified and evaluated. The risks are minimized or eliminated through pre-planning and the development of preventive measures. The types of indicators monitored under this collective system include:

- SOP Tracking
  Current Revisions w/ Effective Dates
  Required Biennial Revisions w/ Due Date

- Proficiency Testing (PT) Sample Tracking
  Pass / Fail – most current 2 out of 3 studies.

- Instrument / Equipment List
  Current / Location

- Accreditations
  New / Expiring

- Method Capabilities
  Current Listing by program (e.g., Potable Water, Soils, etc.)

- Key Personnel
  Technical Managers, Department Supervisors, etc..

These items are maintained on TestAmerica's Intranet (Proposal Library) or on our internal database (TotalAccess) which uploads to our company internet site

SECTION 14. CONTROL OF RECORDS

The laboratory maintains a records management system appropriate to its needs and that complies with applicable standards or regulations as required. The system produces unequivocal, accurate records that document all laboratory activities. The laboratory retains all original observations, calculations and derived data, calibration records and a copy of the analytical report for a minimum of five years after it has been issued. Exceptions for programs with longer retention requirements are discussed in Section 14.1.2.

14.1 Overview

The laboratory has established procedures for identification, collection, indexing, access, filing, storage, maintenance and disposal of quality and technical records. A record index is listed in Table 14-1. More detailed information on retention of specific records is provided in CW-L-P-001, Records Retention Policy and CW-L-WI-001, TestAmerica Records Retention/Storage Schedule. Quality records are maintained by the QA department in a database, which is backed up as part of the regular laboratory backup. Records are of two types; either electronic or hard copy paper formats depending on whether the record is computer or hand generated (some records may be in both formats). Technical records are maintained by Laboratory Operations under the direction of the Laboratory Operations Managers.

Table 14-1. Record Index[1]

	Record Types [1]:	**Retention Time:**
Technical Records	- Raw Data - Logbooks[2] - Standards - Certificates - Analytical Records - MDLs/IDLs/DOCs - Lab Reports	5 Years from analytical report issue*
Official Documents	- Quality Assurance Manual (QAM) - Work Instructions - Policies - SOPs - Policy Memorandums - Manuals - Published Methods	Indefinitely
QA Records	- Certifications - Method and Software Validation / Verification Data	Indefinitely
QA Records	- Internal & External Audits/Responses - Corrective/Preventive Actions - Management Reviews -- Data Investigation	5 Years from archival* **Data Investigation:** 5 years or the life of the affected raw data storage whichever is greater (beyond 5 years if ongoing project or pending investigation)

	Record Types [1]:	Retention Time:
Project Records	- Sample Receipt & COC Documents - Contracts and Amendments - Correspondence - QAPP - SAP - Telephone Logbooks - Lab Reports	5 Years from analytical report issue*
Administrative Records	Financial and Business Operations	Refer to CW-L-WI-001
	EH&S Manual, Permits	Indefinitely
	Disposal Records	Indefinitely
	Employee Handbook	Indefinitely
	Personnel files, Employee Signature & Initials, Administrative Training Records (e.g., Ethics)	Refer to HR Manual
	Administrative Policies	Indefinitely
	Technical Training Records	7 years
	Legal Records	Indefinitely
	HR Records	Refer to CW-L-WI-001
	IT Records	Refer to CW-L-WI-001
	Corporate Governance Records	Refer to CW-L-WI-001
	Sales & Marketing	5 years
	Real Estate	Indefinitely

[1] Record Types encompass hardcopy and electronic records.
[2] Examples of Logbook types: Maintenance, Instrument Run, Preparation (standard and samples), Standard and Reagent Receipt, Archiving, Balance Calibration, Temperature (hardcopy or electronic records).
* Exceptions listed in Table 14-2.

14.1.1 All records are stored and retained in such a way that they are secure and readily retrievable at the laboratory facility which provides a suitable environment to prevent damage or deterioration and to prevent loss. All records shall be protected against fire, theft, loss, environmental deterioration, and vermin. In the case of electronic records, electronic or magnetic sources, storage media are protected from deterioration caused by magnetic fields and/or electronic deterioration.

Access to the data is limited to laboratory and company employees. Records are maintained for a minimum of five years unless otherwise specified by a client or regulatory requirement.

For raw data and project records, record retention shall be calculated from the date the project report is issued. For other records, such as Controlled Documents, QA, or Administrative Records, the retention time is calculated from the date the record is formally retired. Records related to the programs listed in Table 14-2 have lengthier retention requirements and are subject to the requirements in Section 14.1.3.

14.1.2 Programs with Longer Retention Requirements

Some regulatory programs have longer record retention requirements than the standard record retention time. These are detailed in Table 14-2 with their retention requirements. In these cases, the longer retention requirement is enacted. If special instructions exist such that client data cannot be destroyed prior to notification of the client, the container or box containing that data is marked as to who to contact for authorization prior to destroying the data.

Table 14-2. Example: Special Record Retention Requirements

Program	[1]Retention Requirement
Drinking Water – All States	10 years (lab reports and raw data) 10 years - Radiochemistry (project records)
Drinking Water Lead and Copper Rule	12 years (project records)
TSCA - 40 CFR Part 792	10 years after publication of final test rule or negotiated test agreement
OSHA	30 years

[1]Note: Extended retention requirements must be noted with the archive documents or addressed in facility-specific records retention procedures.

14.1.3 The laboratory has procedures to protect and back-up records stored electronically and to prevent unauthorized access to or amendment of these records. All analytical data is maintained as hard copy or in a secure readable electronic format. For analytical reports that are maintained as copies in PDF format, refer to Section 19.14.1 for more information. For additional details please refer to refer to TestAmerica Edison SOP No. ED-GEN-024 (Record Storage and Retention).

14.1.4 The record keeping system allows for historical reconstruction of all laboratory activities that produced the analytical data, as well as rapid recovery of historical data. The history of the sample from when the laboratory took possession of the samples must be readily understood through the documentation. This shall include inter-laboratory transfers of samples and/or extracts.

- The records include the identity of personnel involved in sampling, sample receipt, preparation, or testing. All analytical work contains the initials (at least) of the personnel involved. The laboratory's copy of the COC is stored with the invoice and the work order sheet generated by the LIMS.The chain of custody would indicate the name of the sampler. If any sampling notes are provided with a work order, they are kept with this package.

- All information relating to the laboratory facilities equipment, analytical test methods, and related laboratory activities, such as sample receipt, sample preparation, or data verification are documented.

- The record keeping system facilitates the retrieval of all working files and archived records for inspection and verification purposes (e.g., set format for naming electronic files, set format for what is included with a given analytical data set. Reference TestAmerica Edison SOP No. ED-GEN-024 (Record Storage and Retention).

- Instrument data is stored sequentially by instrument. A given day's analyses are maintained in the order of the analysis. Run logs are maintained for each instrument or method; a copy of each day's run log or instrument sequence is stored with the data to aid in re-constructing an analytical sequence. Where an analysis is performed without an instrument, bound logbooks or bench sheets are used to record and file data. Standard and reagent information is recorded in logbooks or entered into the LIMS for each method as required.

- Changes to hardcopy records shall follow the procedures outlined in Section 12 and 19. Changes to electronic records in LIMS or instrument data are recorded in audit trails.

- The reason for a signature or initials on a document is clearly indicated in the records such as "sampled by," "prepared by," "reviewed by", or "analyzed by".

- All generated data except those that are generated by automated data collection systems, are recorded directly, promptly and legibly in permanent dark ink.

- Hard copy data may be scanned into PDF format for record storage as long as the scanning process can be verified in order to ensure that no data is lost and the data files and storage media must be tested to verify the laboratory's ability to retrieve the information prior to the destruction of the hard copy that was scanned.

- Also refer to Section 19.14.1 'Computer and Electronic Data Related Requirements'**.**

14.2 Technical and Analytical Records

14.2.1 The laboratory retains records of original observations, derived data and sufficient information to establish an audit trail, calibration records, staff records and a copy of each analytical report issued, for a minimum of five years unless otherwise specified by a client or regulatory requirement. The records for each analysis shall contain sufficient information to enable the analysis to be repeated under conditions as close as possible to the original. The records shall include the identity of laboratory personnel responsible for the sampling, performance of each analysis and reviewing results.

14.2.2 Observations, data and calculations are recorded real-time and are identifiable to the specific task.

14.2.3 Changes to hardcopy records shall follow the procedures outlined in Section 12 and 19. Changes to electronic records in LIMS or instrument data are recorded in audit trails.

The essential information to be associated with analysis, such as strip charts, tabular printouts, computer data files, analytical notebooks, and run logs, include:

- laboratory sample ID code**;**
- Date of analysis; Time of Analysis is also required if the holding time is seventy-two (72) hours or less, or when time critical steps are included in the analysis (e.g., drying times, incubations, etc.); instrumental analyses have the date and time of analysis recorded as part of their general operations. Where a time critical step exists in an analysis, location for such a time is included as part of the documentation in a specific logbook or on a benchsheet.

- Instrumentation identification and instrument operating conditions/parameters. Operating conditions/parameters are typically recorded in instrument maintenance logs where available.
- analysis type;
- all manual calculations and manual integrations;
- analyst's or operator's initials/signature;
- sample preparation including cleanup, separation protocols, incubation periods or subculture, ID codes, volumes, weights, instrument printouts, meter readings, calculations, reagents;
- test results;
- standard and reagent origin, receipt, preparation, and use;
- calibration criteria, frequency and acceptance criteria;
- data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions;
- quality control protocols and assessment;
- electronic data security, software documentation and verification, software and hardware audits, backups, and records of any changes to automated data entries; and
- Method performance criteria including expected quality control requirements. These are indicated both in the LIMS and on specific analytical report formats.

14.2.4 All logbooks used during receipt, preparation, storage, analysis, and reporting of samples or monitoring of support equipment shall undergo a documented supervisory or peer review on a monthly basis.

14.3 Laboratory Support Activities

In addition to documenting all the above-mentioned activities, the following are retained QA records and project records (previous discussions in this section relate where and how these data are stored):

- all original raw data, whether hard copy or electronic, for calibrations, samples and quality control measures, including analysts' work sheets and data output records (chromatograms, strip charts, and other instrument response readout records);
- a written description or reference to the specific test method used which includes a description of the specific computational steps used to translate parametric observations into a reportable analytical value;
- copies of final reports;
- archived SOPs;
- correspondence relating to laboratory activities for a specific project;
- all corrective action reports, audits and audit responses;
- proficiency test results and raw data; and

- results of data review, verification, and crosschecking procedures

14.3.1 Sample Handling Records

Records of all procedures to which a sample is subjected while in the possession of the laboratory are maintained. These include but are not limited to records pertaining to:

- sample preservation including appropriateness of sample container and compliance with holding time requirement;
- sample identification, receipt, acceptance or rejection and login;
- sample storage and tracking including shipping receipts, sample transmittal / COC forms; and
- procedures for the receipt and retention of samples, including all provisions necessary to protect the integrity of samples.

14.4 Administrative Records

The laboratory also maintains the administrative records in either electronic or hard copy form. Refer to Table 14-1.

14.5 Records Management, Storage and Disposal

All records (including those pertaining to test equipment), certificates and reports are safely stored, held secure and in confidence to the client. Certification related records are available upon request.

All information necessary for the historical reconstruction of data is maintained by the laboratory. Records that are stored only on electronic media must be supported by the hardware and software necessary for their retrieval.

Records that are stored or generated by computers or personal computers have hard copy, write-protected backup copies, or an electronic audit trail controlling access**.**

The laboratory has a record management system (a.k.a., document control) for control of laboratory notebooks, instrument logbooks, standards logbooks, and records for data reduction, validation, storage and reporting. Laboratory notebooks are issued on a per analysis basis, and are numbered sequentially. All data are recorded sequentially within a series of sequential notebooks. Bench sheets are filed sequentially. Standards are maintained in the LIMS – no logbooks are used to record that data**.** Records are considered archived when noted as such in the records management system (a.k.a., document control.)

14.5.1 Transfer of Ownership

In the event that the laboratory transfers ownership or goes out of business, the laboratory shall ensure that the records are maintained or transferred according to client's instructions. Upon ownership transfer, record retention requirements shall be addressed in the ownership transfer agreement and the responsibility for maintaining archives is clearly established. In addition, in cases of bankruptcy, appropriate regulatory and state legal requirements concerning laboratory

records must be followed. In the event of the closure of the laboratory, all records will revert to the control of the corporate headquarters. Should the entire company cease to exist, as much notice as possible will be given to clients and the accrediting bodies who have worked with the laboratory during the previous 5 years of such action.

14.5.2 Records Disposal

Records are removed from the archive and destroyed after 5 years unless otherwise specified by a client or regulatory requirement. On a project specific or program basis, clients may need to be notified prior to record destruction. Records are destroyed in a manner that ensures their confidentiality such as shredding, mutilation or incineration. (Refer to Tables 14-1 and 14-2).

Electronic copies of records must be destroyed by erasure or physically damaging off-line storage media so no records can be read.

If a third party records management company is hired to dispose of records, a "Certificate of Destruction" is required.

SECTION 15. AUDITS

15.1 Internal Audits

Internal audits are performed to verify that laboratory operations comply with the requirements of the lab's quality system and with the external quality programs under which the laboratory operates. Audits are planned and organized by the QA staff. Personnel conducting the audits should be independent of the area being evaluated. Auditors will have sufficient authority, access to work areas, and organizational freedom necessary to observe all activities affecting quality and to report the assessments to laboratory management and, when requested, to corporate management.

Audits are conducted and documented as described in the TestAmerica Corporate SOP on performing Internal Auditing, SOP No. CW-Q-S-003. The types and frequency of routine internal audits are described in Table 15-1. Special or ad hoc assessments may be conducted as needed under the direction of the QA staff.

Table 15-1. Types of Internal Audits and Frequency

Description	Performed by	Frequency
Quality Systems Audits	QA Department, QA approved designee, or Corporate QA	All areas of the laboratory annually
Method Audits QA Technical Audits	Joint responsibility: a) QA Manager or designee b) Technical Manager or Designee (Refer to CW-Q-S-003)	QA Technical Audits Frequency: 50% of methods annually

Description	Performed by	Frequency
SOP Method Compliance	Joint responsibility: a) QA Manager or designee b) Technical Manager or Designee (Refer to CW-Q-S-003)	SOP Compliance Review Frequency: • Every 2 years
Special	QA Department or Designee	Surveillance or spot checks performed as needed, e.g., to confirm corrective actions from other audits.
Performance Testing	Analysts with QA oversight	Two successful per year for each TNI-field of testing or as dictated by regulatory requirements

15.1.1 Annual Quality Systems Audit

An annual quality systems audit is required to ensure compliance to analytical methods and SOPs, TestAmerica's Data Integrity and Ethics Policies, TNI quality systems, client and state requirements, and the effectiveness of the internal controls of the analytical process, including but not limited to data review, quality controls, preventive action and corrective action. The completeness of earlier corrective actions is assessed for effectiveness & sustainability. The audit is divided into sections for each operating or support area of the lab, and each section is comprehensive for a given area. The area audits may be performed on a rotating schedule throughout the year to ensure adequate coverage of all areas. This schedule may change as situations in the laboratory warrant.

15.1.2 QA Technical Audits

QA technical audits assess data authenticity and analyst integrity. These audits are based on client projects, associated sample delivery groups, and the methods performed. Reported results are compared to raw data to verify the authenticity of results. The validity of calibrations and QC results are compared to data qualifiers, footnotes, and case narratives. Documentation is assessed by examining run logs and records of manual integrations. Manual calculations are checked. Where possible, electronic audit miner programs (e.g., Chrom AuditMiner) are used to identify unusual manipulations of the data deserving closer scrutiny. QA technical audits will include all methods within a two-year period. All analysts should be reviewed over the course of a two year period through at least one QA Technical Audit

15.1.3 SOP Method Compliance

Compliance of all SOPs with the source methods and compliance of the operational groups with the SOPs will be assessed by the Technical Manager or qualified designee at least every two years. It is also recommended that the work of each newly hired analyst is assessed within 3 months of working independently, (e.g., completion of method IDOC). In addition, as analysts add methods to their capabilities, (new IDOC) reviews of the analyst work products will be performed within 3 months of completing the documented training.

15.1.4 Special Audits

Special audits are conducted on an as needed basis, generally as a follow up to specific issues such as client complaints, corrective actions, PT results, data audits, system audits, validation

comments, regulatory audits or suspected ethical improprieties. Special audits are focused on a specific issue, and report format, distribution, and timeframes are designed to address the nature of the issue.

15.1.5 Performance Testing

The laboratory participates semi-annually in performance audits conducted through the analysis of PT samples provided by a third party. The laboratory generally participates in the following types of PT studies: Drinking Water, Non-potable Water, Soil and Hazardous Waste.

It is TestAmerica's policy that PT samples be treated as typical samples in the production process. Furthermore, where PT samples present special or unique problems, in the regular production process they may need to be treated differently, as would any special or unique request submitted by any client. The QA Manager must be consulted and in agreement with any decisions made to treat a PT sample differently due to some special circumstance.

Written responses to unacceptable PT results are required. In some cases it may be necessary for blind QC samples to be submitted to the laboratory to show a return to control.

15.2 External Audits

External audits are performed when certifying agencies or clients conduct on-site inspections or submit performance testing samples for analysis. It is TestAmerica's policy to cooperate fully with regulatory authorities and clients. The laboratory makes every effort to provide the auditors with access to personnel, documentation, and assistance. Laboratory supervisors are responsible for providing corrective actions to the QA Manager who coordinates the response for any deficiencies discovered during an external audit. Audit responses are due in the time allotted by the client or agency performing the audit. When requested, a copy of the audit report and the labs corrective action plan will be forwarded to Corporate Quality.

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. The client may only view data and systems related directly to the client's work. All efforts are made to keep other client information confidential.

15.2.1 Confidential Business Information (CBI) Considerations

During on-site audits, auditors may come into possession of information claimed as business confidential. A business confidentiality claim is defined as "a claim or allegation that business information is entitled to confidential treatment for reasons of business confidentiality or a request for a determination that such information is entitled to such treatment." When information is claimed as business confidential, the laboratory must place on (or attach to) the information at the time it is submitted to the auditor, a cover sheet, stamped or typed legend or other suitable form of notice, employing language such as "trade secret", "proprietary" or "company confidential". Confidential portions of documents otherwise non-confidential must be clearly identified. CBI may be purged of references to client identity by the responsible laboratory official at the time of removal from the laboratory. However, sample identifiers may not be obscured from the information. Additional information regarding CBI can be found in within the 2009 TNI standards.

15.3 Audit Findings

Audit findings are documented using the corrective action process and database. The laboratory's corrective action responses for both types of audits may include action plans that could not be completed within a predefined timeframe. In these instances, a completion date must be set and agreed to by operations management and the QA Manager.

Developing and implementing corrective actions to findings is the responsibility of the Technical Managers where the finding originated. Findings that are not corrected by specified due dates are reported monthly to management in the QA monthly report. When requested, a copy of the audit report and the labs corrective action plan will be forwarded to Corporate Quality.

If any audit finding casts doubt on the effectiveness of the operations or on the correctness or validity of the laboratory's test results, the laboratory shall take timely corrective action, and shall notify clients in writing if the investigations show that the laboratory results have been affected. Once corrective action is implemented, a follow-up audit is scheduled to ensure that the problem has been corrected.

Clients must be notified promptly in writing, of any event such as the identification of defective measuring or test equipment that casts doubt on the validity of results given in any test report or amendment to a test report. The investigation must begin within 24-hours of discovery of the problem and all efforts are made to notify the client within two weeks after the completion of the investigation.

SECTION 16. MANAGEMENT REVIEWS

16.1 Quality Assurance Report

A comprehensive QA Report shall be prepared each month by the laboratory's QA Department and forwarded to the Laboratory Director, their Quality Director as well as the VP of Operations. All aspects of the QA system are reviewed to evaluate the suitability of policies and procedures. During the course of the year, the Laboratory Director, VP of Operations or Corporate QA may request that additional information be added to the report.

On a monthly basis, Corporate QA compiles information from all the monthly laboratory reports. The Corporate Quality Directors prepare a report that includes a compilation of all metrics and notable information and concerns regarding the QA programs within the laboratories. The report also includes a listing of new regulations that may potentially impact the laboratories. This report is presented to the Senior Management Team and VPs of Operations.

16.2 Annual Management Review

The senior lab management team (Laboratory Director, Technical Managers, QA Manager) conducts a review annually of its quality systems and LIMS to ensure its continuing suitability and effectiveness in meeting client and regulatory requirements and to introduce any necessary changes or improvements. It will also provide a platform for defining goals, & objectives and action items that feed into the laboratory planning system. Corporate Operations and Corporate

QA personnel is be included in this meeting at the discretion of the Laboratory Director. The LIMS review consists of examining any audits, complaints or concerns that have been raised through the year that are related to the LIMS. The laboratory will summarize any critical findings that cannot be solved by the lab and report them to Corporate IT.

This management systems review (Corporate SOP No. CW-Q-S-004 and Work Instruction No. CW-Q-WI-003) uses information generated during the preceding year to assess the "big picture" by ensuring that routine actions taken and reviewed on a monthly basis are not components of larger systematic concerns. The monthly review should keep the quality systems current and effective; therefore, the annual review is a formal senior management process to review specific existing documentation. Significant issues from the following documentation are compiled or summarized by the QA Manager prior to the review meeting:

- Matters arising from the previous annual review.
- Prior Monthly QA Reports issues.
- Laboratory QA Metrics.
- Review of report reissue requests.
- Review of client feedback and complaints.
- Issues arising from any prior management or staff meetings.
- Minutes from prior senior lab management meetings. Issues that may be raised from these meetings include:
    - Adequacy of staff, equipment and facility resources.
    - Adequacy of policies and procedures.
    - Future plans for resources and testing capability and capacity.
- The annual internal double blind PT program sample performance (if performed),
- Compliance to the Ethics Policy and Data Integrity Plan. Including any evidence/incidents of inappropriate actions or vulnerabilities related to data Integrity.

A report is generated by the QA Manager and management. The report is distributed to the appropriate VP of Operation and the Quality Director. The report includes, but is not limited to:

- The date of the review and the names and titles of participants.
- A reference to the existing data quality related documents and topics that were reviewed.
- Quality system or operational changes or improvements that will be made as a result of the review [e.g., an implementation schedule including assigned responsibilities for the changes (Action Table)].

Changes to the quality systems requiring update to the laboratory QA Manual shall be included in the next revision of the QA Manual.

16.3 Potential Integrity Related Managerial Reviews

Potential integrity issues (data or business related) must be handled and reviewed in a confidential manner until such time as a follow-up evaluation, full investigation, or other appropriate actions have been completed and issues clarified. TestAmerica's Corporate Internal

Investigations SOP shall be followed (SOP No. CW-L-S-002). All investigations that result in finding of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients.

TestAmerica's President and CEO, Executive VP of Operations, VP of Client & Technical Services, VPs of Operations and Quality Directors receive a monthly report from the VP-QA/EHS summarizing any current data integrity or data recall investigations. The VPs of Operations are also made aware of progress on these issues for their specific labs.

SECTION 17. PERSONNEL

17.1 Overview

The laboratory's management believes that its highly qualified and professional staff is the single most important aspect in assuring a high level of data quality and service. The staff consists of professionals and support personnel as outlined in the organization chart in Figure 4-1.

All personnel must demonstrate competence in the areas where they have responsibility. Any staff that is undergoing training shall have appropriate supervision until they have demonstrated their ability to perform their job function on their own. Staff shall be qualified for their tasks based on appropriate education, training, experience and/or demonstrated skills as required.

The laboratory employs sufficient personnel with the necessary education, training, technical knowledge and experience for their assigned responsibilities.

All personnel are responsible for complying with all QA/QC requirements that pertain to the laboratory and their area of responsibility. Each staff member must have a combination of experience and education to adequately demonstrate a specific knowledge of their particular area of responsibility. Technical staff must also have a general knowledge of lab operations, test methods, QA/QC procedures and records management.

Laboratory management is responsible for formulating goals for lab staff with respect to education, training and skills and ensuring that the laboratory has a policy and procedures for identifying training needs and providing training of personnel. The training shall be relevant to the present and anticipated responsibilities of the lab staff.

The laboratory only uses personnel that are employed by or under contract to, the laboratory. Contracted personnel, when used, must meet competency standards of the laboratory and work in accordance to the laboratory's quality system.

17.2 Education and Experience Requirements for Technical Personnel

The laboratory makes every effort to hire analytical staffs that possess a college degree (AA, BA, BS) in an applied science with some chemistry in the curriculum. Exceptions can be made based upon the individual's experience and ability to learn. Selection of qualified candidates for laboratory employment begins with documentation of minimum education, training, and experience prerequisites needed to perform the prescribed task. Minimum education and training requirements for TestAmerica employees are outlined in job descriptions and are generally summarized for analytical staff in the table below.

The laboratory maintains job descriptions for all personnel who manage, perform or verify work affecting the quality of the environmental testing the laboratory performs. Job Descriptions are located on the TestAmerica intranet site's Human Resources web-page (Also see Section 4 for position descriptions/responsibilities).

Experience and specialized training are occasionally accepted in lieu of a college degree (basic lab skills such as using a balance, colony counting, aseptic or quantitation techniques, etc., are also considered).

As a general rule for analytical staff:

Specialty	Education	Experience
Extractions, Digestions, some electrode methods (pH, DO, Redox, etc.), or Titrimetric and Gravimetric Analyses	H.S. Diploma	On the job training (OJT)
GFAA, CVAA, FLAA, Single component or short list Chromatography (e.g., Fuels, BTEX-GC, IC	A college degree in an applied science or 2 years of college and at least 1 year of college chemistry	Or 2 years prior analytical experience is required
ICP, ICPMS, Long List or complex chromatography (e.g., Pesticides, PCB, Herbicides, HPLC, etc.), GCMS	A college degree in an applied science or 2 years of college chemistry	or 5 years of prior analytical experience
Spectra Interpretation	A college degree in an applied science or 2 years of college chemistry	And 2 years relevant experience Or 5 years of prior analytical experience
Department Managers (i.e,Technical Managers) - **General**	Bachelor's Degree in an applied science or engineering with 24 semester hours in chemistry An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years experience in environmental analysis of representative analytes for which they will oversee
Department Managers (i.e,Technical Managers)– **Wet Chem** only (no advanced instrumentation)	Associates degree in an applied science or engineering or 2 years of college with 16 semester hours in chemistry	And 2 years relevant experience

When an analyst does not meet these requirements, they can perform a task under the direct supervision of a qualified analyst, peer reviewer or Technical Manager, and are considered an analyst in training. The person supervising an analyst in training is accountable for the quality of the analytical data and must review and approve data and associated corrective actions.

17.3 Training

The laboratory is committed to furthering the professional and technical development of employees at all levels.

Orientation to the laboratory's policies and procedures, in-house method training, and employee attendance at outside training courses and conferences all contribute toward employee proficiency. Below are examples of various areas of required employee training:

Required Training	Time Frame	Employee Type
Environmental Health & Safety	Prior to lab work	All
Ethics – New Hires	1 week of hire	All
Ethics – Comprehensive	90 days of hire	All
Data Integrity	30 days of hire	Technical and PMs
Quality Assurance	90 days of hire	All
Ethics – Comprehensive Refresher	Annually	All
Initial Demonstration of Capability (DOC)	Prior to unsupervised method performance	Technical

The laboratory maintains records of relevant authorization/competence, education, professional qualifications, training, skills and experience of technical personnel (including contracted personnel) as well as the date that approval/authorization was given. These records are kept on file at the laboratory. Also refer to "Demonstration of Capability" in Section 19.

The training of technical staff is kept up to date by:

- Each employee must have documentation in their training file that they have read, understood and agreed to follow the most recent version of the laboratory QA Manual and SOPs in their area of responsibility. This documentation is updated as SOPs are updated.
- Documentation from any training courses or workshops on specific equipment, analytical techniques or other relevant topics are maintained in their training file.
- Documentation of proficiency (refer to Section 19).
- An Ethics Agreement signed by each staff member (renewed each year) and evidence of annual ethics training.
- A Confidentiality Agreement signed by each staff member signed at the time of employment.
- Human Resources maintains documentation and attestation forms on employment status & records; benefit programs; timekeeping/payroll; and employee conduct (e.g., ethics violations). This information is maintained in the employee's secured personnel file.

Further details of the laboratory's training program are described in the Laboratory Training SOP (TestAmerica Edison SOP No. ED-GEN-022).

17.4 Data Integrity and Ethics Training Program

Establishing and maintaining a high ethical standard is an important element of a Quality System. Ethics and data integrity training is integral to the success of TestAmerica and is provided for each employee at TestAmerica. It is a formal part of the initial employee orientation within 1 week of hire followed by technical data integrity training within 30 days, comprehensive training within 90 days, and an annual refresher for all employees. Senior management at each facility performs the ethics training for their staff.

In order to ensure that all personnel understand the importance TestAmerica places on maintaining high ethical standards at all times; TestAmerica has established a Corporate Ethics Policy (Policy No. CW-L-P-004) and an Ethics Statement. All initial and annual training is documented by signature on the signed Ethics Statement demonstrating that the employee has participated in the training and understands their obligations related to ethical behavior and data integrity.

Violations of this Ethics Policy will not be tolerated. Employees who violate this policy will be subject to disciplinary actions up to and including termination. Criminal violations may also be referred to the Government for prosecution. In addition, such actions could jeopardize TestAmerica's ability to do work on Government contracts, and for that reason, TestAmerica has a Zero Tolerance approach to such violations.

Employees are trained as to the legal and environmental repercussions that result from data misrepresentation. Key topics covered in the presentation include:

- Organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting.
- Ethics Policy
- How and when to report ethical/data integrity issues. Confidential reporting.
- Record keeping.
- Discussion regarding data integrity procedures.
- Specific examples of breaches of ethical behavior (e.g. peak shaving, altering data or computer clocks, improper macros, etc., accepting/offering kickbacks, illegal accounting practices, unfair competition/collusion)
- Internal monitoring. Investigations and data recalls.
- Consequences for infractions including potential for immediate termination, debarment, or criminal prosecution.
- Importance of proper written narration / data qualification by the analyst and project manager with respect to those cases where the data may still be usable but are in one sense or another partially deficient.

Additionally, a data integrity hotline (1-800-736-9407) is maintained by TestAmerica and administered by the Corporate Quality Department.

SECTION 18. ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS

18.1 Overview

The laboratory is a 42,000 ft^2 secure laboratory facility with controlled access and designed to accommodate an efficient workflow and to provide a safe and comfortable work environment for employees. All visitors sign in and are escorted by laboratory personnel. Access is controlled by various measures.

The laboratory is equipped with structural safety features. Each employee is familiar with the location, use, and capabilities of general and specialized safety features associated with their workplace. The laboratory provides and requires the use of protective equipment including safety glasses, protective clothing, gloves, etc., OSHA and other regulatory agency guidelines regarding required amounts of bench and fume hood space, lighting, ventilation (temperature and humidity controlled), access, and safety equipment are met or exceeded.

Traffic flow through sample preparation and analysis areas is minimized to reduce the likelihood of contamination. Adequate floor space and bench top area is provided to allow unencumbered sample preparation and analysis space. Sufficient space is also provided for storage of reagents and media, glassware, and portable equipment. Ample space is also provided for refrigerated sample storage before analysis and archival storage of samples after analysis. Laboratory HVAC and deionized water systems are designed to minimize potential trace contaminants.

The laboratory is separated into specific areas for sample receiving, sample preparation, volatile organic sample analysis, non-volatile organic sample analysis, inorganic sample analysis, and administrative functions.

18.2 Environment

Laboratory accommodation, test areas, energy sources, lighting are adequate to facilitate proper performance of tests. The facility is equipped with heating, ventilation, and air conditioning (HVAC) systems appropriate to the needs of environmental testing performed at this laboratory.

The environment in which these activities are undertaken does not invalidate the results or adversely affect the required accuracy of any measurements.

The laboratory provides for the effective monitoring, control and recording of environmental conditions that may affect the results of environmental tests as required by the relevant specifications, methods, and procedures. Such environmental conditions include humidity, voltage, temperature, and vibration levels in the laboratory.

When any of the method or regulatory required environmental conditions change to a point where they may adversely affect test results, analytical testing will be discontinued until the environmental conditions are returned to the required levels.

Environmental conditions of the facility housing the computer network and LIMS are regulated to protect against raw data loss.

18.3 Work Areas

There is effective separation between neighboring areas when the activities therein are incompatible with each other. Examples include:

- Volatile organic chemical handling areas, including sample preparation and waste disposal, and volatile organic chemical analysis areas.

Access to and use of all areas affecting the quality of analytical testing is defined and controlled by secure access to the laboratory building as described below in the Building Security section.

Adequate measures are taken to ensure good housekeeping in the laboratory and to ensure that any contamination does not adversely affect data quality. These measures include regular cleaning to control dirt and dust within the laboratory. Work areas are available to ensure an unencumbered work area. Work areas include:

- Access and entryways to the laboratory.
- Sample receipt areas.
- Sample storage areas.
- Chemical and waste storage areas.
- Data handling and storage areas.
- Sample processing areas.
- Sample analysis areas.

18.4 Floor Plan

A floor plan can be found in Appendix 1.

18.5 Building Security

Building keys are distributed to employees as necessary.

Visitors to the laboratory sign in and out in a visitor's logbook. A visitor is defined as any person who visits the laboratory who is not an employee of the laboratory. In addition to signing into the laboratory, the Environmental, Health and Safety Manual contains requirements for visitors and vendors. There are specific safety forms that must be reviewed and signed. Visitors (with the exception of company employees) are escorted by laboratory personnel at all times, or the location of the visitor is noted in the visitor's logbook.

SECTION 19. TEST METHODS AND METHOD VALIDATION

19.1 Overview

The laboratory uses methods that are appropriate to meet our clients' requirements and that are within the scope of the laboratory's capabilities. These include sampling, handling, transport, storage and preparation of samples, and, where appropriate, an estimation of the measurement of uncertainty as well as statistical techniques for analysis of environmental data.

Instructions are available in the laboratory for the operation of equipment as well as for the handling and preparation of samples. All instructions, Standard Operating Procedures (SOPs), reference methods and manuals relevant to the working of the laboratory are readily available to all staff. Deviations from published methods are documented (with justification) in the laboratory's approved SOPs. SOPs are submitted to clients for review at their request. Significant deviations from published methods require client approval and regulatory approval where applicable.

19.2 Standard Operating Procedures (SOPS)

The laboratory maintains SOPs that accurately reflect all phases of the laboratory such as assessing data integrity, corrective actions, handling customer complaints as well as all analytical methods and sampling procedures. The method SOPs are derived from the most recently promulgated/approved, published methods and are specifically adapted to the laboratory facility. Modifications or clarifications to published methods are clearly noted in the SOPs. All SOPs are controlled in the laboratory.

- All SOPs contain a revision number, effective date, and appropriate approval signatures. Controlled copies are available to all staff.
- Procedures for writing an SOP are incorporated by reference to TestAmerica's Corporate SOP entitled 'Writing a Standard Operating Procedure', No. CW-Q-S-002.
- SOPs are reviewed at a minimum of every 2 years (annually for Drinking Water and DoD/DOE SOPs), and where necessary, revised to ensure continuing suitability and compliance with applicable requirements.

19.3 Laboratory Methods Manual

For each test method, the laboratory shall have available the published referenced method as well as the laboratory developed SOP.

Note: If more stringent standards or requirements are included in a mandated test method or regulation than those specified in this manual, the laboratory shall demonstrate that such requirements are met. If it is not clear which requirements are more stringent, the standard from the method or regulation is to be followed. Any exceptions or deviations from the referenced methods or regulations are noted in the specific analytical SOP.

The laboratory maintains an SOP Index for both technical and non-technical SOPs. Technical SOPs are maintained to describe a specific test method. Non-technical SOPs are maintained to describe functions and processes not related to a specific test method.

19.4 Selection of Methods

Since numerous methods and analytical techniques are available, continued communication between the client and laboratory is imperative to assure the correct methods are utilized. Once client methodology requirements are established, this and other pertinent information is summarized by the Project Manager. These mechanisms ensure that the proper analytical methods are applied when the samples arrive for log-in. For non-routine analytical services (e.g., special matrices, non-routine compound lists), the method of choice is selected based on client needs and available technology. The methods selected should be capable of measuring the specific parameter of interest, in the concentration range of interest, and with the required precision and accuracy.

19.4.1 Sources of Methods

Routine analytical services are performed using standard EPA-approved methodology. In some cases, modification of standard approved methods may be necessary to provide accurate analyses of particularly complex matrices. When the use of specific methods for sample

analysis is mandated through project or regulatory requirements, only those methods shall be used.

When clients do not specify the method to be used or methods are not required, the methods used will be clearly validated and documented in an SOP and available to clients and/or the end user of the data.

The analytical methods used by the laboratory are those currently accepted and approved by the U. S. EPA and the state or territory from which the samples were collected. Reference methods include:

- *Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act; Analysis and Sampling Procedures; 40CFR Part 136 as amended by Method Update Rule; May 18, 2012.*
- *Methods for Chemical Analysis of Water and Wastes, EPA 600 (4-79-020), 1983.*
- *Methods for the Determination of Inorganic Substances in Environmental Samples, EPA-600/R-93/100, August 1993.*
- *Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91/010, June 1991. Supplement I: EPA-600/R-94/111, May 1994.*
- *Methods for the Determination of Organic Compounds in Drinking Water, EPA-600/4-88-039, December 1988, Revised, July 1991, Supplement I, EPA-600-4-90-020, July 1990, Supplement II, EPA-600/R-92-129, August 1992. Supplement III EPA/600/R-95/131 - August 1995 (EPA 500 Series) (EPA 500 Series methods)*
- *Technical Notes on Drinking Water Methods, EPA-600/R94-173, October 1994*
- *NIOSH Manual of Analytical Methods, 4th ed., August 1994.*
- *Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.*
- *Standard Methods for the Examination of Water and Wastewater, 18th/19th /20th/ on-line edition; Eaton, A.D. Clesceri, L.S. Greenberg, A.E. Eds; American Water Works Association, Water Pollution Control Federation, American Public Health Association: Washington, D.C.*
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008; Final Update V, August 2015.*
- *Annual Book of ASTM Standards, American Society for Testing & Materials (ASTM), Philadelphia, PA.*
- *National Status and Trends Program, National Oceanographic and Atmospheric Administration, Volume I-IV, 1985-1994.*
- *Manual for the Certification of Laboratories Analyzing Drinking Water (EPA 815-R-05-004, January 2005)* ***(DW labs only)***
- *Code of Federal Regulations (CFR) 40, Parts 136, 141, 172, 173, 178, 179 and 261*

The laboratory reviews updated versions to all the aforementioned references for adaptation based upon capabilities, instrumentation, etc., and implements them as appropriate. As such, the laboratory strives to perform only the latest versions of each approved method as regulations allow or require.

Other reference procedures for non-routine analyses may include methods established by specific states (e.g., Underground Storage Tank methods), ASTM or equipment manufacturers. Sample type, source, and the governing regulatory agency requiring the analysis will determine the method utilized.

The laboratory shall inform the client when a method proposed by the client may be inappropriate or out of date. After the client has been informed, and they wish to proceed contrary to the laboratory's recommendation, it will be documented.

19.4.2 Demonstration of Capability

Before the laboratory may institute a new method and begin reporting results, the laboratory shall confirm that it can properly operate the method. In general, this demonstration does not test the performance of the method in real world samples, but in an applicable and available clean matrix sample. If the method is for the testing of analytes that are not conducive to spiking, demonstration of capability may be performed on quality control samples.

A demonstration of capability (DOC) (reference TestAmerica Edison Training SOP No. ED-GEN-022) is performed whenever there is a change in instrument type (e.g., new instrumentation), matrix, method or personnel (e.g., analyst hasn't performed the test within the last 12 months).

Note: The laboratory shall have a DOC for all analytes included in the methods that the laboratory performs, and proficiency DOCs for each analyst shall include all analytes that the laboratory routinely performs. Addition of non-routine analytes does not require new DOCs for all analysts if those analysts are already qualified for routine analytes tested using identical chemistry and instrument conditions.

The initial demonstration of capability must be thoroughly documented and approved by the Department Manager (i.e., Technical Manager) and QA Manager prior to independently analyzing client samples. All associated documentation must be retained in accordance with the laboratories archiving procedures.

The laboratory must have an approved SOP, demonstrate satisfactory performance, and conduct an MDL study (when applicable). There may be other requirements as stated within the published method or regulations (i.e., retention time window study).

Note: In some instances, a situation may arise where a client requests that an unusual analyte be reported using a method where this analyte is not normally reported. If the analyte is being reported for regulatory purposes, the method must meet all procedures outlined within this QA Manual (SOP, MDL, and Demonstration of Capability). If the client states that the information is not for regulatory purposes, the result may be reported as long as the following criteria are met:

- The instrument is calibrated for the analyte to be reported using the criteria for the method and ICV/CCV criteria are met (unless an ICV/CCV is not required by the method or criteria are per project DQOs).

- The laboratory's nominal or default reporting limit (RL) is equal to the quantitation limit (QL), must be at or above the lowest non-zero standard in the calibration curve and must be reliably determined. Project RLs are client specified reporting levels which may be higher than the QL. Results reported below the QL must be qualified as estimated values. Also see Section 19.6.1.3, Relationship of Limit of Detection (LOD) to Quantitation Limit (QL).
- The client request is documented and the lab informs the client of its procedure for working with unusual compounds. The final report must be footnoted: *Reporting Limit based on the low standard of the calibration curve.*

19.4.3 Initial Demonstration of Capability (IDOC) Procedures

19.4.3.1 The spiking standard used must be prepared independently from those used in instrument calibration.

19.4.3.2 The analyte(s) shall be diluted in a volume of clean matrix sufficient to prepare four aliquots at the concentration specified by a method or the laboratory SOP.

19.4.3.3 At least four aliquots shall be prepared (including any applicable clean-up procedures) and analyzed according to the test method (either concurrently or over a period of days).

19.4.3.4 Using all of the results, calculate the mean recovery in the appropriate reporting units and the standard deviations for each parameter of interest.

19.4.3.5 When it is not possible to determine the mean and standard deviations, such as for presence, absence and logarithmic values, the laboratory will assess performance against criteria described in the Method SOP.

19.4.3.6 Compare the information obtained above to the corresponding acceptance criteria for precision and accuracy in the test method (if applicable) or in laboratory generated acceptance criteria (LCS or interim criteria) if there is no mandatory criteria established. If any one of the parameters do not meet the acceptance criteria, the performance is unacceptable for that parameter.

19.4.3.7 When one or more of the tested parameters fail at least one of the acceptance criteria, the analyst must proceed according to either option listed below:

- Locate and correct the source of the problem and repeat the test for all parameters of interest beginning with 19.4.3.3 above.
- Beginning with 19.4.3.3 above, repeat the test for all parameters that failed to meet criteria. Repeated failure, however, will confirm a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds of interest beginning with 19.4.3.1 above.

Note: Results of successive LCS analyses can be used to fulfill the DOC requirement.

A certification statement (refer to Figure 19-1 as an example shall be used to document the completion of each initial demonstration of capability. A copy of the certification is archived in the analyst's training folder.

Methods on line prior to the effective date of this Section shall be updated to the procedures outlined above as new analysts perform their demonstration of capability. A copy of the new record will replace that which was used for documentation in the past. At a minimum, the precision and accuracy of four mid-level laboratory control samples must have been compared to the laboratory's quality control acceptance limits.

19.5 Laboratory Developed Methods and Non-Standard Methods

Any new method developed by the laboratory must be fully defined in an SOP and validated by qualified personnel with adequate resources to perform the method. Method specifications and the relation to client requirements must be clearly conveyed to the client if the method is a non-standard method (not a published or routinely accepted method). The client must also be in agreement to the use of the non-standard method.

19.6 Validation of Methods

Validation is the confirmation by examination and the provision of objective evidence that the particular requirements for a specific intended use are fulfilled.
All non-standard methods, laboratory designed/developed methods, standard methods used outside of their scope, and major modifications to published methods must be validated to confirm they are fit for their intended use. The validation will be as extensive as necessary to meet the needs of the given application. The results are documented with the validation procedure used and contain a statement as to the fitness for use.

19.6.1 Method Validation and Verification Activities for All New Methods

While method validation can take various courses, the following activities can be required as part of method validation. Method validation records are designated QC records and are archived accordingly.

19.6.1.1 Determination of Method Selectivity – Method selectivity is the demonstrated ability to discriminate the analyte(s) of interest from other compounds in the specific matrix or matrices from other analytes or interference. In some cases to achieve the required selectivity for an analyte, a confirmation analysis is required as part of the method.

19.6.1.2 Determination of Method Sensitivity – Sensitivity can be both estimated and demonstrated. Whether a study is required to estimate sensitivity depends on the level of method development required when applying a particular measurement system to a specific set of samples. Where estimations and/or demonstrations of sensitivity are required by regulation or client agreement, such as the procedure in 40 CFR Part 136 Appendix B, under the Clean Water Act, these shall be followed.

19.6.1.3 Relationship of Limit of Detection (LOD) to the Quantitation Limit (QL) – An important characteristic of expression of sensitivity is the difference in the LOD and the QL. The LOD is the minimum level at which the presence of an analyte can be reliably concluded. The QL is the minimum concentration of analyte that can be quantitatively determined with acceptable precision and bias. For most instrumental measurement systems, there is a region where semi-quantitative data is generated around the LOD (both above and below the estimated MDL or LOD) and below the QL. In this region, detection of an analyte may be confirmed but quantification of the analyte is unreliable within the accuracy and precision

guidelines of the measurement system. When an analyte is detected below the QL, and the presence of the analyte is confirmed by meeting the qualitative identification criteria for the analyte, the analyte can be reliably reported, but the amount of the analyte can only be estimated. If data is to be reported in this region, it must be done so with a qualification that denotes the semi-quantitative nature of the result.

19.6.1.4 Determination of Interferences – A determination that the method is free from interferences in a blank matrix is performed.

19.6.1.5 Determination of Range – Where appropriate to the method, the quantitation range is determined by comparison of the response of an analyte in a curve to established or targeted criteria. Generally the upper quantitation limit is defined by highest acceptable calibration concentration. The lower quantitation limit or QL cannot be lower than the lowest non-zero calibration level, and can be constrained by required levels of bias and precision.

19.6.1.6 Determination of Accuracy and Precision – Accuracy and precision studies are generally performed using replicate analyses, with a resulting percent recovery and measure of reproducibility (standard deviation, relative standard deviation) calculated and measured against a set of target criteria.

19.6.1.7 Documentation of Method – The method is formally documented in an SOP. If the method is a minor modification of a standard laboratory method that is already documented in an SOP, an SOP Attachment describing the specific differences in the new method is acceptable in place of a separate SOP.

19.6.1.8 Continued Demonstration of Method Performance – Continued demonstration of Method Performance is addressed in the SOP. Continued demonstration of method performance is generally accomplished by batch specific QC samples such as LCS, method blanks or PT samples.

19.7 Method Detection Limits (MDL) / Limits of Detection (LOD)

Method detection limits (MDL) are initially determined in accordance with 40 CFR Part 136, Appendix B or alternatively by other technically acceptable practices that have been accepted by regulators. MDL is also sometimes referred to as Limit of Detection (LOD). The MDL theoretically represents the concentration level for each analyte within a method at which the analyst is 99% confident that the true value can be differentiated from blanks. The MDL is determined for each analyte initially during the method validation process and updated as required in the analytical methods, whenever there is a significant change in the procedure or equipment, or based on project specific requirements. Generally, the analyst prepares at least seven replicates of solution spiked at one to five times the estimated method detection limit (most often at the lowest standard in the calibration curve) into the applicable matrix with all the analytes of interest. Each of these aliquots is extracted (including any applicable clean-up procedures) and analyzed in the same manner as the samples. Where possible, the seven replicates should be analyzed over 2-4 days to provide a more realistic MDL.

Refer to the Corporate SOP No. CA-Q-S-006 for details on the laboratory's MDL process.

19.8 Instrument Detection Limits (IDL)

The IDL is sometimes used to assess the reasonableness of the MDLs or in some cases required by the analytical method or program requirements. IDLs are most used in metals analyses but may be useful in demonstration of instrument performance in other areas.

IDLs are calculated to determine an instrument's sensitivity independent of any preparation method. IDLs are calculated either using 7 replicate spike analyses, like MDL but without sample preparation, or by the analysis of 10 instrument blanks and calculating 3 x the absolute value of the standard deviation.

If IDL is > than the MDL, it may be used as the reported MDL.

19.9 Verification of Detection and Reporting Limits

Once an MDL is established, it must be verified, on each instrument, by analyzing a quality control sample (prepared as a sample) at no more than 3 times the calculated MDL for single analyte analyses (e.g. most wet chemistry methods, Atomic Absorption, etc.) and no more than 4 times the calculated MDL for multiple analyte methods (e.g. GC, GCMS, ICP, etc.). The analytes must be qualitatively identified. This verification does not apply to methods that are not readily spiked (e.g. pH, turbidity, etc.) or where the lab does not report to the MDL. If the MDL does not verify, then the lab will not report to the MDL, or redevelop their MDL or use the level where qualitative identification is established. MDLs must be verified at least annually

When the laboratory establishes a quantitation limit, it must be initially verified by the analysis of a low level standard or QC sample at 1-2 times the reporting limit and annually thereafter. The annual requirement is waived for methods that have an annually verified MDL. The laboratory will comply with any regulatory requirements.

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19.10 Retention Time Windows

Most organic analyses and some inorganic analyses use chromatography techniques for qualitative and quantitative determinations. For every chromatography analysis or as specific in the reference method, each analyte will have a specific time of elution from the column to the detector. This is known as the analyte's retention time. The variance in the expected time of elution is defined as the retention time window. As the key to analyte identification in chromatography, retention time windows must be established on every column for every analyte used for that method. These records are kept with the files associated with an instrument for later quantitation of the analytes. Complete details are available in the laboratory SOPs.

19.11 Evaluation of Selectivity

The laboratory evaluates selectivity by following the checks within the applicable analytical methods, which include mass spectral tuning, second column confirmation, ICP interelement interference checks, chromatography retention time windows, sample blanks, spectrochemical, atomic absorption or fluorescence profiles, co-precipitation evaluations and specific electrode response factors.

19.12 Estimation of Uncertainty of Measurement

19.12.1 Uncertainty is "a parameter associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand" (as defined by the International Vocabulary of Basic and General Terms in Metrology, ISO Geneva, 1993, ISBN 92-67-10175-1). Knowledge of the uncertainty of a measurement provides additional confidence in a result's validity. Its value accounts for all the factors which could possibly affect the result, such as adequacy of analyte definition, sampling, matrix effects and interferences, climatic conditions, variances in weights, volumes, and standards, analytical procedure, and random variation. Some national accreditation organizations require the use of an "expanded uncertainty": the range within which the value of the measurand is believed to lie within at least a 95% confidence level with the coverage factor k=2.

19.12.2 Uncertainty is not error. Error is a single value, the difference between the true result and the measured result. On environmental samples, the true result is never known. The measurement is the sum of the unknown true value and the unknown error. Unknown error is a combination of systematic error, or bias, and random error. Bias varies predictably, constantly, and independently from the number of measurements. Random error is unpredictable, assumed to be Gaussian in distribution, and reducible by increasing the number of measurements.

19.12.3 The minimum uncertainty associated with results generated by the laboratory can be determined by using the Laboratory Control Sample (LCS) accuracy range for a given analyte. The LCS limits are used to assess the performance of the measurement system since they take into consideration all of the laboratory variables associated with a given test over time (except for variability associated with the sampling and the variability due to matrix effects). The percent recovery of the LCS is compared either to the method-required LCS accuracy limits or to the statistical, historical, in-house LCS accuracy limits.

19.12.4 To calculate the uncertainty for the specific result reported, multiply the result by the decimal of the lower end of the LCS range percent value for the lower end of the uncertainty range, and multiply the result by the decimal of the upper end of the LCS range percent value for the upper end of the uncertainty range. These calculated values represent uncertainties at approximately the 99% confidence level with a coverage factor of k = 3. As an example, for a reported result of 1.0 mg/L with an LCS recovery range of 50 to 150%, the estimated uncertainty in the result would be 1.0 +/- 0.5 mg/L.

19.12.5 In the case where a well-recognized test method specifies limits to the values of major sources of uncertainty of measurement (e.g., 524.2, 525, etc.) and specifies the form of presentation of calculated results, no further discussion of uncertainty is required.

19.13 Sample Reanalysis Guidelines

Because there is a certain level of uncertainty with any analytical measurement, a sample re-preparation (where appropriate) and subsequent analysis (hereafter referred to as 'reanalysis') may result in either a higher or lower value from an initial sample analysis. There are also variables that may be present (e.g., sample homogeneity, analyte precipitation over time, etc.) that may affect the results of a reanalysis. Based on the above comments, the laboratory will reanalyze samples at a client's request with the following caveats. Client specific Contractual Terms & Conditions for reanalysis protocols may supersede the following items.

- Homogenous samples: If a reanalysis agrees with the original result to within the RPD limits for MS/MSD or Duplicate analyses, or within ± 1 reporting limit for samples ≤ 5x the reporting limit, the original analysis will be reported. At the client's request, both results may be reported on the same report but not on two separate reports.

- If the reanalysis does not agree (as defined above) with the original result, then the laboratory will investigate the discrepancy and reanalyze the sample a third time for confirmation if sufficient sample is available.

- Any potential charges related to reanalysis are discussed in the contract terms and conditions or discussed at the time of the request. The client will typically be charged for reanalysis unless it is determined that the lab was in error.

- Due to the potential for increased variability, reanalysis may not be applicable to Non-homogenous, Encore, and Sodium Bisulfate preserved samples. See the Area Supervisor *or* Laboratory Director if unsure.

19.14 Control of Data

The laboratory has policies and procedures in place to ensure the authenticity, integrity, and accuracy of the analytical data generated by the laboratory.

19.14.1 Computer and Electronic Data Related Requirements

The three basic objectives of our computer security procedures and policies are shown below. More detail is outlined in the TestAmerica Corporate IT SOPs and in TestAmerica Edison SOPs No. ED-GEN-001 (Data Management and Handling Procedures) and ED-GEN-002 (Document Control). The laboratory is currently running the TALS LIMS which is a custom in-house developed LIMS system that has been highly customized to meet the needs of the laboratory. It is referred to as LIMS for the remainder of this section. The LIMS utilizes Microsoft SQL Server which is an industry standard relational database platform. It is referred to as Database for the remainder of this section.

19.14.1.1 Maintain the Database Integrity – Assurance that data is reliable and accurate through data verification (review) procedures, password-protecting access, anti-virus protection, data change requirements, as well as an internal LIMS permissions procedure.

- LIMS Database Integrity is achieved through data input validation, internal user controls, and data change requirements.
- Spreadsheets and other software developed in-house must be verified with documentation through hand calculations prior to use. Cells containing calculations must be lock-protected and controlled.
- Instrument hardware and software adjustments are safeguarded through maintenance logs, audit trails and controlled access.

19.14.1.2 Ensure Information Availability – Protection against loss of information or service is ensured through scheduled back-ups, stable file server network architecture,

secure storage of media, line filter, Uninterruptible Power Supply (UPS), and maintaining older versions of software as revisions are implemented.

19.14.1.3 **Maintain Confidentiality** – Ensure data confidentiality through physical access controls such as password protection or website access approval when electronically transmitting data.

19.14.2 Data Reduction

The complexity of the data reduction depends on the analytical method and the number of discrete operations involved (e.g., extractions, dilutions, instrument readings and concentrations). The analyst calculates the final results from the raw data or uses appropriate computer programs to assist in the calculation of final reportable values.

For manual data entry, e.g., Wet Chemistry, the data is reduced by the analyst and then verified by the Department Technical Manager or alternate analyst prior to updating the data in LIMS. The spreadsheets, or any other type of applicable documents, are signed by both the analyst and alternate reviewer to confirm the accuracy of the manual entry(s).

Manual integration of peaks will be documented and reviewed and the raw data will be flagged in accordance with the TestAmerica Corporate SOP No. CA-Q-S-002, *Acceptable Manual Integration Practices*.

Analytical results are reduced to appropriate concentration units specified by the analytical method, taking into account factors such as dilution, sample weight or volume, etc. Blank correction will be applied only when required by the method or per manufacturer's indication; otherwise, it should not be performed. Calculations are independently verified by appropriate laboratory staff. Calculations and data reduction steps for various methods are summarized in the respective analytical SOPs or program requirements.

19.14.2.1 All raw data must be retained in the worklist folder, computer file (if appropriate), and/or runlog. All criteria pertinent to the method must be recorded. The documentation is recorded at the time observations or calculations are made and must be signed or initialed/dated (month/day/year). It must be easily identifiable who performed which tasks if multiple people were involved.

19.14.2.2 In general, concentration results are reported in milligrams per liter (mg/l) or micrograms per liter (µg/l) for liquids and milligrams per kilogram (mg/kg) or micrograms per kilogram (µg/kg) for solids. For values greater than 10,000 mg/l, results can be reported in percent, i.e., 10,000 mg/l = 1**%.** Units are defined in each lab SOP.

19.14.2.3 In reporting, the analyst or the instrument output records the raw data result using values of known certainty plus one uncertain digit. If final calculations are performed external to LIMS, the results should be entered in LIMS with at least three significant figures. In general, results are reported to 2 significant figures on the final report.

19.14.2.4 For those methods that do not have an instrument printout or an instrumental output compatible with the LIMS System, the raw results and dilution factors are entered directly into LIMS by the analyst, and the software calculates the final result for the analytical report. LIMS has a defined significant figure criterion for each analyte.

19.14.2.5 The laboratory strives to import data directly from instruments or calculation spreadsheets to ensure that the reported data are free from transcription and calculation errors. For those analyses with an instrumental output compatible with the LIMS, the raw results and dilution factors are transferred into LIMS electronically after reviewing the quantitation report, and removing unrequested or poor spectrally-matched compounds. The analyst prints a copy of what has been entered to check for errors. This printout and the instrument's printout of calibrations, concentrations, retention times, chromatograms, and mass spectra, if applicable, are retained with the data file. The data file is stored in a monthly folder on the instrument computer; periodically, this file is transferred to the server and, eventually, to a tape file.

19.14.3 Logbook / Worksheet Use Guidelines

Logbooks and worksheets are filled out 'real time' and have enough information on them to trace the events of the applicable analysis/task. (e.g. calibrations, standards, analyst, sample ID, date, time on short holding time tests, temperatures when applicable, calculations are traceable, etc.)

- Corrections are made following the procedures outlined in Section 12.
- Logbooks are controlled by the QA department. A record is maintained of all logbooks in the lab.
- Unused portions of pages must be "Z"'d out, signed and dated.
- Worksheets are created with the approval of the Department Technical Manager/QA Manager at the facility. The QA Manager controls all worksheets following the procedures in Section 6.

19.14.4 Review / Verification Procedures

Review procedures are out lined in several SOPs (including but not limited to, TestAmerica Edison SOP Nos. ED-GEN-021: Data Review, ED-SPM-001:Login, and ED-RP-001:Reports Production) to ensure that reported data are free from calculation and transcription errors, that QC parameters have been reviewed and evaluated before data is reported. The general review concepts are discussed below, more specific information can be found in the SOPs

19.14.4.1 Log-In Review - The data review process starts at the sample receipt stage. Sample control personnel review chain-of-custody forms and project instructions from the project management group. This is the basis of the sample information and analytical instructions entered into the LIMS. The log-in instructions are reviewed by the personnel entering the information, and a second level review is conducted by the project management staff.

19.14.4.2 First Level Data Review - The next level of data review occurs with the analysts. As data are generated, analysts review their work to ensure that the results meet project and SOP requirements. First level reviews include inspection of all raw data (e.g., instrument output for continuous analyzers, chromatograms, spectra, and manual integrations), evaluation of calibration/calibration verification data in the day's

analytical run, evaluation of QC data, and reliability of sample results. The analyst transfers data into LIMS, data qualifiers are added as needed. All first level reviews are documented.

19.14.4.3 Second Level Data Review – All analytical data are subject to review by a second qualified analyst or supervisor. Second level reviews include inspection of all raw data (e.g., instrument output, chromatograms, and spectra) including 100% of data associated with any changes made by the primary analyst, such as manual integrations or reassignment of peaks to different analytes, or elimination of false negative analytes. The second review also includes evaluation of initial calibration/calibration verification data in the day's analytical run, evaluation of QC data, reliability of sample results, qualifiers and NCM narratives. Manual calculations are checked in second level review. All second level reviews are documented.

Issues that deem further review include the following:

- QC data are outside the specified control limits for accuracy and precision
- Reviewed sample data does not match with reported results
- Unusual detection limit changes are observed
- Samples having unusually high results
- Samples exceeding a known regulatory limit
- Raw data indicating some type of contamination or poor technique
- Inconsistent peak integration
- Transcription errors
- Results outside of calibration range

19.14.4.4 Unacceptable analytical results may require reanalysis of the samples. Any problems are brought to the attention of the Laboratory Director, Project Manager, Quality Director/Manager, Technical Manager, or Supervisor for further investigation. Corrective action is initiated whenever necessary.

19.14.4.5 The results are then entered or directly transferred into the computer database and a hard copy (or .pdf) is printed for the client.

19.14.4.6 As a final review prior to the release of the report, the Project Manager reviews the results for appropriateness and completeness. This review and approval ensures that client requirements have been met and that the final report has been properly completed. The process includes, but is not limited to, verifying that the COC is followed, cover letters / narratives are present, flags are appropriate, and project specific requirements are met. The Project Manager may also evaluate the validity of results for different test methods given expected chemical relationships.

19.14.4.7 Any project that requires a data package is subject to a tertiary data review for transcription errors and acceptable quality control requirements. The Project Manager then signs the final report. The accounting personnel also check the report for any clerical or invoicing errors. When complete, the report is sent out to the client.

19.14.5 Manual Integrations

Computerized data systems provide the analyst with the ability to re-integrate raw instrument data in order to optimize the interpretation of the data. Though manual integration of data is an invaluable tool for resolving variations in instrument performance and some sample matrix problems, when used improperly, this technique would make unacceptable data appear to meet quality control acceptance limits. Improper re-integrations lead to legally indefensible data, a poor reputation, or possible laboratory decertification. Because guidelines for re-integration of data are not provided in the methods and most methods were written prior to widespread implementation of computerized data systems, the laboratory trains all analytical staff on proper manual integration techniques using TestAmerica's Corporate SOP (CA-Q-S-002).

19.14.5.1 The analyst must adjust baseline or the area of a peak in some situations, for example when two compounds are not adequately resolved or when a peak shoulder needs to be separated from the peak of interest. The analyst must use professional judgment and common sense to determine when manual integrating is required. Analysts are encouraged to ask for assistance from a senior analyst or manager when in doubt.

19.14.5.2 Analysts shall not increase or decrease peak areas for the sole purpose of achieving acceptable QC recoveries that would have otherwise been unacceptable. The intentional recording or reporting of incorrect information (or the intentional omission of correct information) is against company principles and policy and is grounds for immediate termination.

19.14.5.3 Client samples, performance evaluation samples, and quality control samples are all treated equally when determining whether or not a peak area or baseline should be manually adjusted.

19.14.5.4 All manual integrations receive a second level review. Manual integrations must be indicated on an expanded scale "after" chromatograms such that the integration performed can be easily evaluated during data review. Expanded scale "before" chromatograms are also required for all manual integrations on QC parameters (calibrations, calibration verifications, laboratory control samples, internal standards, surrogates, etc.) unless the laboratory has another documented corporate approved procedure in place that can demonstrate an active process for detection and deterrence of improper integration practices.

Figure 19-1. Example - Demonstration of Capability Documentation

DEMONSTRATION OF CAPABILITIY (DOC)

Laboratory Name:_____
Laboratory Address:_____
Method:_____ Matrix:_____
Date:_____ Analyst(s):_____
Source of Analyte(s):_____

Analytical Results

Analyst	Conc. (Units)	Rep 1	Rep 2	Rep 3	Rep 4	Avg. % Recovery	% RSD

% RSD = Percent relative standard deviation = standard deviation divided by average % Recovery

Raw data reference: _____

Certification Statement:

We, the undersigned, certify that:
1. The cited test method has met Demonstration of Capability requirements.
2. The test method was performed by the analyst(s) identified on this certification.
3. A copy of the test method and the laboratory-specific SOPs are available for all personnel on site.
4. The data associated with the method demonstration of capability are true, accurate, complete, and self-explanatory.
5. All raw data necessary to reconstruct and validate these analyses have been retained at the facility, and the associated information is well organized and available for review.
6.

_____ _____
Analyst Signature Date

_____ _____
Technical Manager Signature Date

_____ _____
Quality Assurance Coordinator Signature Date

SECTION 20. EQUIPMENT and CALIBRATIONS

20.1 Overview

The laboratory purchases the most technically advanced analytical instrumentation for sample analyses. Instrumentation is purchased on the basis of accuracy, dependability, efficiency and sensitivity. Each laboratory is furnished with all items of sampling, preparation, analytical testing and measurement equipment necessary to correctly perform the tests for which the laboratory has capabilities. Each piece of equipment is capable of achieving the required accuracy and complies with specifications relevant to the method being performed. Before being placed into use, the equipment (including sampling equipment) is calibrated and checked to establish that it meets its intended specification. The calibration routines for analytical instruments establish the range of quantitation. Calibration procedures are specified in laboratory SOPs. A list of laboratory instrumentation is presented in Table 20-1. The most current list of laboratory instrumentation can be found in TestAmerica Edison Work Instruction No. ED-WI-002 (Equipment Inventory).

Equipment is only operated by authorized and trained personnel. Manufacturer's instructions for equipment use are readily accessible to all appropriate laboratory personnel.

20.2 Preventive Maintenance

The laboratory follows a well-defined maintenance program to ensure proper equipment operation and to prevent the failure of laboratory equipment or instrumentation during use. This program of preventive maintenance helps to avoid delays due to instrument failure.

Routine preventive maintenance procedures and frequency, such as cleaning and replacements, should be performed according to the procedures outlined in the manufacturer's manual. Qualified personnel must also perform maintenance when there is evidence of degradation of peak resolution, a shift in the calibration curve, loss of sensitivity, or failure to continually meet one of the quality control criteria.

Table 20-2 lists examples of scheduled routine maintenance. It is the responsibility of each Department Technical Manager to ensure that instrument maintenance logs are kept for all equipment in his/her department. Preventative maintenance procedures may also be outlined in analytical SOPs or instrument manuals. (Note: for some equipment, the log used to monitor performance is also the maintenance log. Multiple pieces of equipment may share the same log as long as it is clear as to which instrument is associated with an entry.)

Instrument maintenance logs are controlled and are used to document instrument problems, instrument repair and maintenance activities. Maintenance logs shall be kept for all major pieces of equipment. Instrument maintenance logs may also be used to specify instrument parameters.

- Documentation must include all major maintenance activities such as contracted preventive maintenance and service and in-house activities such as the replacement of electrical components, lamps, tubing, valves, columns, detectors, cleaning and adjustments.
- Each entry in the instrument log includes the Analyst's initials, the date, a detailed description of the problem (or maintenance needed/scheduled), a detailed explanation of the solution or maintenance performed, and a verification that the equipment is functioning properly (state what was used to determine a return to control. e.g. CCV run on *'date'* was acceptable, or instrument recalibrated on 'date' with acceptable verification, etc.) must also be documented in the instrument records.
- When maintenance or repair is performed by an outside agency, service receipts detailing the service performed can be affixed into the logbooks adjacent to pages describing the maintenance performed. This stapled in page must be signed across the page entered and the logbook so that it is clear that a page is missing if only half a signature is found in the logbook.

If an instrument requires repair (subjected to overloading or mishandling, gives suspect results, or otherwise has shown to be defective or outside of specified limits) it shall be taken out of operation and tagged as out-of-service or otherwise isolated until such a time as the repairs have been made and the instrument can be demonstrated as operational by calibration and/or verification or other test to demonstrate acceptable performance. The laboratory shall examine the effect of this defect on previous analyses.

In the event of equipment malfunction that cannot be resolved, service shall be obtained from the instrument vendor manufacturer, or qualified service technician, if such a service can be tendered. If on-site service is unavailable, arrangements shall be made to have the instrument shipped back to the manufacturer for repair. Back up instruments, which have been approved, for the analysis shall perform the analysis normally carried out by the malfunctioning instrument. If the back-up is not available and the analysis cannot be carried out within the needed timeframe, the samples shall be subcontracted.

At a minimum, if an instrument is sent out for service or transferred to another facility, it must be recalibrated and the laboratory MDL verified (using an MDLV) prior to return to lab operations.

20.3 Support Equipment

This section applies to all devices that may not be the actual test instrument, but are necessary to support laboratory operations. These include but are not limited to: balances, ovens, refrigerators, freezers, incubators, water baths, field sampling devices, temperature measuring devices, thermal/pressure sample preparation devices and volumetric dispensing devices if quantitative results are dependent on their accuracy, as in standard preparation and dispensing or dilution into a specified volume. All raw data records associated with the support equipment are retained to document instrument performance.

20.3.1 Weights and Balances

The accuracy of the balances used in the laboratory is checked every working day, before use. All balances are placed on stable counter tops.

Each balance is checked prior to initial serviceable use with at least two certified ASTM type 1 weights spanning its range of use (weights that have been calibrated to ASTM type 1 weights may also be used for daily verification). ASTM type 1 weights used only for calibration of other weights (and no other purpose) are inspected for corrosion, damage or nicks at least annually and if no damage is observed, they are calibrated at least every 5 years by an outside calibration laboratory. Any weights (including ASTM Type 1) used for daily balance checks or other purposes are recalibrated/recertified annually to NIST standards (this may be done internally if laboratory maintains “calibration only” ASTM type 1 weights).
All balances are serviced annually by a qualified service representative, who supplies the laboratory with a certificate that identifies traceability of the calibration to the NIST standards.

All of this information is recorded in logs, and the recalibration/recertification certificates are kept on file.

20.3.2 pH, Conductivity, and Turbidity Meters

The pH meters used in the laboratory are accurate to ± 0.1 pH units, and have a scale readability of at least 0.05 pH units. The meters automatically compensate for the temperature, and are calibrated with at least two working range buffer solutions before each use.

Conductivity meters are also calibrated before each use with a known standard to demonstrate the meters do not exceed an error of 1% or one umhos/cm.

Turbidity meters are also calibrated before each use. All of this information is documented in logs.

Consult pH and Conductivity, and Turbidity SOPs for further information.

20.3.3 Thermometers

All thermometers are calibrated on an annual basis with a NIST-traceable thermometer.

- If the temperature measuring device is used over a range of 10°C or less, then a single point verification within the range of use is acceptable;
- If the temperature measuring device is used over a range of greater than 10°C, then the verification must bracket the range of use.

IR thermometers, digital probes and thermocouples are calibrated quarterly. IR Thermometers should be calibrated over the full range of use, including ambient, iced (4°C) and frozen (0°C to -5°C), per the Drinking Water Manual.

The digital NIST thermometer is recalibrated every five years (unless thermometer has been exposed to temperature extremes or apparent separation of internal liquid) by an approved outside service and the provided certificate of traceability is kept on file. The NIST thermometer(s) have increments of 1 degree (0.5 degree or less increments are required for drinking water microbiological laboratories), and have ranges applicable to method and certification requirements. The NIST traceable thermometer is used for no other purpose than to calibrate other thermometers.

All of this information is documented in logbooks. Monitoring method-specific temperatures, including incubators, heating blocks, water baths, and ovens, is documented in method-specific logbooks. More information on this subject can be found in the laboratory SOP No. ED-GEN-014 (Thermometer Calibration***).***

20.3.4 Refrigerators/Freezer Units, Waterbaths, Ovens and Incubators

The temperatures of all refrigerator units and freezers used for sample and standard storage are monitored each working day.

Ovens, waterbaths and incubators are monitored on days of use.

All of this equipment has a unique identification number, and is assigned a unique thermometer for monitoring.

Sample storage refrigerator temperatures are kept between > 0ºC and $\leq$ 6 ºC.

Specific temperature settings/ranges for other refrigerators, ovens waterbaths, and incubators can be found in method specific SOPs.

All of this information is documented in Daily Temperature Logbooks and method-specific logbooks.

20.3.5 Autopipettors, Dilutors, and Syringes

Mechanical volumetric dispensing devices including burettes (except Class A Glassware and Glass microliter syringes) are given unique identification numbers and the delivery volumes are verified gravimetrically, at a minimum, on a quarterly basis.

For those dispensers that are not used for analytical measurements, a label is / can be applied to the device stating that it is not calibrated. Any device not regularly verified cannot be used for any quantitative measurements. Refer to TestAmerica Edison SOP No. ED-GEN-011 (Calibration and Use of Lab Pipettes).

Micro-syringes are purchased from Hamilton Company. Each syringe is traceable to NIST. The laboratory keeps on file an "Accuracy and Precision Statement of Conformance" from Hamilton attesting established accuracy.

20.3.6 Field Sampling Devices (Isco Auto Samplers)

Each Auto Sampler (ISCO) is assigned a unique identification number in order to keep track of the calibration. This number is also recorded on the sampling documentation.

The Auto Sampler is calibrated as needed based on manufacturer's recommendations.

20.4 Instrument Calibrations

Calibration of analytical instrumentation is essential to the production of quality data. Strict calibration procedures are followed for each method. These procedures are designed to determine and document the method detection limits, the working range of the analytical instrumentation and any fluctuations that may occur from day to day.

Sufficient raw data records are retained to allow an outside party to reconstruct all facets of the initial calibration. Records contain, but are not limited to, the following: calibration date, method, instrument, analyst(s) initials or signatures, analysis date, analytes, concentration, response, type of calibration (Avg RF, curve, or other calculations that may be used to reduce instrument responses to concentration.)

Sample results must be quantitated from the initial calibration and may not be quantitated from any continuing instrument calibration verification unless otherwise required by regulation, method or program.

If the initial calibration results are outside of the acceptance criteria, corrective action is performed and any affected samples are reanalyzed if possible. If the reanalysis is not possible, any data associated with an unacceptable initial calibration will be reported with appropriate data qualifiers (refer to Section 12).

Note: Instruments are calibrated initially and as needed after that and at least annually *(the annual requirement does not apply to Isotope dilution).*

20.4.1 Calibration Standards

Calibration standards are prepared using the procedures indicated in the Reagents and Standards section of the determinative method SOP. If a reference method does not specify the number of calibration standards, a minimum of 3 calibration points will be used.

Standards for instrument calibration are obtained from a variety of sources. All standards are traceable to national or international standards of measurement, or to national or international standard reference materials.

The lowest concentration calibration standard that is analyzed during an initial calibration must be at or below the stated reporting limit for the method based on the final volume of extract (or sample).

The other concentrations define the working range of the instrument/method or correspond to the expected range of concentrations found in actual samples that are also within the working range of the instrument/method. Results of samples not bracketed by initial instrument calibration standards (within calibration range to at least the same number of significant figures used to report the data) must be reported as having less certainty, e.g., defined qualifiers or flags (additional information may be included in the case narrative). The exceptions to these rules. ICP and ICPMS methods which define the working range with periodic linear dynamic range studies, rather than through the range of concentrations of daily calibration standards.

All initial calibrations are verified with a standard obtained from a second source and traceable to a national standard, when available (or vendor certified different lot if a second source is not available). For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst at a different time or a different preparation would be considered a second source. This verification occurs immediately after the calibration curve has been analyzed, and before the analysis of any samples.

20.4.1.1 Calibration Verification

The calibration relationship established during the initial calibration must be verified initially and at least daily as specified in the laboratory method SOPs in accordance with the referenced analytical methods and in the 2009 TNI Standard. The process of calibration verification applies to both external standard and internal standard calibration techniques, as well as to linear and non-linear calibration models. Initial calibration verification is with a standard source secondary (second source standard) to the calibration standards, but continuing calibration verifications may use the same source standards as the calibration curve.

Note: The process of calibration verification referred to here is fundamentally different from the approach called "calibration" in some methods. As described in those methods, the calibration factors or response factors calculated during calibration are used to update the calibration factors or response factors used for sample quantitation. This approach, while employed in other EPA programs, amounts to a daily single-point calibration.

All target analytes and surrogates, including those reported as non-detects, must be included in periodic calibration verifications for purposes of retention time confirmation and to demonstrate that calibration verification criteria are being met, i.e., RPD, per 2009 TNI Std. EL-V1M4 Sec. 1.7.2.

All samples must be bracketed by periodic analyses of standards that meet the QC acceptance criteria (e.g., calibration and retention time). The frequency is found in the determinative methods or SOPs.

Note: If an internal standard calibration is being used then bracketing calibration verification standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

Generally, the initial calibrations must be verified at the beginning of each 12-hour analytical shift during which samples are analyzed. (Some methods may specify more or less frequent verifications). The 12-hour analytical shift begins with the injection of the calibration verification standard (or the MS tuning standard in MS methods). The shift ends after the completion of the analysis of the last sample, QC, or standard that can be injected within 12-hours of the beginning of the shift.

A continuing instrument calibration verification (CCV) must be repeated at the beginning and, for methods that have quantitation by external calibration models, at the end of each analytical batch. Some methods have more frequent CCV requirements see specific SOPs. Most Inorganic methods require the CCV to be analyzed after ever 10 samples or injections, including matrix or batch QC samples.

Note: If an internal standard calibration is being used (basically GCMS) then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

If the results of a CCV are outside the established acceptance criteria and analysis of a second consecutive (and immediate) CCV fails to produce results within acceptance criteria, corrective action shall be performed. Once corrective actions have been completed & documented, the laboratory shall demonstrate acceptable instrument / method performance by analyzing two consecutive CCVs, or a new initial instrument calibration shall be performed.

Sample analyses and reporting of data may not occur or continue until the analytical system is calibrated or calibration verified. However, data associated with an unacceptable calibration verification may be fully useable under the following special conditions:

a). when the acceptance criteria for the CCV are exceeded high (i.e., high bias) and the associated samples within the batch are non-detects, then those non-detects may be reported with a footnote or case narrative explaining the high bias. Otherwise the samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted; or

b). when the acceptance criteria for the CCV are exceeded low (i.e., low bias), those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise the samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted.

Samples reported by the 2 conditions identified above will be appropriately flagged.

20.4.1.2 Verification of Linear and Non-Linear Calibrations

Calibration verification for calibrations involves the calculation of the percent drift or the percent difference of the instrument response between the initial calibration and each subsequent analysis of the verification standard. (These calculations are available in the laboratory method SOPs. Verification standards are evaluated based on the % Difference from the average CF or RF of the initial calibration or based on % Drift or % Recovery if a linear or quadratic curve is used.

Regardless of whether a linear or non-linear calibration model is used, if initial verification criterion is not met, then no sample analyses may take place until the calibration has been verified or a new initial calibration is performed that meets the specifications listed in the method SOPs. If the calibration cannot be verified after the analysis of a single verification standard, then adjust the instrument operating conditions and/or perform instrument maintenance, and analyze another aliquot of the verification standard. If the calibration cannot be verified with the second standard, then a new initial calibration is performed.

- When the acceptance criteria for the calibration verification are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported. Otherwise, the samples affected by the unacceptable calibration verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted.

- When the acceptance criteria for the calibration verification are exceeded low, i.e., low bias, those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise, the samples affected by the unacceptable verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted. Alternatively, a

reporting limit standard may be analyzed to demonstrate that the laboratory can still support non-detects at their reporting limit.

20.5 Tentatively Identified Compounds (TICs) – GC/MS Analysis

For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by the purpose of the analyses being conducted. Data system library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other.

Note: If the TIC compound is not part of the client target analyte list but is calibrated by the laboratory and is both qualitatively and/or quantitatively identifiable, it should not be reported as a TIC. If the compound is reported on the same form as true TICs, it should be qualified and/or narrated that the reported compound is qualitatively and quantitatively (if verification in control) reported compared to a known standard that is in control (where applicable).

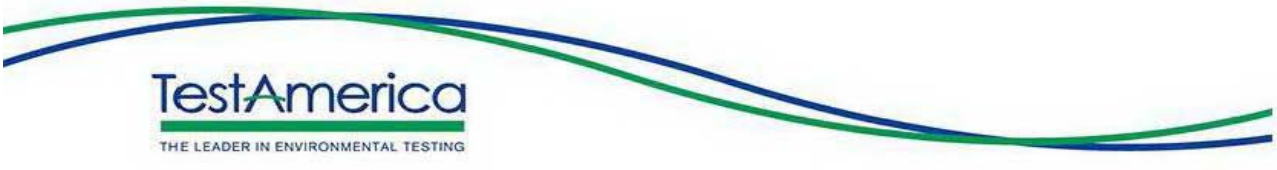
For example, the RCRA permit or waste delisting requirements may require the reporting of non-target analytes. Only after visual comparison of sample spectra with the nearest library searches may the analyst assign a tentative identification.

20.6 GC/MS Tuning

Prior to any GCMS analytical sequence, including calibration, the instrument parameters for the tune and subsequent sample analyses within that sequence must be set.

Prior to tuning/auto-tuning the mass spec, the parameters may be adjusted within the specifications set by the manufacturer or the analytical method. These generally don't need any adjustment but it may be required based on the current instrument performance. If the tune verification does not pass it may be necessary to clean the source or perform additional maintenance. Any maintenance is documented in the maintenance log.

Table 20-1. Example: Instrumentation List



TestAmerica Edison Instrument List

Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Metals Department					
ICP (ICP5)	Thermo Jarrell Ash	ICAP 6500 DUO View	IC5D20121709	2012	New
ICP (ICP4)	Thermo Jarrell Ash	ICAP 6500 DUO View	ICP-20073407	2009	New
ICP/MS (ICPMS1)	Agilent Technologies	7500CE	JP51201560	2006	New
Heat Exchanger	Agilent Technologies	3370	G57335		
Autosampler	Cetac	G3286A	US0808108A520		
ICP/MS (ICPMS2)	Agilent Technologies	7500CX	JP82802644	2010	New
Heat Exchanger	Agilent Technologies	3370	1C1160265	2006	Used
Autosampler	Cetac	ASX500	021134A520	2006	New
ICP/MS (ICPMS3)	Agilent Technologies	G8403A	JP16121357	2016	New
Heat Exchanger	PolyScience	G3292-80000	2U1570105	2016	New
Autosampler	Agilent Technologies	G8410A	AU16101128	2016	New
Mercury Analyzer 6	Leeman Labs	Hydra II	2008 112-00064-1	2014	New
Mercury Analyzer 7	Leeman Labs	Hydra II	US17159010	2017	New
Hot Block (Hot Block 2)	Environmental Express Limited	SC-154	2391CE1273	2004	New
Hot Block (Hot Block 3)	Environmental Express Limited	SC-150	4298CEC2048	2004	New
Hot Block (Hot Block 4)	Environmental Express Limited	SC-150	4507CEC2115	2006	New
Hot Block (Hot Block 5)	Environmental Express Limited	SC-150	466CEC2183	2006	New
Hot Block (Hot Block 7)	Environmental Express Limited	SC-150	2772CDC1378	2006	New
Hot Block (Hot Block 8)	Environmental Express Limited	SC154	1423CEC1154		
Hot Block (Hot Block 9)	Environmental Express Limited	SC-150	1917CEC1155		

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Hot Block (Hot Block 11) **OUT FOR REPAIR – 11/7/17**	Environmental Express Limited	DigiPrep	4102030316		
Hot Block (Hot Block 12)	Environmental Express Limited	SC-154	3098CEC1508		
Top Loading Balance (Balance #35)	Acculab	VIC-412	18255989	2005	New
Top Loading Balance (Balance #33)	Ohaus	AR5120	F0461200521139	2001	New
Semivolatile GC/MS Department					
GC/MS System (BNAMS2)					
Gas Chromatograph	Agilent Technologies	6890A	CN10447031	TBD	New
MS Detector	Agilent Technologies	5973	US44647039	TBD	New
Autosampler Tower	Agilent Technologies	7683B	US82410944	TBD	New
Autosampler Tray	Agilent Technologies	7683	US85002901	TBD	New
GC/MS System (BNAMS4)					
Gas Chromatograph	Hewlett Packard	5890 Series II	3108A34490	1986	New
MS Detector	Hewlett Packard	5971A	3114A02077	1986	New
Autosampler Tower	Hewlett Packard	7673A	3429A33228	1986	New
Autosampler Tray	Hewlett Packard	7673	3624A42191	1986	New
Controller	Hewlett Packard		2803A11211	1986	New
GC/MS System (BNAMS5)					
Gas Chromatograph	Agilent Technologies	7890A	CN10726100	2005	New
MS Detector	Agilent Technologies	5975C	US35120328	2005	New
Autosampler Tower	Agilent Technologies	7673B	CN72441261	2005	New
Autosampler Tray	Agilent Technologies	7673	CN43830668	2005	New
Controller	Agilent Technologies		CN40427800	2005	New

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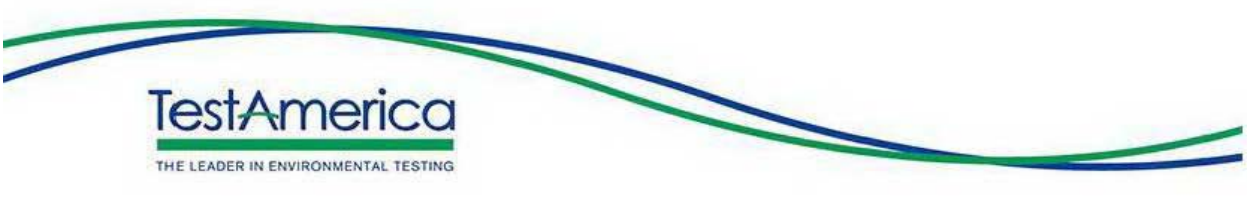
Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
GC/MS System (BNAMS9)					
Gas Chromatograph	Agilent Technologies	6890N	CN10349071	2004	New
MS Detector	Agilent Technologies	5973	US35120328	2004	New
Autosampler Tower	Agilent Technologies	7683	CN34433497	2004	New
Autosampler Tray	Agilent Technologies	7683	CN40327770	2004	New
Controller	Agilent Technologies		CN40427800	2004	New
GC/MS System (BNAMS11)					
Gas Chromatograph	Agilent Technologies	7890A	CN10727109	2007	New
MS Detector	Agilent Technologies	5975C	US71236621	2007	New
Autosampler Tower	Agilent Technologies	7683B	CN72441255	2007	New
Autosampler Tray	Agilent Technologies	7683	CN72544441	2007	New
Controller	Agilent Technologies			2007	New
GC/MS System (BNAMS12)					
Gas Chromatograph	Agilent Technologies	6890A	CN10531011	2012	New
MS Detector	Agilent Technologies	5975C	US52420834	2012	New
Autosampler Tower	Agilent Technologies	7683B	CN61732705	2012	New
Autosampler Tray	Agilent Technologies	7683	CN24322270	2012	New
Controller	Agilent Technologies				
GC/MS System (BNAMS13)					
Gas Chromatograph	Agilent Technologies	6890A	CN10529024	2012	New
MS Detector	Agilent Technologies	5975C	US10503712	2012	New
Autosampler Tower	Agilent Technologies	7683B	CN48320808	2012	New
Autosampler Tray	Agilent Technologies	7683	CN40327583	2012	New



Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Controller	Agilent Technologies			2012	New
GC/MS System (BNAMS14)					
Gas Chromatograph	Agilent Technologies	7890B	CN14393167	2012	New
MS Detector	Agilent Technologies	5975C	US83131020	2012	New
Autosampler Tower	Agilent Technologies	7683B	CN759A2046	2012	New
Autosampler Tray	Agilent Technologies	7683	CN72544431	2012	New
Controller	Agilent Technologies			2012	New
GC/MS System (BNAMS15)	Agilent Technologies				
Gas Chromatograph	Agilent Technologies	9000 Intuvo	CN17010006	2015	New
MS Detector	Agilent Technologies	5977A	US1433L427	2015	New
Autosampler Tower	Agilent Technologies	7963A	CN14410091	2015	New
Autosampler Tray	Agilent Technologies	7963	CN14360040	2015	New
GC/MS System (BNAMS16)					
Gas Chromatograph	Agilent Technologies	6890N	CN10402079	TBD	New
MS Detector	Agilent Technologies	5975	US55132182	TBD	New
Autosampler Tower	Agilent Technologies	7683	CN22025342	TBD	New
Autosampler Tray	Agilent Technologies	G2614A	CN404427800	TBD	New
GC/FID System (BNAGC8)					
Gas Chromatograph	Hewlett-Packard	5890	3121A35833	1986	New
Autosampler Tower	Hewlett-Packard	7673A	2704805765	1986	New
Autosampler Tray	Hewlett-Packard		3131A25914	1986	New
Controller	Hewlett-Packard		2921A03449	1986	New
Manifold	Western Enterprise	Innovator HBAC2-5-4	28452	2004	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Volatiles Department (GC and GC/MS)					
GC/MS System (VOAMS1)					
Gas Chromatograph	Agilent Technologies	6890N	CN10606023	2006	New
MS Detector	Agilent Technologies	5975	US60532504	2006	New
Autosampler	OI	4551A	D60745B342	2006	New
Concentrator	OI	Eclipse 4660	D608466853	2006	New
Spiker	OI	SAM	E54175492	2006	New
GC/MS System (VOAMS2)					
Gas Chromatograph	Hewlett-Packard	7890A	CN10813013	2008	New
MS Detector	Hewlett-Packard	5975C	US80838709	2008	New
Autosampler	OI	4552 (Archon 5100)	14608	2008	New
Concentrator	OI	Eclipse 4660	K41746689OP	2008	New
GC/MS System (VOAMS3)					
Gas Chromatograph	Agilent Technologies	6890N	CN10406105	2004	New
MS Detector	Agilent Technologies	5973 Inert	US35120382	2004	New
Autosampler	EST	Centurion	CENT140051304	2004	New
Concentrator	EST	Encon	478021506	2004	New
Concentrator	EST	Encon	478021506	2004	New
GC/MS System (VOAMS4)					
Gas Chromatograph	Hewlett-Packard	7890A	CN10813014	2008	New
MS Detector	Hewlett-Packard	5975C	US80838712	2008	New
Autosampler	OI	4552	15264	2008	New
Concentrator	OI	2008	D809466076	2008	New
GC/MS System (VOAMS5)					
Gas Chromatograph	Agilent	6890	US10518019	TBD	New
MS Detector	Hewlett-Packard	5973	US44621422	TBD	New
Autosampler	OI	4552 (Archon 5100)	12206	1998	New
Concentrator	OI/EST	Encon	425042704	TBD	New
Concentrator	OI/EST	Encon	425042705	TBD	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
GC/MS System (VOAMS6)					
Gas Chromatograph	Agilent Technologies	6890N	CN10406076	2004	New
MS Detector	Agilent Technologies	5973 Inert	US35120322	2004	New
Autosampler	OI	4551A	D54645B461	2005	New
Concentrator	OI	4660	D548466579	2005	New
Spiker	OI	SAM	C425475656	2004	New
GC/MS System (VOAMS7)					
Gas Chromatograph	Agilent Technologies	6890N	CN10437064	2006	New
MS Detector	Agilent Technologies	5973 Inert	US43110514	2004	New
Autosampler	Teledyne Tekmar	Solatek	US08121007	2008	New
Concentrator	Teledyne Tekmar	Stratum	US08007007	2008	New
GC/MS System (VOAMS8)					
Gas Chromatograph	Hewlett-Packard	6890	US00028879	TBD	New
MS Detector	Hewlett-Packard	5973	US91411758	TBD	New
Autosampler	EST Archon	5100A	13097	TBD	New
Concentrator	EST Encon	4560	389092704E	TBD	New
GC/MS System (VOAMS9)					
Gas Chromatograph	Agilent	6890	CN10517107	TBD	New
MS Detector	Agilent	5973	US44610847	TBD	New
Autosampler	OI	4552	15266	2008	New
Concentrator	OI	4660	D548466579	TBD	New
GC/MS System (VOAMS10)					
Gas Chromatograph	Agilent	6890	CN10419047	TBD	New
MS Detector	Hewlett-Packard	5973	US10461695	TBD	New
Autosampler	OI	4100	D714410066	TBD	New
Concentrator	OI	4760	A714447065	TBD	New
GC/MS System (VOAMS11)					
Gas Chromatograph	Agilent Technologies	6890N	CN10324011	2003	New
MS Detector	Agilent Technologies	5973N	US30965664	2003	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Autosampler	EST Archon	5100A	13970	2003	New
Concentrator	EST	Encon Eclipse	A714447060	2017	New
GC/MS System (VOAMS12)					
Gas Chromatograph	Agilent Technologies	6890N	CN10439051	2005	New
MS Detector	Agilent Technologies	5973 inert	US43110519	2004	New
Autosampler	EST	5100A	14448	2005	New
Concentrator	EST	Encon	430051605	2005	New
Turbo Pump Upgrade	Agilent Technologies	Performance	56115832	2005	New
GC/MS System (VOAMS13)					
Gas Chromatograph	Agilent Technologies	6890N	CN10439052	2005	New
MS Detector	Agilent Technologies	5973 inert	US43110517	2004	New
Autosampler	EST	5100A	14449	2005	New
Concentrator	EST	Encon	431051605	2005	New
Turbo Pump Upgrade	Agilent Technologies	Performance	56069171	2005	New
GC/MS System (VOAMS14)					
Gas Chromatograph	Agilent Technologies	7890B	17293078	2017	New
MS Detector	Agilent Technologies	5977B	US1731M027	2017	New
Autosampler					
Concentrator					
GC/MS System (VOAMS15)					
Gas Chromatograph	Agilent Technologies	7890B	CN17293101	2017	New
MS Detector	Agilent Technologies	5977B	US1731M011	2017	New
Autosampler					
Concentrator					
GC/FID System (VOAGC1)					
Gas Chromatograph	Agilent Technologies	6890N	US10610006	2006	New
Autosampler	OI	4552	14608	2006	New
Concentrator	OI	4660	D607466340	2006	New
Autosampler	OI	4551A	D60745B342	2006	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Concentrator	OI	4660	D607466341	2006	New
Spiker	OI	SAM	E610475713	2006	New
GC/FID System (VOAGC3)					
Gas Chromatograph	Hewlett-Packard	5890 II	3310A49242	1996	New
Autosampler	Dynatech Archon	5100	11780-795	1996	New
Concentrator	OI	4560	J437460274	1996	New
GC/FID System (VOAGC4)					
Gas Chromatograph	Hewlett-Packard	6890	00031073	TBD	New
Headspace Autosampler	Teledyne Tekmar	HT3	US17187006	TBD	New
Headspace Autosampler	Teledyne Tekmar	HT3	US1715201	TBD	New
GC/FID System (VOASCREEN5/6)					
Gas Chromatograph	Hewlett-Packard	5890 II	2921A23492	1993	New
Autosampler	Tekmar	7050	US04156005	2004	New
Headspace Sampler	Tekmar	7000	US04156003	2004	New
Autosampler	Tekmar	7050	US04148014	2004	New
Headspace Sampler	Tekmar	7000	US04163001	2004	New
Top Loading Balance (Balance #22)	Mettler	PB1501	2115517886	1997	New
Precision Balance (Balance #50)	Ohaus	Explorer Pro 413	1125573353	2006	New
Top Loading Balance (Balance #32)	Denver Instruments	P602	126008	2009	New
Drying Oven	Fisher Isotemp Oven	13-246-516G	502N0045	2005	New
Drying Oven	Baxter	DX-1	199012	2000	New
H-Nu PID	H-Nu Systems	PI101	801023	1989	New
Fume Hood	Air Science	PurAir15	P41007	2004	New
GC Semivolatile Department					
Analytical Balance (Balance #30)	A&D	HR200C	12315880		
Ion Chromatograph (IC-B)	Metrohm Peak, Inc.			2005	New
Pump 1	Metrohm Peak, Inc.	818	04187	2005	New
Pump 2	Metrohm Peak, Inc.	818	04197	2005	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Conductivity Detector	Metrohm Peak, Inc.	819	03195	2005	New
Injector and Oven	Metrohm Peak, Inc.	820	04147	2005	New
2-channel interface	Metrohm Peak, Inc.	830	04184	2005	New
Liquid Handling 1	Metrohm Peak, Inc.	833	04154	2005	New
Liquid Handling 12	Metrohm Peak, Inc.	833	04118	2005	New
Autosample	Metrohm Peak, Inc.	838	03198	2005	New
Ion Chromatograph (IC-A)	Metrohm Peak, Inc.			2010	New
Pump 1	Metrohm Peak, Inc.	818	SS4818011006190	2010	New
Pump 2	Metrohm Peak, Inc.	818	SS1818011003192	2010	New
UV-VIS Detector	Metrohm Peak, Inc.	1010 (Bischoff)	SS1153001010101	2010	New
Conductivity Detector	Metrohm Peak, Inc.	819	03181	2005	New
IC Interface	Metrohm Peak, Inc.	830	SS1830002003180	2010	New
Separation Center	Metrohm Peak, Inc.	820	SS1820023003168	2010	New
Sample Processor	Metrohm Peak, Inc.	838	SS1838001009171	2010	New
Filter Pump 1	Emerson		N SA55-NXGTB 4142		New
Filter Pump 2	Emerson	SA55JXgtd-4144	G8ECX	2002	New
Ion Chromatograph (IC-1)	Metrohm USA, Inc.	Compact IC Flex 930.2460		2017	New
Compact Flex Oven/Ses/Deg	Metrohm USA, Inc.	29302460	00103716	2017	New
Conductivity Detector	Metrohm USA, Inc.	28509010			
Dosino	Metrohm USA, Inc.	28000010	00099636		
MSM-A Rotor	Metrohm USA, Inc.	28509010	00102177		
Metrohm Data Management System	Metrohm USA, Inc.	66059321	JB5FKH2		

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
ProfIC Sample Processor Pump	Metrohm USA, Inc.	28580020	000091657		
Ion Chromatograph (IC-2)	Metrohm USA, Inc.	Compact IC Flex 930.2460		2017	New
Compact Flex Oven/Ses/Deg	Metrohm USA, Inc.	29302460	00103714	2017	New
Conductivity Detector	Metrohm USA, Inc.	28509010			
Dosino	Metrohm USA, Inc.	28000010	00099712		
Dosino Invial Dilution	Metrohm USA, Inc.	28000010	00099731		
MSM-A Rotor	Metrohm USA, Inc.	28509010	00102177		
Metrohm Data Management System	Metrohm USA, Inc.	66059321	JB5DKH2		
ProfIC Sample Processor Pump	Metrohm USA, Inc.	28580020	000098576		
GC/FID System (BNAGC1)					
Gas Chromatograph	Agilent Technologies	6890N	US10248079		
Autosampler	Agilent Technologies	G2913A	**CHECK**		
Autosampler	Agilent Technologies	G2913A	US95110886 (Compco)		
Autosampler Tray	Agilent Technologies	G2914A	CN82949935		
GC/FID System (BNAGC2)					
Gas Chromatograph	Agilent Technologies	6890N	US00005410		
Autosampler	Agilent Technologies	G2913A	US00210996		
Autosampler	Agilent Technologies	G2914A	**CHECK**		
Autosampler Tray	Agilent Technologies	G2914A	CN21420543		
GC/FID System (BNAGC3)					
Gas Chromatograph	Agilent Technologies	6890N	US10202132		

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Autosampler	Agilent Technologies	G2913A	CN22025340		
Autosampler	Agilent Technologies	G2914A	US00210996		
Autosampler Tray	Agilent Technologies	G2914A	CN43830663		
GC/FID System (BNAGC4)					
Gas Chromatograph	Agilent Technologies	6890N	US10610005	2006	New
Autosampler	Agilent Technologies	G2913A	CN24428046	2006	New
Autosampler	Agilent Technologies	G2913A	CN43820799	2006	New
Autosampler Tray	Agilent Technologies	G2914A	CN43930714	2006	New
GC/ECD System (PESTGC1)					
Gas Chromatograph	Hewlett-Packard	5890A	2612A07669	1992	New
Autosampler	Hewlett-Packard	G1513A	US72202218	1992	New
Autosampler Tray	Hewlett-Packard	18596C	3401A34202	1992	New
Controller	Hewlett-Packard	G1512A	CN00005085	1992	New
GC/ECD System (PESTGC3)					
Gas Chromatograph	Hewlett-Packard	5890A	3223A42873	1992	New
Autosampler	Hewlett-Packard	18593B	3216A38325	1992	New
Autosampler Tray	Hewlett-Packard	18596B	3120A27740	1992	New
Controller	Hewlett-Packard	18594B	3049A23890	1992	New
GC/ECD System (PESTGC4)					
Gas Chromatograph	Hewlett-Packard	5890A Series II	US00024529	1997	New
Autosampler	Hewlett-Packard	18593B	**Check?**	1997	New
Autosampler Tray	Hewlett-Packard	7673	US13807350	1997	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Controller	Hewlett-Packard	18594B	3227A29129	1997	New
GC/ECD System (PESTGC5)					
Gas Chromatograph	Agilent Technologies	6890N	US10226033	2002	New
Autosampler	Agilent Technologies	G2613A	US83301937	2002	New
Autosampler Tray	Agilent Technologies	G2614A	CN61739524	2002	New
GC/ECD System (PESTGC6)					
Gas Chromatograph	Hewlett-Packard	5890A	2950A26642	1998	New
Autosampler	Hewlett-Packard	18593B	US83301937	1998	New
Autosampler Tray	Hewlett-Packard	18596B	2942A20025	1998	New
Controller	Hewlett-Packard	G1512A	CN00004777	1998	New
GC/ECD System (PESTGC7)					
Gas Chromatograph	Hewlett-Packard	5890A	3029A29927	1998	New
Autosampler	Hewlett-Packard	18593A	3120A28315	1998	New
Autosampler Tray	Hewlett-Packard	18596B	3346A33861	1998	New
Controller	Hewlett-Packard	18594A	626059	1998	New
GC/ECD System (PESTGC8)					
Gas Chromatograph	Agilent Technologies	6890	US00004463	2000	New
Autosampler	Agilent Technologies	G1513A	**Check**	2000	New
Autosampler Tray	Agilent Technologies	18596M	3334A32973	2000	New
Controller	Agilent Technologies	G1512A	3631A05939	2000	New
GC/ECD System (PESTGC9)					
Gas Chromatograph	Agilent Technologies	6890	US00043694	2001	New
Autosampler	Agilent Technologies	G1513A	**Check**	2001	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Autosampler Tray	Agilent Technologies	18596B	3228A29094	2001	New
Controller	Agilent Technologies	G1512A	CN00004150	2001	New
GC/ECD System (PESTGC11)					
Gas Chromatograph	Agilent Technologies	6890	US00008746	2003	New
Autosampler	Agilent Technologies	18593B	3120A28308	2003	New
Autosampler Tray	Agilent Technologies	18596C	3249A30680	2003	New
Controller	Agilent Technologies	G2512A	US72202100	2003	New
Wet Chemistry Department					
UV/VIS Spectrophotometer	HACH	DR2800	1205122	2007	New
UV/VIS Spectrophotometer	HACH	DR2800	1204684	2007	New
UV/VIS Spectrophotometer	HACH	DR2800	1120442	2007	New
Turbidimeter	HACH	HACH 2100N	12050C028810	2006	New
Ion Selective Meter	Orion	720A	006825	1994	New
Ion Selective Meter	Orion	720A+	092904	2007	New
pH Meter	Orion	A211	X16125	2017	New
pH Meter	Orion	A211	X39284	2017	New
pH Meter	Orion	A211	X37844	2017	New
pH Meter	Orion	A211	26256	2017	New
pH Meter	Orion	A211	Y28592	2016	New
Oven	VWR	1320	0402001	2001	New
Oven	VWR	1300U	VWR	2001	New
Oven	VWR	1305U	VWR	2001	New
Oven	Fisher	230G	Fisher	1997	New
Muffle Furnace	Fisher	550-14	901N002	2002	New
Drying Oven	VWR	1320	VWR	2001	New
Analytical Balance (Balance #27)	A&D	HR-200C	12315883	2005	New
Analytical Balance (Balance #29)	A&D	HR-200C	12315872	2005	New
Micro Balance (Balance #100)	Mettler	MX-5	122423439	2006	New
Top Loading Balance (Balance #13)	Sartorius	LC-421	50709085		
Top Loading Balance (Balance #200)	Denver Instruments	P-602	095010		
Analytical Balance (Balance #900)	Ohaus	GA-110	2220		
Top Loading Balance (Balance #25)	Sartorius		3403003		

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Water Bath	Precision	50	9302-112	1995	New
Water Bath	Precision	50	9305-024	1995	New
COD Reactor	Hach	DRB 200	960800014651		
COD Reactor	Hach	DRB 200	13060C0213	2007	New
COD Reactor	Hach	DRB 200	1202323	2007	New
COD Reactor	Hach	DRB 200	1209887	2015	New
Flow Injection Autoanalyzer	Lachat	Quickem 8000	A83000	1997	New
Flow Injection Autoanalyzer	Lachat	8000 Series	8300-1658	2000	New
Total Organic Carbon (TOC) Analyzer	Shimadzu	TOC 5000	31242909	1997	New
Autosampler	Shimadzu	ASI 5000	31816800	1997	New
Solid Sample Module	Shimadzu	SSM-5000A	31303115	1997	New
Total Organic Carbon (TOC) Soil Analyzer #2	Thermo Electron Corp.	Flash EA 1112 Series	20034945	2004	New
Printer	Epson	LQ570	41NE28676	1997	New
Total Organic Carbon (TOC) Analyzer	Shimadzu	TOC_VCSH	H51104335164	2006	New
Autosampler	Shimadzu	ASI-V	H52104301656SA	2006	New
Solid Sample Module	Shimadzu	SSM-500A	H52504300040NK	2006	New
BOD Meter	YSI	5000	97S0534AE	1998	New
BOD Meter1 Rinse Pump Interface Control Box Automax 390 autosampler Software Seed pump Dilution pump Computer Monitor		PBM-BOD/AM39010 PC-1000-475 PC-1085-00 PB-10030 PC-1000-1074 PB-10600 PC-1000-408 PC-1000-443	 MT-1F7-414 MT-1G7-249 MT-1H7-200 MT-1H7-100 MT-1K6-559 MT-1G7-230 MXL7112917 CNK72411GS	2017	New
Incubator	GCA Precision Scientific			1998	New
Hot Plate	Corning		103N0071	2001	New
Hot Plate	Fischer Scientific	PC-400	370301092774	2007	New
Hot Plate	Corning	PC-420	390502148495	2007	New
Hot Plate	Fischer Scientific	PC-620	220897070707	2007	New
Conductivity Meter	Fischer Scientific	Accumetab 30	81209007	2002	New
Vortex Mixer	Thermolyne	M63215	632000855604	2002	New
Dishwasher	Miele Professional	G7783CD	208479	2003	New
Easy-Dist Distillation	Westco		1095	2003	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Easy	Westco		J097	2003	New
Easy	Westco		1063	2007	New
Easy	Westco		1110	2007	New
Automated Discrete Analyzer #1	Konelab	20	S2019177	2003	New
Automated Discrete Analyzer #2	Konelab	20	2519236	2003	New
Computer	Dell		246175	2003	New
PC-Titration Plus Autotitrator	Mantech Assoc., Inc			2004	New
Interface		PC-1000-102/4	MS-0H4-373		
Titra-Rinse 1		PC-1000-408	MS-0G4-198		
Titra-Rinse 2		PC-1000-408	MS-0G4-200		
Buret Module 1		PC-1104-00	MS-0H4-627		
Buret Module 2		PC-1104-00	MS-0H4-625		
Titration Module		PC-1300-475	MS-0B5-657		
Redox Meter	VWR	8005	001149	1997	New
TCLP Extraction Laboratory					
Peristaltic Pump	PC-Titrate	PC-1000-40	MS-OF3-568	2004	New
TCLP Extraction Apparatus/Timer included	Assoc. Design and Mfg. Co.	3740-4 BRE	1320	2006	New
TCLP Extraction1 Apparatus/Timer included	Assoc. Design and Mfg. Co.	3740-12 BRE	1352	1997	New
TCLP Extraction2 Apparatus/Timer included	Assoc. Design and Mfg. Co.	3740-12 BRE	1053	1997	New
TCLP Extraction3 Apparatus/Timer included	Assoc. Design and Mfg. Co.	3740-12 BRE	1249	1997	New
TCLP Extraction4 Apparatus/Timer included	Environmental Express Ltd	LE 1002	3384-12-473	2005	New
TCLP Extraction5 Apparatus/Timer included	Environmental Express Ltd	LE 1002	3384-12-472	2005	New
TCLP Extraction6 Apparatus/Timer included	Assoc. Design and Mfg. Co.	3740-12 BREII	2125	2006	New
TCLP Extraction7 Apparatus/Timer included	Assoc. Design and Mfg. Co.	3740-12 BREII	2126	2006	New
Sample Control Department					
Top Loading Balance (Balance #104)	Denver Instruments	P602	126006		
Oven #1	Fisher	Isotemp 637G	410B01117	2005	New
Oven #2	Fisher	Isotemp 637G	505N0063	2005	New
Oven #3	Fisher	6921			
DI Water System (LOGIN)	Millipore		07348-C	1990	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Organic Prep Department					
Analytical Balance (Balance #28)	A&D	HR200C	12315879		
Analytical Balance (Balance #A1)	Denver Instruments	P214	1050008		
Top Loading Balance (Balance #60)	Denver Instruments	P602	115003		
DI Water System	Barnstead	D11911	1191020210415	1995	New
Microwave Extraction System	MARS Xpress 230/60	907501	MD5095	2012	Inter-company transfer
Microwave Extraction System	MARS Xpress 230/60	907501	MD1952	2009	
Microwave Extraction System	MARS Xpress 230/60	907501	MD4965	2014	
Sonicator (Controller)	Sonic & Material, Inc.	VC750	58783	2012	Inter - company transfer
Sonicator Horn	Sonic & Material, Inc.	CV335	33107206	2012	Inter-company transfer
N-Evap #1	Organomation	112	52792	2004	New
N-Evap #2	Organomation	112	1694	1990	New
N-Evap #3	Organomation	112	59284	2014	New
N-Evap #4	Organomation	112	10203	2014	New
Water Bath #1	Fischer	15-491	605021280	2005	New
Water Bath #2	Fischer	15-491	204272	2007	New
Large Muffle Furnace	Wilt Industries	210	041213	2001	New
Dishwasher #1	Miele Professional	G7783CD	53081646	2003	New
Dishwasher #2	LabConco	4540031	130576299 E	2003	New
Vacuum Pump #1	Emerson Electric MLD	5KH36KN90HX	UNL231171	1990	New
Vortex Mixer	Scientific Industries	6560	2-318564	1995	New
Electric Mixer	Barnstead/Thermlyne		125404091646	1995	New
Mini Stirring Hotplate	VWR	220	33918-604	1995	New
Separatory Funnel Rotator 1	AP & R Machine & Tool		222307	2003	New
Separatory Funnel Rotator 2	AP & R Machine & Tool		222306	2003	New
Separatory Funnel Rotator 3	AP & R Machine & Tool		222305	2003	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Separatory Funnel Rotator 4	AP & R Machine & Tool		222304	2003	New
Separatory Funnel Rotator 5	AP & R Machine & Tool		222303	2003	New
Separatory Funnel Rotator 6	AP & R Machine & Tool		222302	2003	New
Centriguge #1	Sigma	2-5	78646	2001	New
Field Services Department					
pH meter E-036	HACH	Sension1-5170060	10120C210304		New
pH meter E-019	HACH	Sension1-5170060	412000029333	2006	New
pH meter E-035	HACH	Sension1-5170060	08040C310395		
pH meter M-016	Hach	Sension1	050400022762	2005	New
pH meter M-039	Hach	Sension1	08040C410063	2006	New
pH meter M-031	Hach	HQ40D			
pH meter	Hach	Sension1	050600C10445	2005	New
pH meter E-036	HACH	5170060	0C260049		New
pH meter M-042	HACH	5170060	08110C111808		New
pH meter M-010	HACH	5170060	40300004162		New
pH meter E-021	ThermoOrion	230A	017900		New
pH meter E-033	ThermoOrion	230A	017788		New
pH/COND M-059	HACH	HQ40Dmulti	130800092563		New
pH+EC Sensor EP-091	HACH	5059	230		New
pH+ORP+EC Sensor MP-162	HACH	5048	151		New
DO meter M-056	HACH	Sension+DO6	401123		New
DO meter M-058	HACH	Sension+DO6	326101		New
DO meter M-032	HACH	Sension6-5185060	05070C360249	2006	New
DO meter E-037	HACH	Sension6-5185060	10120C260049		
DO meter M-027	Hach	Sension6	050500C60066	2005	New
DO meter M-007	Hach	Sension6	020900001321		New
DO meter	Hach	Sension6			New
DO meter M-015	Hach	Sension6	001200002352	2000	New
DO Meter E-037	HACH	5185000	0C260049		New
DO Meter	Hach	Sension +DO6	348155		New
DO Meter	Hach	Sension +DO6	403037		New
Conductivity Meter E-038	HACH	Sension5-5180060	10120C250073		New
Conductivity Meter M-028	HACH	Sension5-5180060	050500C50288	2005	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Conductivity Meter E-006	HACH	Sension5-5180060	501000002708		New
Conductivity Meter M-018	HACH	Sension5	050300013668		New
Conductivity Meter M-0055	HACH	HQ40D	12080078247		New
Conductivity Meter	HACH	Sension5			New
Conductivity Meter M-014	HACH	Sension5	030500006215		New
Conductivity Meter E-038	HACH	5180000	0C250073		New
Conductivity Meter E-027	HACH	5180060	050500C50193		New
ORP Meter E-039	HACH	Sension1-5170060	10120C210070		New
ORP Meter M-060	HACH	HQ40Dmulti	130100083125		New
ORP Meter E-028	HACH	Sension1-5170060	40800010007		New
ORP Meter E-009	HACH	Sension1-5170060	402000003831		New
ORP Meter M-017	HACH	Sension1	05040002039		New
ORP Meter M-041	HACH	Sension1	08040C410042		New
ORP Meter	HACH	Sension1			New
ORP Meter M-006	HACH	Sension1	04030004238		New
ORP Meter E-039	HACH	5170000	0C210070		New
ORP Meter M-069	HACH	HQ40D	140300101090		New
Turbidity Meter E-056	Lamotte	2020we	584-0311		New
Turbidity Meter M-056	Lamotte	2020we	3458-2313		New
Turbidity Meter M-053	Lamotte	2020we	2404-3012		New
Turbidity Meter E-058	Lamotte	2020we	371-4610		New
Turbidity Meter M-047	Lamotte	2020we	567-0111		New
Turbidity Meter M-048	Lamotte	2020we	639-0411		New
Turbidity Meter	Lamotte	2020we			New
Turbidity Meter M-049	Lamotte	2020we	546-0111		New
Turbidity Meter M-066	Lamotte	2020we	4225-1014		New
Turbidity Meter M-054	Lamotte	2020we	2385-0312		New
Turbidity Meter E-059	Lamotte	2020we	3462-2313		New
Turbidity Meter E-055	Lamotte	2020we	180-3710		New
Turbidity Meter M-050	Lamotte	2020we	640-0411		New
Turbidity Meter EP-057	Lamotte	2020we	369-4610		New
Multi Meter (pH/Cond/ORP) M-064	Hach	HQ40D	131200097322		New
Multi Meter (pH/Cond/ORP) M-062	Hach	HQ40D	131100096885		New
Multi Meter (pH/Cond/ORP) M-068	Hach	HQ40D	140300101093		New
Chlorine Meter CL-007	HACH	Pocket Colorimeter II	040200011290	2006	New
Chlorine Meter CL-002	HACH	Pocket Colorimeter	020100174404	2006	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Chlorine Meter CL-003	HACH	Pocket Colorimeter II	040200011345	2006	New
Chlorine Meter CL-004	HACH	Pocket Colorimeter	961200102549	2006	New
Chlorine Meter CL-006	HACH	Pocket Colorimeter	030400034505		New
Chlorine Meter CL-005	HACH	Pocket Colorimeter	020100174252		New
Chlorine Meter CL-008	HACH	Colorimeter 1200	4796-4900		New
PID	RAE	Min:RAE2000	110-010940		New
PID	RAE	Min:RAE2000	110-010984		New
Peristaltic Pump	Solonist	410	003270		New
Peristaltic Pump	Solonist	410	002642		
Peristaltic Pump	Solonist	410	002634		New
Peristaltic Pump	ISCO	ISCO 150	202F01835		New
Peristaltic Pump	ISCO	ISCO 150	195K01032		New
Peristaltic Pump	ISCO	ISCO 150	N/A		New
Peristaltic Pump	Sigma	N/A	22151		New
Peristaltic Pump	GeoPump	9001280	603003533		New
Composite sampler	ISCO	3700	204G00978		New
Composite sampler	ISCO	3700	210S00481		New
Composite sampler	ISCO	3700	211D00260		New
Composite sampler	ISCO	3700	212L00333		New
Grundfos	Grundfos	MP1/1A106003 P1	10460002		New
Grundfos	Grundfos	MP1/1A106003 P1	11030045		New
Grundfos	Grundfos	MP1/1A106003 P1	7460012		New
Grundfos	Grundfos	MP1/1A106003	98040466		New
Grundfos	Grundfos	MP1/1A106003	51418349		New
Sub Pump	Proactive	N/A	1371		New
Monsoon Control	Proactive	N/A	NA		New
Compressor	QED	3020	18323		New
Compressor	Coleman	CT5090412	D02812339		New
Compressor	Honda/Cambell	N/A	091593L689231VT69 7203AJ		New
Control Pack	QED	MP15	1278		New
Control Pack	QED	MP15	1299		New
Control Pack	QED	MP15	1079		New
Control Pack	QED	MP15	1528		New
Control Pack	QED	MP15	1280		New
Control Box	Grundfos	96765947	H100520040		New
Control Box	Grundfos	81128527	H0303130012		New
Control Box	Grundfos	91126028	H0412210115		New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Control Box	Grundfos	91126028	H0412210120		New
Control Box	Grundfos	SI-MP1115	151131		New
Control Box	Grundfos	SI-MP1115	203718		New
Bladder Pump	QED	MP-SPK-4P	12219		New
Bladder Pump	QED	MP-SPK-4P	10218		New
Bladder Pump	QED	MP-SPK-4P	12794		New
Bladder Pump	QED	MP-SPK-4P	12523		New
Bladder Pump	QED	MP-SPK-4P	11191		New
Bladder Pump	QED	MP-SPK-4P	11192		New
Bladder Pump	QED	MP-SPK-4P	11991		New
Bladder Pump	QED	MP-SPK-4P	11697		New
Bladder Pump	QED	MP-SPK-4P	11714		New
Bladder Pump	QED	MP-SPK-4P	12751		New
Bladder Pump	QED	MP-SPK-4P	11512		New
Bladder Pump	GeoTech	Model D 0.675	18		New
Bladder Pump	GeoTech	Model D 0.675	93		New
Generator	Honda	EU Inverter 2000	EAAS-2126666		New
Generator	Honda	EM 1800	E2CK-1011585		New
Generator	Honda	EM 3000	E2GL-1002925		New
Metal Detector	Fisher	FX-3	10123978		New
Marshaulk	N/A	N/A	N/A		New
Water Level Meter	Solonist	101	236477		New
Water Level Meter	Solonist	101	236505		New
Water Level Meter	Solonist	101	200769		New
Water Level Meter	Solonist	101	58356		New
Water Level Meter	Solonist	N/A	N/A		New
Interphase	Solonist	122	58167		New
Interphase	N/A	N/A	N/A		New
PID	RAE	MiniRae 2000	110-010953		New
PID	RAE	PGM-7615	103958		New
PID	RAE	MiniRae 3000	592-906947		New
YSI Meter	YSI Inc.	556MPS	06F1362 AC		New
Bladder Pump	QED	MP-SPK-4P	12870		New
Bladder Pump	QED	MP-SPK-4P	12175		New
Bladder Pump	QED	MP-SPK-4P	10996		New
Bladder Pump	QED	MP-SPK-4P	12023		New
Bladder Pump	QED	MP-SPK-4P	12752		New
Bladder Pump	QED	MP-SPK-4P	10997		New
Bladder Pump	QED	MP-SPK-4P	10200		New
Bladder Pump	QED	MP-SPK-4P	12087		New
Bladder Pump	QED	MP-SPK-4P	10649		New
Bladder Pump	QED	MP-SPK-4P	12568		New
Bladder Pump	QED	MP-SPK-4P	12654		New
Bladder Pump	Solinst	NA	NA		New
Bladder Pump	Solinst	NA	NA		New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Submersible Pump	Proactive	Monsoon XL	24730		New
Monsoon Control Box	Proactive	LCD Controller	H10867		New
Grundfos Pump	Grundfos	MP1/1A106003	044917629		New
Grundfos Pump	Grundfos	MP1/1A106003	06029591		New
Grundfos Pump	Grundfos	MP1/1A106003	051418361		New
Grundfos Pump	Grundfos	A 1A106003PI	10030064		New
Grundfos Pump	Grundfos	A 1A106003PI	07460012		New
Grundfos Pump	Grundfos	A 1A106003PI	11150009		New
Control Box	Grundfos	BMI/MP1-115V	9517		New
Control Box	Grundfos	SI/MP1-115/230V	203831		New
Control Box	Grundfos	IN2039B11	H1006080040		New
Control Box	Grundfos	IN0853A43	H0303130012		New
Control Box	Grundfos	IN0903A44	H0412210120		New
Control Pack	QED	MP-15	1181		New
Control Pack	QED	MP-15	1537		New
Control Pack	QED	MP-15	1615		New
Control Pack	QED	MP-15	1297		New
Control Pack	QED	MP-15	1060		New
Control Pack	QED	MP-15	1538		New
Control Pack	QED	MP-15	1180		New
Control Pack	QED	MP-15	1300		New
Peristaltic Pump	Solinst	410	002562		New
Peristaltic Pump	Solinst	410	002071		New
Peristaltic Pump	Solinst	410	001979		New
Peristaltic Pump	Solinst				New
Peristaltic Pump	GeoTech	900-1280	J02003143		New
Interface Meter	Solinst	122	59307		New
Interface Meter	Solinst	122	122 008699-1		New
Water Level Meter	Solinst	101	50333		New
Water Level Meter	Solinst	101	200766		New
Water Level Meter	Solinst	101	50331		New
Water Level Meter	Solinst	101	236317		New
Water Level Meter	Solinst	101	35312		New
Water Level Meter	Solinst	101	222854		New
Composite sampler	ISCO	3700 Sampler	212L00327		New
Composite sampler	ISCO	3700 Sampler	205C01380		New
Composite sampler	ISCO	3700 Sampler	205C01376		New
Composite sampler	ISCO	2700 Sampler	04939-054		New
Composite sampler	ISCO	2910 Sampler	197J00505		New
Composite sampler	ISCO	2700 Sampler	06522-094		New
Metal Detector	Chicago Steel Tape	Magna-Trak 102	102066024		New
Metal Detector	Chicago Steel Tape	Magna-Trak 102			New
Fresh Water Pump	NorthStar	10633	2252957		New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Generator	Honda	EB 3000C	EZGP-1145763		New
Generator	Honda	EB 3000C	EZGP-1151238		New
Generator	Honda	EM 3000C	EZGL-1002930		New
Compressor	Industrial Air	CTA5090412.GNE	K13110207A		New
Power Inverter	N Power	NA	120270929		New
PID	PE Photovac	2020	DQ-GD-302		New
Control Box	Grundfos	SI/MP1-115/230V	9909		New
Generator	Troy Bilt	01924	1010594921		New
Composite sampler	ISCO	2710 Sampler	05248-001		New
Mini Interface Meter	Water Mark	H01L/SM01L	01-1096		New
Interface Meter	Testwell Inc.	NA	NA		New
Water Level Meter	Fisher	M-Scope	NA		New
Water Level Meter	Fisher	M-Scope	NA		New
Varistaltic Pump	Manostat	72-310-000	M97005467		New
Utility Pump	TEEL	2P110A	1962		New
Utility Pump	TEEL	2P110B	3021		New
Utility Pump	TEEL	2P110B	0034		New
Utility Pump	TEEL	2P110B	0036		New

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Table 20-2. Example: Schedule of Routine Maintenance

Table 20-2. Example: Schedule of Routine Maintenance		
Instrument	**Procedure**	**Frequency**
Leeman Mercury Analyzer	Check tubing for wear Fill rinse tank with 10% HCl Change dryer tube Fill reductant bottle with 10% Stannous Chloride	Daily Daily As needed Daily
ICP	Check pump tubing Check liquid argon supply Check fluid level in waste container Check filters Clean or replace filters Check torch Check sample spray chamber for debris Clean and align nebulizer Check entrance slit for debris Change printer ribbon Replace pump tubing	Daily Daily Daily Weekly As required Daily Monthly Monthly Monthly As required As required
ICP MS	Change pump tubing Clean torch Check / clean nebulizer Clean cones Check air filters Check multiplier voltages & do cross calibration Replace sample uptake tubing Check rotary pump oil Check oil mist filters Check chiller water level	Weekly or As required Weekly or As required Weekly or As required Weekly or As required Weekly or As required Weekly or As required Weekly or As required Weekly or As required Monthly Monthly
UV-Vis Spectrophotometer	Clean ambient flow cell Precision check/alignment of flow cell Wavelength verification check	As required As required Semi-annually
Auto Analyzers	Clean sampler Check all tubing Clean inside of colorimeter Clean pump well and pump rollers Clean wash fluid receptacle Oil rollers/chains/side rails Clean optics and cells	Daily Daily Daily Quarterly Weekly Weekly Quarterly

Table 20-2. Example: Schedule of Routine Maintenance

Instrument	Procedure	Frequency
Gas Chromatograph/Mass Spectrometer (GC/MS)	Ion gauge tube degassing Pump oil-level check Pump oil changing Analyzer bake-out Analyzer cleaning Resolution adjustment COMPUTER SYSTEM AND PRINTER: Air filter cleaning Change data system air filter Printer head carriage lubrication Paper sprocket cleaning Drive belt lubrication	As required Monthly Annually As required As required As required As required As required As required As required As required
Gas Chromatograph	Compare standard response to previous day or since last initial calibration Check carrier gas flow rate in column Check temp. of detector, inlet, column oven Septum replacement Glass wool replacement Check system for gas leaks with SNOOP Check for loose/frayed wires and insulation Bake injector/column Change/remove sections of guard column Replace connectors/liners Change/replace column(s)	Daily Daily via use of known compound retention Daily As required As required W/cylinder change as required Monthly As Required As Required As Required As Required
Electron Capture Detector (ECD)	Detector wipe test (Ni-63) Detector cleaning	Semi-annually As required
Flame Ionization Detector (FID)	Detector cleaning	As required
Photoionization Detector (PID)	Change O-rings Clean lamp window	As required As required
HPLC	Change guard columns Change lamps Change pump seals Replace tubing Change fuses in power supply Filter all samples Change autosampler rotor/stator	As required As required Semi-annually or as required As required As required Daily As required
Balances	Class “S” traceable weight check Clean pan and check if level Field service	Daily, when used Daily At least Annually
Conductivity Meter	0.01M KCl calibration Conductivity cell cleaning	Daily As required
Turbidimeter	Check light bulb	Daily, when used
Deionized/Distilled Water	Daily conductivity check Check deionizer light Monitor for VOA’s System cleaning Replace cartridge & large mixed bed resins	Daily Daily Daily As required As required

Table 20-2. Example: Schedule of Routine Maintenance

Instrument	Procedure	Frequency
Drying Ovens	Temperature monitoring Temperature adjustments	Daily As required
Refrigerators/ Freezers	Temperature monitoring Temperature adjustment Defrosting/cleaning	Daily As required As required
Vacuum Pumps/ Air Compressor	Drained Belts checked Lubricated	Weekly Monthly Semi-annually
pH/Specific Ion Meter	Calibration/check slope Clean electrode	Daily As required
BOD Incubator	Temperature monitoring Coil and incubator cleaning	Daily Monthly
Centrifuge	Check brushes and bearings	Every 6 months or as needed
Water baths	Temperature monitoring Water replaced	Daily Monthly or as needed

SECTION 21. MEASUREMENT TRACEABILITY

21.1 Overview

Traceability of measurements shall be assured using a system of documentation, calibration, and analysis of reference standards. Laboratory equipment that are peripheral to analysis and whose calibration is not necessarily documented in a test method analysis or by analysis of a reference standard shall be subject to ongoing certifications of accuracy. At a minimum, these must include procedures for checking specifications of ancillary equipment: balances, thermometers, temperature, Deionized (DI) and Reverse Osmosis (RO) water systems, automatic pipettes and other volumetric measuring devices. (Refer to Section 20.3). With the exception of Class A Glassware and Glass microliter syringes, quarterly accuracy checks are performed for all mechanical volumetric devices. Wherever possible, subsidiary or peripheral equipment is checked against standard equipment or standards that are traceable to national or international standards. Class A Glassware and Glass microliter syringes should be routinely inspected for chips, acid etching or deformity (e.g., bent needle). If the Class A glassware or syringe is suspect, the accuracy of the glassware will be assessed prior to use.

21.2 NIST-Traceable Weights and Thermometers

Reference standards of measurement shall be used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

For NIST-traceable weights and thermometers, the laboratory requires that all calibrations be conducted by a calibration laboratory accredited by A2LA, NVLAP (National Voluntary Laboratory Accreditation Program), or another accreditation organization that is a signatory to a MRA (Mutual Recognition Arrangement) of one or more of the following cooperations – ILAC (International Laboratory Accreditation Cooperation) or APLAC (Asia–Pacific Laboratory Accreditation Cooperation). A calibration certificate and scope of accreditation is kept on file at the laboratory.

21.3 Reference Standards / Materials

Reference standards/materials, where commercially available, are traceable to certified reference materials. Commercially prepared reference standards, to the extent available, are purchased from vendors that are accredited to ISO Guide 34 and ISO/IEC Guide 17025. All reference standards from commercial vendors shall be accompanied with a certificate that includes at least the following information:

- Manufacturer
- Analytes or parameters calibrated
- Identification or lot number
- Calibration method
- Concentration with associated uncertainties
- Purity

If a standard cannot be purchased from a vendor that supplies a Certificate of Analysis, the purity of the standard is documented by analysis. The receipt of all reference standards must be documented. Reference standards are labeled with a unique Standard Identification Number

and expiration date. All documentation received with the reference standard is retained as a QC record and references the Standard Identification Number.

All reference, primary and working standards/materials, whether commercially purchased or laboratory prepared, must be checked regularly to ensure that the variability of the standard or material from the 'true' value does not exceed method requirements. The accuracy of calibration standards is checked by comparison with a standard from a second source. In cases where a second standard manufacturer is not available, a vendor certified different lot is acceptable for use as a second source. For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst would be considered a second source. The appropriate Quality Control (QC) criteria for specific standards are defined in laboratory SOPs. In most cases, the analysis of an Initial Calibration Verification (ICV) or LCS (where there is no sample preparation) is used as the second source confirmation. These checks are generally performed as an integral part of the analysis method (e.g. calibration checks, laboratory control samples).

All standards and materials must be stored and handled according to method or manufacturer's requirements in order to prevent contamination or deterioration. Refer to the Corporate Environmental Health & Safety Manual or laboratory SOPs. For safety requirements, please refer to method SOPs and the laboratory Environmental Health and Safety Manual.

Standards and reference materials shall not be used after their expiration dates unless their reliability is verified by the laboratory and their use is approved by the Quality Assurance Manager. The laboratory must have documented contingency procedures for re-verifying expired standards.

21.4 Documentation and Labeling of Standards, Reagents, and Reference Materials

Reagents must be at a minimum the purity required in the test method. The date of reagent receipt and the expiration date are documented. The lots for most of the common solvents and acids are tested for acceptability prior to company-wide purchase. [Refer to TestAmerica's Corporate SOP (CA-Q-S-001), Solvent and Acid Lot Testing and Approval.]

All manufacturer or vendor supplied Certificate of Analysis or Purity must be retained, stored appropriately, and readily available for use and inspection. These records are maintained applicable analytical Departments. Records must be kept of the date of receipt and date of expiration of standards, reagents and reference materials. In addition, records of preparation of laboratory standards, reagents, and reference materials must be retained, stored appropriately, and be readily available for use and inspection. For detailed information on documentation and labeling, please refer to method specific SOPs.

Commercial materials purchased for preparation of calibration solutions, spike solutions, etc.., are usually accompanied with an assay certificate or the purity is noted on the label. If the assay purity is 96% or better, the weight provided by the vendor may be used without correction. If the assay purity is less than 96% a correction will be made to concentrations applied to solutions prepared from the stock commercial material. Blended gas standard cylinders use a nominal concentration if the certified value is within +/-15%, otherwise the certified values is used for the canister concentration.

21.4.1 All standards, reagents, and reference materials must be labeled in an unambiguous manner. Standards are logged into the laboratory's LIMS system, and are assigned a unique identification number. The following information is typically recorded in the electronic database within the LIMS.

- Standard ID
- Description of Standard
- Department
- Preparer's name
- Final volume and number of vials prepared
- Solvent type and lot number
- Preparation Date
- Expiration Date
- Standard source type (stock or daughter)
- Standard type (spike, surrogate, other)
- Parent standard ID (if applicable)
- Parent Standard Analyte Concentration (if applicable)
- Parent Standard Amount used (if applicable)
- Component Analytes
- Final concentration of each analyte
- Comment box (text field)

Records are maintained electronically for standard and reference material preparation. These records show the traceability to purchased stocks or neat compounds. These records also include method of preparation, date of preparation, expiration date and preparer's name or initials. Preparation procedures are provided in the Method SOPs.

21.4.2 All standards, reagents, and reference materials must be clearly labeled with a minimum of the following information:

- Expiration Date (include prep date for reagents)
- Standard ID (***from LIMS***)
- Special Health/Safety warnings if applicable

Records must also be maintained of the date of receipt for commercially purchased items or date of preparation for laboratory prepared items. Special Health/Safety warnings must also be available to the analyst. This information is maintained by the facility Environmental Health and Safety Coordinator.

21.4.3 In addition, the following information may be helpful:

- Date opened (for multi-use containers, if applicable)
- Description of standard (if different from manufacturer's label or if standard was prepared in the laboratory)

- Recommended Storage Conditions
- Concentration (if applicable)
- Initials of analyst preparing standard or opening container

All containers of prepared reagents must include an expiration date and an ID number to trace back to preparation.

Procedures for preparation of reagents can be found in the Method SOPs.

Standard ID numbers must be traceable through associated logbooks, worksheets and preparation/analytical batch records.

All reagents and standards must be stored in accordance to the following priority: 1) with the manufacturer's recommendations; 2) with requirements in the specific analytical methods as specified in the laboratory SOP.

SECTION 22. SAMPLING

22.1 Overview

The laboratory provides sampling services. Sampling procedures are described in the following SOPs as applicable::

- Groundwater Sampling (TestAmerica Edison SOP #s ED-FLD-008 and ED-FLD-009)
- Wastewater Sampling (TestAmerica Edison SOP # ED-FLD-014)
- Potable Sampling
- Waste Sampling
- Soil and Sediment Sampling
- Flow Monitoring (TestAmerica Edison SOP #s ED-FLD-008 and ED-FLD-009)
- Field Parameter Analysis (TestAmerica Edison SOPs ED-FLD-001 thru ED-FLD-007, ED-FLD-010)
- Cleaning and Decontamination of Field Equipment (see individual SOPs listed above and TestAmerica Edison SOP# ED-GEN-013)

22.2 Sampling Containers

The laboratory offers clean sampling containers for use by clients. These containers are obtained from reputable container manufacturers and meet EPA specifications as required. Certificates of cleanliness for bottles and preservatives are provided by the supplier and are maintained at the laboratory. Alternatively, the certificates may be maintained by the supplier and available to the laboratory on-line.

22.2.1 Preservatives

Upon request, preservatives are provided to the client in pre-cleaned sampling containers. In some cases containers may be purchased pre-preserved from the container supplier. Whether prepared by the laboratory or bought pre-preserved, the grades of the preservatives are at a minimum:

- Hydrochloric Acid – Reagent ACS (Certified VOA Free) or equivalent
- Methanol – Purge and Trap grade
- Nitric Acid – Instra-Analyzed or equivalent
- Sodium Bisulfate – ACS Grade or equivalent
- Sodium Hydroxide – Instra-Analyzed or equivalent
- Sulfuric Acid – Instra-Analyzed or equivalent
- Sodium Thiosulfate – ACS Grade or equivalent

22.3 Definition of Holding Time

The date and time of sampling documented on the COC form establishes the day and time zero. As a general rule, when the maximum allowable holding time is expressed in “days” (e.g., 14 days, 28 days), the holding time is based on calendar day measured. Holding times expressed in “hours” (e.g., 6 hours, 24 hours, etc.) are measured from date and time zero. Holding times for analysis include any necessary reanalysis. However, there are some programs that determine holding time compliance based on the date and specific time of analysis compared to the time of sampling regardless of how long the holding time is.

22.4 Sampling Containers, Preservation Requirements, Holding Times

The preservation and holding time criteria specified in the laboratory SOPs are derived from the source documents for the methods. If method required holding times or preservation requirements are not met, the reports will be qualified using a flag, footnote or case narrative. As soon as possible or “ASAP” is an EPA designation for tests for which rapid analysis is advised, but for which neither EPA nor the laboratory have a basis for a holding time.

22.5 Sample Aliquots / Subsampling

Taking a representative sub-sample from a container is necessary to ensure that the analytical results are representative of the sample collected in the field. The size of the sample container, the quantity of sample fitted within the container, and the homogeneity of the sample need consideration when sub-sampling for sample preparation. It is the laboratory’s responsibility to take a representative subsample or aliquot of the sample provided for analysis.

Analysts should handle each sample as if it is potentially dangerous. At a minimum, safety glasses, gloves, and lab coats must be worn when preparing aliquots for analysis.

Guidelines on taking sample aliquots & subsampling are located SOP No. ED-GEN-007 (Subsampling).

SECTION 23. HANDLING OF SAMPLES

Sample management procedures at the laboratory ensure that sample integrity and custody are maintained and documented from sampling/receipt through disposal.

23.1 Chain of Custody (COC)

The COC form is the written documented history of any sample and is initiated when bottles are sent to the field, or at the time of sampling. This form is completed by the sampling personnel and accompanies the samples to the laboratory where it is received and stored under the laboratory's custody. The purpose of the COC form is to provide a legal written record of the handling of samples from the time of collection until they are received at the laboratory. It also serves as the primary written request for analyses from the client to the laboratory. The COC form acts as a purchase order for analytical services when no other contractual agreement is in effect. An example of a COC form may be found in Figure 23-1.

23.1.1 Field Documentation

The information the sampler needs to provide at the time of sampling on the container label is:

- Sample identification
- Date and time
- Preservative

During the sampling process, the COC form is completed and must be legible (see Figure 23-1). This form includes information such as:

- Client name, address, phone number and fax number (if available)
- Project name and/or number
- The sample identification
- Date, time and location of sampling
- Sample collectors name
- The matrix description
- The container description
- The total number of each type of container
- Preservatives used
- Analysis requested
- Requested turnaround time (TAT)
- Any special instructions
- Purchase Order number or billing information (e.g. quote number) if available

- The date and time that each person received or relinquished the sample(s), including their signed name.

When the sampling personnel deliver the samples directly to TestAmerica personnel, the samples are stored in a cooler with ice, as applicable, and remain solely in the possession of the client's field technician until the samples are delivered to the laboratory personnel. The sample collector must assure that each container is in his/her physical possession or in his/her view at all times, or stored in such a place and manner to preclude tampering. The field technician relinquishes the samples in writing on the COC form to the sample control personnel at the laboratory or to a TestAmerica courier. When sampling personnel deliver the samples through a common carrier (Fed-Ex, UPS), the CoC relinquished date/time is completed by the field personnel and samples are released to the carrier. Samples are only considered to be received by lab when personnel at the fixed laboratory facility have physical contact with the samples.

Note: Independent couriers are not required to sign the COC form. The COC is usually kept in the sealed sample cooler. The receipt from the courier is stored in log-in by date; it lists all receipts each date.

23.1.2 Legal / Evidentiary Chain-of-Custody

The laboratory may, upon special request, adhere to legal/evidentiary chain of custody requirements. If TestAmerica agrees to such procedures the samples are identified for legal/evidentiary purposes on the COC, login will complete the custody seal retain the shipping record with the COC, and initiate an internal COC for laboratory use by analysts and a sample disposal record.

23.2 Sample Receipt

Samples are received at the laboratory by designated sample receiving personnel and a unique laboratory project identification number is assigned. Each sample container shall be assigned a unique sample identification number that is cross-referenced to the client identification number such that traceability of test samples is unambiguous and documented. Each sample container is affixed with a durable sample identification label. Sample acceptance, receipt, tracking and storage procedures are summarized in the following sections.

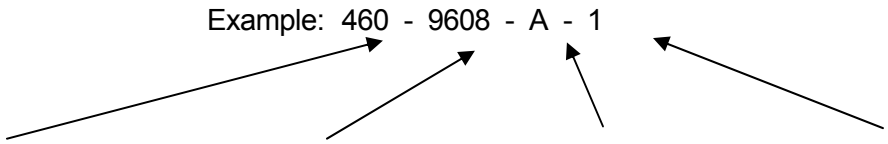
23.2.1 Laboratory Receipt

When samples arrive at the laboratory, sample receiving personnel inspect the coolers and samples. The integrity of each sample must be determined by comparing sample labels or tags with the COC and by visual checks of the container for possible damage. Any non-conformance, irregularity, or compromised sample receipt must be documented on a via the Sample Receipt application within TALS (the laboratory LIMS) and brought to the immediate attention of the client. The COC, shipping documents, documentation of any non-conformance, irregularity, or compromised sample receipt, record of client contact, and resulting instructions become part of the project record.

23.2.1.1 Unique Sample Identification

All samples that are processed through the laboratory receive a unique sample identification to ensure that there can be no confusion regarding the identity of such samples at anytime. This system includes identification for all samples, subsamples and subsequent extracts and/or digestates.

The laboratory assigns a unique identification (e.g., Sample ID) code to each sample container received at the laboratory. This Primary ID is made up of the following information (consisting of 4 components):



The above example states that TestAmerica Edison Laboratory (Location 460). Login ID is 9608 (unique to a particular client/job occurrence). The container code indicates it is the first container ("A") of Sample #1.

If the primary container goes through a prep step that creates a "new" container, then the new container is considered secondary and gets another ID. An example of this being a client sample in a 1-Liter amber bottle is sent through a Liquid/Liquid Extraction and an extraction vial is created from this step. The vial would be a SECONDARY container. The secondary ID has 5 components.

Example: 460 - 9608 - A - 1 - **A** ←——**Secondary Container Occurrence**

Example: 460-9608-A-1-A, would indicate the PRIMARY container listed above that went through a step that created the 1st occurrence of a Secondary container.

With this system, a client sample can literally be tracked throughout the laboratory in every step from receipt to disposal.

23.3 Sample Acceptance Policy

The laboratory has a written sample acceptance policy (Figure 23-2) that clearly outlines the circumstances under which samples shall be accepted or rejected. These include:

- a COC filled out completely;
- samples must be properly labeled;
- proper sample containers with adequate volume for the analysis (Sampling Guide) and necessary QC;
- samples must be preserved according to the requirements of the requested analytical method (Sampling Guide);
- sample holding times must be adhered to (Sampling Guide);

- all samples submitted for water/solid Volatile Organic analyses must have a Trip Blank submitted at the same time;
- the project manager will be notified if any sample is received in damaged condition.

Data from samples which do not meet these criteria are flagged and the nature of the variation from policy is defined.

23.3.1 After inspecting the samples, the sample receiving personnel sign and date the COC form, make any necessary notes of the samples' conditions and store them in appropriate refrigerators or storage locations.

23.3.2 Any deviations from these checks that question the suitability of the sample for analysis, or incomplete documentation as to the tests required will be resolved by consultation with the client. If the sample acceptance policy criteria are not met, the laboratory shall either:

- Retain all correspondence and/or records of communications with the client regarding the disposition of rejected samples, or
- Fully document any decision to proceed with sample analysis that does not meet sample acceptance criteria.

Once sample acceptance is verified, the samples are logged into the LIMS according SOP No. ED-SPM-001.

23.4 Sample Storage

In order to avoid deterioration, contamination or damage to a sample during storage and handling, from the time of receipt until all analyses are complete, samples are stored in refrigerators, freezers or protected locations suitable for the sample matrix. Sample containers designated for metals only analysis are stored un-refrigerated. In addition, samples to be analyzed for volatile organic parameters are stored in separate refrigerators designated for volatile organic parameters only. Samples are never to be stored with reagents, standards or materials that may create contamination.

To ensure the integrity of the samples during storage, refrigerator blanks are maintained in the volatile sample refrigerators and analyzed every two weeks.

Analysts and technicians retrieve the sample container allocated to their analysis from the designated refrigerator and place them on carts, analyze the sample, and return the remaining sample or empty container to the refrigerator from which it originally came. All unused portions of samples, including empty sample containers, are returned to the secure sample control area. All samples are kept in the refrigerators for 30 days after delivery of the final report to the client, which meets or exceeds most sample holding times. After 30 days the samples are disposed of or, upon client request moved to a sample archive area where they are stored for an additional time period agreed upon with the client or dictated by the applicable analytical program (ex. USEPA CLP).

Access to the laboratory is controlled such that sample storage need not be locked at all times unless a project specifically demands it. Samples are accessible to laboratory personnel only. Visitors to the laboratory are prohibited from entering the refrigerator and laboratory areas unless accompanied by an employee of TestAmerica.

23.5 Hazardous Samples and Foreign Soils

To minimize exposure to personnel and to avoid potential accidents, hazardous and foreign soil samples are stored in an isolated area designated for hazardous waste only.

Procedures for the handling and storage of hazardous samples are addressed in the TestAmerica Corporate Safety Manual (TestAmercia Document No. CW-E-M-001) and in TestAmerica Edison SOP No. ED-SPM-001 (Sample Receipt, Login, Identification, and Storage).

Procedures for the acceptance and handling of USDA regulated domestic and foreign soils are detailed in TestAmerica SOP No. ED-SPM-006 (Procedure for Acceptance and Handling of Regulated Domestic and Foreign Soils).

23.6 Sample Shipping

In the event that the laboratory needs to ship samples, the samples are placed in a cooler with enough ice to ensure the samples remain just above freezing and at or below 6.0°C during transit. The samples are carefully surrounded by packing material to avoid breakage (yet maintain appropriate temperature). A trip blank is enclosed for those samples requiring water/solid volatile organic analyses (see Note). The chain-of-custody form is signed by the sample control technician and attached to the shipping paperwork. Samples are generally shipped overnight express or hand-delivered by a TestAmerica courier to maintain sample integrity. All personnel involved with shipping and receiving samples must be trained to maintain the proper chain-of-custody documentation and to keep the samples intact and on ice. The Environmental, Health and Safety Manual contains additional shipping requirements.

Note: If a client does not request trip blank analysis on the COC or other paperwork, the laboratory will not analyze the trip blanks that were supplied. However, in the interest of good client service, the laboratory will advise the client at the time of sample receipt that it was noted that they did not request analysis of the trip blank; and that the laboratory is providing the notification to verify that they are not inadvertently omitting a key part of regulatory compliance testing.

23.7 Sample Disposal

Samples should be retained for a minimum of 30 days after the project report is sent, however, provisions may be made for earlier disposal of samples once the holding time is exceeded. Some samples are required to be held for longer periods based on regulatory or client requirements (e.g., 60 days after project report is sent). The laboratory must follow the longer sample retention requirements where required by regulation or client agreement. Several possibilities for sample disposal exist: the sample may be consumed completely during analysis, the sample may be returned to the customer or location of sampling for disposal, or the sample

may be disposed of in accordance with the laboratory's waste disposal procedures, TestAmerica Edison SOP No. ED-SPM-007 (Disposal of Samples and Associated Laboratory Waste). All procedures in the laboratory Environmental, Health and Safety Manual are followed during disposal. Samples are normally maintained in the laboratory no longer than two months from receipt unless otherwise requested. Unused portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work.

If a sample is part of a known litigation, the affected legal authority, sample data user, and/or submitter of the sample must participate in the decision about the sample's disposal. All documentation and correspondence concerning the disposal decision process must be kept on file. Pertinent information includes the date of disposal, nature of disposal (such as sample depletion, hazardous waste facility disposal, return to client), names of individuals who conducted the arrangements and physically completed the task. The laboratory will remove or deface sample labels prior to disposal unless this is accomplished through the disposal method (e.g., samples are incinerated).

Figure 23-1. Example: Chain of Custody (COC)

CHAIN OF CUSTODY / ANALYSIS REQUEST

TestAmerica Edison
777 New Durham Road
Edison, New Jersey 08817
Phone: (732) 549-3900 Fax: (732) 549-3679

Page ___ of ___

Name (for report and invoice)	Samplers Name (Printed)	Site/Project Identification
Company	P.O. #	State (Location of site): NJ: ☐ NY: ☐ Other:
		Regulatory Program:
Address	Analysis Turnaround Time Standard ☐	ANALYSIS REQUESTED (ENTER "X" BELOW TO INDICATE REQUEST)
City State	Rush Charges Authorized For: 2 Week ☐	LAB USE ONLY Project No:
Phone Fax	1 Week ☐ Other ☐ _____	Job No:

Sample Identification	Date	Time	Matrix	No. of. Cont.									Sample Numbers
Preservation Used: 1 = ICE, 2 = HCl, 3 = H_2SO_4, 4 = HNO_3, 5 = NaOH					Soil:								
6 = Other _____, 7 = Other _____					Water:								

Special Instructions_____ Water Metals Filtered (Yes/No)?_____

Relinquished by	Company	Date / Time	Received by	Company
1)		|	1)	
Relinquished by	Company	Date / Time	Received by	Company
2)		|	2)	
Relinquished by	Company	Date / Time	Received by	Company
3)		|	3)	
Relinquished by	Company	Date / Time	Received by	Company
4)		|	4)	

Laboratory Certifications: New Jersey (12028), New York (11452), Pennsylvania (68-522), Connecticut (PH-0200), Rhode Island (132).

Figure 23-2. Example: Sample Acceptance Policy

All incoming work will be evaluated against the criteria listed below. Where applicable, data from any samples that do not meet the criteria listed below will be noted on the laboratory report defining the nature and substance of the variation. In addition the client will be notified either by telephone, fax or e-mail ASAP after the receipt of the samples.

Per State and/or Federal Regulation, the client is responsible to ensure that samples are shipped in accordance with DOT/IATA requirements, and that radioactive materials may only be delivered to licensed facilities. Any samples containing (or suspected to contain) Source, Byproduct, or Special Nuclear Material as defined by 10 CFR should be delivered directly to facilities licensed to handle such radioactive material. Natural material or ores containing naturally occurring radionuclides may be delivered to any TestAmerica facility or courier as long as the activity concentration of the material does not exceed 270 pCi/g alpha or 2700 pCi/g beta (49 CFR Part 173).

1) Samples must arrive with labels intact with a Chain of Custody filled out completely. The following information must be recorded.
   - Client name, address, phone number and fax number (if available)
   - Project name and/or number
   - The sample identification
   - Date, time and location of sampling
   - The collectors name
   - The matrix description
   - The container description
   - The total number of each type of container
   - Preservatives used
   - Analysis requested
   - Requested turnaround time (TAT)
   - Any special instructions
   - Purchase Order number or billing information (e.g. quote number) if available
   - The date and time that each person received or relinquished the sample(s), including their signed name.
   - The date and time of receipt must be recorded between the last person to relinquish the samples and the person who receives the samples in the lab, and they must be exactly the same.
   - Information must be legible

2) Samples must be properly labeled.
   - Use durable labels (labels provided by TestAmerica are preferred)
   - Include a unique identification number
   - Include sampling date and time & sampler ID
   - Include preservative used.
   - Use indelible ink
   - Information must be legible

3) Proper sample containers with adequate volume for the analysis and necessary QC are required for each analysis requested.

4) Samples must be preserved according to the requirements of the requested analytical method.

5) Most analytical methods require chilling samples to 4° C (other than water samples for metals analysis). For these methods, the criteria are met if the samples are chilled to below 6° C and above freezing (0°C). For methods with other temperature criteria (e.g. some bacteriological methods require ≤ 10 °C), the samples must arrive within ± 2° C of the required temperature or within the method specified range. **Note:** Samples that are hand delivered to the laboratory immediately after collection may not have had time to cool sufficiently. In this case the samples will be considered acceptable as long as there is evidence that the chilling process has begun (arrival on ice).

5i.) Samples that are delivered to the laboratory on the same day they are collected may not meet the requirements of Section 5. In these cases, the samples shall be considered acceptable if the samples were received on ice.

5ii.) If sample analysis is begun within fifteen (15) minutes of collection, thermal preservation is not required.

5iii.) Thermal preservation is not required in the field if the laboratory receives and refrigerates the sample within fifteen (15) minutes of collection.

- Chemical preservation (pH) will be verified prior to analysis and documented, either in sample control or at the analyst's level. The project manager will be notified immediately if there is a discrepancy. If analyses will still be performed, all affected results will be flagged to indicate improper preservation.

- **For Volatile Organic analyses in drinking water (Methods 502.2 or 524.2**). Residual chlorine must be neutralized prior to preservation. If there is prior knowledge that the samples are not chlorinated, state it on the COC and use the VOA vials pre-preserved with HCl. The following are other options for a sampler and laboratory where the presence of chlorine is not known:

  - 1. Test for residual chlorine in the field prior to sampling.
    - If no chlorine is present, the samples are to be preserved using HCl as usual.
    - If chlorine is present, add either ascorbic acid or sodium thiosulfate prior to adding HCl.

  - 2. Use VOA vials pre-preserved with sodium thiosulfate or ascorbic acid and add HCl after filling the VOA vial with the sample.

- **FOR WATER SAMPLES TESTED FOR CYANIDE (by Standard Methods or EPA 335)**
  - In the Field: Samples are to be tested for Sulfide using lead acetate paper prior to the addition of Sodium Hydroxide (NaOH). If sulfide is present, the sample must be treated with Cadmium Chloride and filtered prior to the addition of NaOH.

    - If the sulfide test and treatment is not performed in the field, the lab will test the samples for sulfide using lead acetate paper at the time of receipt and if sulfide is present in the sample, the client will be notified and given the option of retaking the sample and treating in the field per the method requirements or the laboratory can analyze the samples as delivered and qualify the results in the final report.

  - It is the responsibility of the client to notify the laboratory if thiosulfate, sulfite, or thiocyanate are known or suspected to be present in the sample. This notification may be on the chain of custody. The samples may need to be subcontracted to a laboratory that performs a UV digestion. If the lab does not perform the UV digestion on samples that contain these compounds, the results must be qualified in the final report.

- The laboratory must test the sample for oxidizing agents (e.g. Chlorine) prior to analysis and treat according to the methods prior to distillation. (ascorbic acid or sodium arsenite are the preferred choice).

6) Sample Holding Times
   - TestAmerica will make every effort to analyze samples within the regulatory holding time. Samples must be received in the laboratory with enough time to perform the sample analysis. Except for short holding time samples (< 48hr HT) sample must be received with at least 48 hrs (2 working days) remaining on the holding time for us to ensure analysis.

   - Analyses that are designated as "field" analyses (Odor, pH, Dissolved Oxygen, Disinfectant Residual; a.k.a. Residual Chlorine, and Redox Potential) should be analyzed ASAP by the field sampler prior to delivering to the lab (within 15 minutes). However, if the analyses are to be performed in the laboratory, TestAmerica will make every effort to analyze the samples within 24 hours from receipt of the samples in the testing laboratory. Samples for "field" analyses received after 4:00 pm on Friday or on the weekend will be analyzed no later than the next business day after receipt (i.e., Monday, unless Monday is a holiday). Samples will remain refrigerated and sealed until the time of analysis. The actual times of all "field" sample analyses are noted in the final report. Samples analyzed in the laboratory will be qualified on the final report with an 'H' to indicate holding time exceedance.

7) All samples submitted for Volatile Organic analyses must have a Trip Blank submitted at the same time. TestAmerica will supply a blank with the bottle order.

8) The project manager will be notified if any sample is received in damaged condition. TestAmerica will request that a sample be resubmitted for analysis.

9) Recommendations for packing samples for shipment.

   - Pack samples in Ice rather than "Blue" ice packs.

   - Soil samples should be placed in plastic zip-lock bags. The containers often have dirt around the top, do not seal very well and are prone to intrusion from the water which results from melted ice.

   - Water samples are best package when wrapped with bubble-wrap or paper (newspaper, or paper towels) and then placed in plastic zip-lock bags.

   - Fill cooler void spaces with bubble wrap.

Figure 23-3. Example: Cooler Receipt Form

TestAmerica Edison
Receipt Temperature and pH Log

Page ___ of ____

Job Number: _____

Number of Coolers: _____ IR Gun # _____

Cooler Temperatures

	RAW	CORRECTED		RAW	CORRECTED		RAW	CORRECTED
Cooler #1:	°C	°C	Cooler #4:	°C	°C	Cooler #7:	°C	°C
Cooler #2:	°C	°C	Cooler #5:	°C	°C	Cooler #8:	°C	°C
Cooler #3:	°C	°C	Cooler #6:	°C	°C	Cooler #9:	°C	°C

TALS Sample Number	Ammonia (pH<2)	COD (pH<2)	Nitrate Nitrite (pH<2)	Metals* (pH<2)	Hardness (pH<2)	Pest (pH 5-9)	EPH or QAM (pH<2)	Phenols (pH<2)	Sulfide (pH>9)	TKN (pH<2)	TOC (pH<2)	Total Cyanide (pH>12)	Total Phos (pH<2)	Other	Other

If pH adjustments are required record the information below:

Sample No(s). adjusted: _____

Preservative Name/Conc.: _____ Volume of Preservative used (ml): _____

Lot # of Preservative(s): _____ Expiration Date: _____

The appropriate Project Manager and Department Manager should be notified about the samples which were pH adjusted.

** Samples for Metal analysis which are out of compliance must be acidified at least 24 hours prior to analysis.*

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Initials: _____ Date: _____

SECTION 24. ASSURING THE QUALITY OF TEST RESULTS

24.1 Overview

In order to assure our clients of the validity of their data, the laboratory continuously evaluates the quality of the analytical process. The analytical process is controlled not only by instrument calibration as discussed in Section 20, but also by routine process quality control measurements (e.g. Blanks, Laboratory Control Samples (LCS), Matrix Spikes (MS), duplicates (DUP), surrogates, Internal Standards (IS)). These quality control checks are performed as required by the method or regulations to assess precision and accuracy. Quality control samples are to be treated in the exact same manner as the associated field samples being tested. In addition to the routine process quality control samples, Proficiency Testing (PT) Samples (concentrations unknown to laboratory) are analyzed to help ensure laboratory performance.

24.2 Controls

Sample preparation or pre-treatment is commonly required before analysis. Typical preparation steps include homogenization, grinding, solvent extraction, sonication, acid digestion, distillation, reflux, evaporation, drying and ashing. During these pre-treatment steps, samples are arranged into discreet manageable groups referred to as preparation (prep) batches. Prep batches provide a means to control variability in sample treatment. Control samples are added to each prep batch to monitor method performance and are processed through the entire analytical procedure with investigative/field samples.

24.3 Negative Controls

Table 24-1. Example – Negative Controls

Control Type	Details
Method Blank (MB)	are used to assess preparation and analysis for possible contamination during the preparation and processing steps.
	The specific frequency of use for method blanks during the analytical sequence is defined in the specific standard operating procedure for each analysis. Generally it is 1 for each batch of samples; not to exceed 20 environmental samples.
	The method blank is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (e.g., Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The method blank goes through all of the steps of the process (including as necessary: filtration, clean-ups, etc.).
	Reanalyze or qualify associated sample results when the concentration of a targeted analyte in the blank is at or above the reporting limit as established by the method or by regulation, AND is greater than 1/10 of the amount measured in the sample.
Calibration Blanks	are prepared and analyzed along with calibration standards where applicable. They are prepared using the same reagents that are used to prepare the standards. In some analyses the calibration blank may be included in the calibration curve.
Instrument Blanks	are blank reagents or reagent water that may be processed during an analytical sequence in order to assess contamination in the analytical system. In general, instrument blanks are used to differentiate between contamination caused by the analytical system and that caused by the sample handling or sample prep process. Instrument blanks may also be inserted throughout the analytical sequence to minimize the effect of carryover from samples with high analyte content.

Table 24-1. Example – Negative Controls

Control Type	Details
Trip Blank [1]	are required to be submitted by the client with each shipment of samples requiring aqueous and solid volatiles analyses (or as specified in the client's project plan). Additionally, trip blanks may be prepared and analyzed for volatile analysis of air samples, when required by the client. A trip blank may be purchased (certified clean) or is prepared by the laboratory by filling a clean container with pure deionized water that has been purged to remove any volatile compounds. Appropriate preservatives are also added to the container. The trip blank is sent with the bottle order and is intended to reflect the environment that the containers are subjected to throughout shipping and handling and help identify possible sources if contamination is found. The field sampler returns the trip blank in the cooler with the field samples.
Field Blanks [1]	are sometimes used for specific projects by the field samplers. A field blank prepared in the field by filling a clean container with pure reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken. (EPA OSWER)
Equipment Blanks [1]	are also sometimes created in the field for specific projects. An equipment blank is a sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (TNI)
Holding Blanks	also referred to as refrigerator or freezer blanks, are used to monitor the sample storage units for volatile organic compounds during the storage of VOA samples in the laboratory

[1] When known, these field QC samples should not be selected for matrix QC as it does not provide information on the behavior of the target compounds in the field samples. Usually, the client sample ID will provide information to identify the field blanks with labels such as "FB", "EB", or "TB."

Evaluation criteria and corrective action for these controls are defined in the specific standard operating procedure for each analysis.

24.4 Positive Controls

Control samples (e.g., QC indicators) are analyzed with each batch of samples to evaluate data based upon (1) Method Performance (Laboratory Control Sample (LCS) or Blank Spike (BS)), which entails both the preparation and measurement steps; and (2) Matrix Effects (Matrix Spike (MS) or Sample Duplicate (MD, DUP), which evaluates field sampling accuracy, precision, representativeness, interferences, and the effect of the matrix on the method performed. Each regulatory program and each method within those programs specify the control samples that are prepared and/or analyzed with a specific batch

Note that frequency of control samples vary with specific regulatory, methodology and project specific criteria. Complete details on method control samples are as listed in each analytical SOP.

24.4.1 Method Performance Control - Laboratory Control Sample (LCS)

The LCS measures the accuracy of the method in a blank matrix and assesses method performance independent of potential field sample matrix affects in a laboratory batch.

The LCS is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (for example: Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The LCS is spiked with verified known amounts of analytes or is made of a material containing known and verified amounts of analytes, taken through all preparation and analysis steps along with the

field samples. Where there is no preparation taken for an analysis (such as in aqueous volatiles), or when all samples and standards undergo the same preparation and analysis process (such as Phosphorus), a calibration verification standard is reported as the LCS. In some instances where there is no practical clean solid matrix available, aqueous LCS's may be processed for solid matrices; final results may be calculated as mg/kg or ug/kg, assuming 100% solids and a weight equivalent to the aliquot used for the corresponding field samples, to facilitate comparison with the field samples.

Certified pre-made reference material purchased from a NIST/A2LA accredited vendor may also be used for the LCS when the material represents the sample matrix or the analyte is not easily spiked (e.g. solid matrix LCS for metals, TDS, etc.).

The specific frequency of use for LCS during the analytical sequence is defined in the specific standard operating procedure for each analysis. It is generally 1 for each batch of samples; not to exceed 20 environmental samples.

If the mandated or requested test method, or project requirements, do not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample (and Matrix Spike) where applicable (e.g. no spike of pH). However, in cases where the components interfere with accurate assessment (such as simultaneously spiking chlordane, toxaphene and PCBs in Method 608), the test method has an extremely long list of components or components are incompatible, at a minimum, a representative number of the listed components (see below) shall be used to control the test method. The selected components of each spiking mix shall represent all chemistries, elution patterns and masses, permit specified analytes and other client requested components. However, the laboratory shall ensure that all reported components are used in the spike mixture within a two-year time period.

- For methods that have 1-10 target analytes, spike all components.

- For methods that include 11-20 target analytes, spike at least 10 or 80%, whichever is greater.
- For methods with more than 20 target analytes, spike at least 16 components.

- Exception: Due to analyte incompatibility in pesticides, Toxaphene and Chlordane are only spiked at client request based on specific project needs.

- Exception: Due to analyte incompatibility between the various PCB Aroclors, Aroclors 1016 and 1260 are used for spiking as they cover the range of all of the Aroclors. Specific Aroclors may be used by request on a project specific basis.

24.5 Sample Matrix Controls

Table 24-3. Sample Matrix Control

Control Type	Details	
Matrix Spikes (MS)	Use	used to assess the effect sample matrix of the spiked sample has on the precision and accuracy of the results generated by the method used;
	Typical Frequency [1]	At a minimum, with each matrix-specific batch of samples processed, an MS is carried through the complete analytical procedure. Unless specified by the client, samples used for spiking are randomly selected and rotated between different client projects. If the mandated or requested test method does not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample and Matrix Spike. Refer to the method SOP for complete details
	Description	essentially a sample fortified with a known amount of the test analyte(s).
Surrogate	Use	Measures method performance to sample matrix (organics only).
	Typical Frequency [1]	Are added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. The recovery of the surrogates is compared to the acceptance limits for the specific method. Poor surrogate recovery may indicate a problem with sample composition and shall be reported, with data qualifiers, to the client whose sample produced poor recovery.
	Description	Are similar to matrix spikes except the analytes are compounds with properties that mimic the analyte of interest and are unlikely to be found in environment samples.
Duplicates[2]	Use	For a measure of analytical precision, with each matrix-specific batch of samples processed, a matrix duplicate (MD or DUP) sample, matrix spike duplicate (MSD), or LCS duplicate (LCSD) is carried through the complete analytical procedure.
	Typical Frequency [1]	Duplicate samples are usually analyzed with methods that do not require matrix spike analysis.
	Description	Performed by analyzing two aliquots of the same field sample independently or an additional LCS.
Internal Standards	Use	Are spiked into all environmental and quality control samples (including the initial calibration standards) to monitor the qualitative aspect of organic and some inorganic analytical measurements.
	Typical Frequency [1]	All organic and ICP methods as required by the analytical method.
	Description	Used to correct for matrix effects and to help troubleshoot variability in analytical response and are assessed after data acquisition. Possible sources of poor internal standard response are sample matrix, poor analytical technique or instrument performance.

[1] See the specific analytical SOP for type and frequency of sample matrix control samples.

[2] LCSD's are normally not performed except when regulatory agencies or client specifications require them. The recoveries for the spiked duplicate samples must meet the same laboratory established recovery limits as the accuracy QC samples. If an LCSD is analyzed both the LCS and LCSD must meet the same recovery criteria and be included in the final report. The precision measurement is reported as "Relative Percent Difference" (RPD). Poor precision between duplicates (except LCS/LCSD) may indicate non-homogeneous matrix or sampling.

24.6 Acceptance Criteria (Control Limits)

As mandated by the test method and regulation, each individual analyte in the LCS, MS, or Surrogate Spike is evaluated against the control limits published in the test method. Where there are no established acceptance criteria, the laboratory calculates in-house control limits with the use of control charts or, in some cases, utilizes client project specific control limits. When this occurs, the regulatory or project limits will supersede the laboratory's in-house limits.

Note: For methods, analytes and matrices with very limited data (e.g., unusual matrices not analyzed often), interim limits are established using available data or by analogy to similar methods or matrices.

Once control limits have been established, they are verified, reviewed, and updated if necessary on an annual basis unless the method requires more frequent updating. Control limits are established per method (as opposed to per instrument) regardless of the number of instruments utilized.

Laboratory generated % Recovery acceptance (control) limits are generally established by taking $\pm$ 3 Standard Deviations (99% confidence level) from the average recovery of a minimum of 20-30 data points (more points are preferred).

- Regardless of the calculated limit, the limit should be no tighter than the Calibration Verification (ICV/CCV). (Unless the analytical method specifies a tighter limit).

- In-house limits cannot be any wider than those mandated in a regulated analytical method. Client or contract required control limits are evaluated against the laboratory's statistically derived control limits to determine if the data quality objectives (DQOs) can be achieved. If laboratory control limits are not consistent with DQOs, then alternatives must be considered, such as method improvements or use of an alternate analytical method.

- The lowest acceptable recovery limit will be 10% (the analyte must be detectable and identifiable). Exception: The lowest acceptable recovery limit for Benzidine will be 5% and the analyte must be detectable and identifiable.

- The maximum acceptable recovery limit will be 150%.

- The maximum acceptable RPD limit will be 35% for waters and 40% for soils. The minimum RPD limit is 10%.

- If either the high or low end of the control limit changes by $\leq$ 5% from previous, the control chart is visually inspected and, using professional judgment, they may be left unchanged if there is no affect on laboratory ability to meet the existing limits.

24.6.1 The lab must be able to generate a current listing of their control limits and track when the updates are performed. In addition, the laboratory must be able to recreate historical control limits.

24.6.1.1 The QA Department generates and reviews Quality Control Limit Summaries using the TALS Control Chart module. These tables summarize the updated, proposed precision and accuracy acceptability limits for each applicable analysis performed at TestAmerica Edison. Once the QA Department is satisfied that the proposed limits are satisfactory the tables are forwarded to the applicable Department (Technical) Manager for final review. Once the proposed limits have been reviewed they entered into the appropriate TALS Method Limit Group database and approved for use (effectively replacing the existing limits in the database). The Quality Assurance Department maintains an archive of all limits used within the laboratory. Reference TestAmerica

Edison SOP No. ED-GEN-026 (Evaluation of Analytical Accuracy and Precision Through The Use of Control Charts).

24.6.2 A LCS that is within the acceptance criteria establishes that the analytical system is in control and is used to validate the process. Samples that are analyzed with an LCS with recoveries outside of the acceptance limits may be determined as out of control and should be reanalyzed if possible. If reanalysis is not possible, then the results for all affected analytes for samples within the same batch must be qualified when reported. The internal corrective action process (see Section 12) is also initiated if an LCS exceeds the acceptance limits. Sample results may be qualified and reported without reanalysis if:

- The analyte results are below the reporting limit and the LCS is above the upper control limit.
- If the analytical results are above the relevant regulatory limit and the LCS is below the lower control limit.

24.6.3 If the MS/MSDs do not meet acceptance limits, the MS/MSD and the associated spiked sample is reported with a qualifier for those analytes that do not meet limits. If obvious preparation errors are suspected, or if requested by the client, unacceptable MS/MSDs are reprocessed and reanalyzed to prove matrix interference. A more detailed discussion of acceptance criteria and corrective action can be found in the lab's method SOPs and in Section 12.

24.6.4 If a surrogate standard falls outside the acceptance limits, if there is not obvious chromatographic matrix interference, reanalyze the sample to confirm a possible matrix effect. If the recoveries confirm or there was obvious chromatographic interference, results are reported from the original analysis and a qualifier is added. If the reanalysis meets surrogate recovery criteria, the second run is reported (or both are reported if requested by the client). Under certain circumstances, where all of the samples are from the same location and share similar chromatography, the reanalysis may be performed on a single sample rather than all of the samples and if the surrogate meets the recovery criteria in the reanalysis, all of the affected samples would require reanalysis.

24.7 Additional Procedures to Assure Quality Control

The laboratory has written and approved method SOPs to assure the accuracy of the test method including calibration (see Section 20), use of certified reference materials (see Section 21) and use of PT samples (see Section 15).

A discussion regarding MDLs, Limit of Detection (LOD) and Limit of Quantitation (LOQ) can be found in Section 19.

- Use of formulae to reduce data is discussed in the method SOPs and in Section 20.
- Selection of appropriate reagents and standards is included in Section 9 and 21.
- A discussion on selectivity of the test is included in Section 5.
- Constant and consistent test conditions are discussed in Section 18.
- The laboratories sample acceptance policy is included in Section 23.

SECTION 25. REPORTING RESULTS

25.1 Overview

The results of each test are reported accurately, clearly, unambiguously, and objectively in accordance with State and Federal regulations as well as client requirements. Analytical results are issued in a format that is intended to satisfy customer and laboratory accreditation requirements as well as provide the end user with the information needed to properly evaluate the results. Where there is conflict between client requests and laboratory ethics or regulatory requirements, the laboratory's ethical and legal requirements are paramount, and the laboratory will work with the client during project set up to develop an acceptable solution. Refer to Section 7.

A variety of report formats are available to meet specific needs.

In cases where a client asks for simplified reports, there must be a written request from the client. There still must be enough information that would show any analyses that were out of conformance (QC out of limits) and there should be a reference to a full report that is made available to the client. Review of reported data is included in Section 19.

25.2 Test Reports

Analytical results are reported in a format that is satisfactory to the client and meets all requirements of applicable accrediting authorities and agencies. A variety of report formats are available to meet specific needs. The report is printed on laboratory letterhead, reviewed, and signed by the appropriate project manager. At a minimum, the standard laboratory report shall contain the following information:

25.2.1 A report title (e.g. Analytical Report For Samples) with a "sample results" column header.

25.2.2 Each report cover page printed on company letterhead, which includes the laboratory name, address and telephone number.

25.2.3 A unique identification of the report (e.g. work order number) and on each page an identification in order to ensure the page is recognized as part of the report and a clear identification of the end.

Note: Page numbers of report are represented as page # of ##. Where the first number is the page number and the second is the total number of pages.

25.2.4 A copy of the chain of custody (COC).

- Any COCs involved with Subcontracting are included.

25.2.5 The name and address of client and a project name/number, if applicable.

25.2.6 Client project manager or other contact

25.2.7 Description and unambiguous identification of the tested sample(s) including the client identification code.

25.2.8 Date of receipt of sample, date and time of collection, and date(s) of test preparation and performance, and time of preparation or analysis if the required holding time for either activity is less than or equal to 72 hours.

25.2.9 Date reported or date of revision, if applicable.

25.2.10 Method of analysis including method code (EPA, Standard Methods, etc.).

25.2.11 Reporting limit.

25.2.12 Method detection limits (if requested)

25.2.13 Definition of Data qualifiers and reporting acronyms (e.g. ND).

25.2.14 Sample results.

25.2.15 QC data consisting of method blank, surrogate, LCS, and MS/MSD recoveries and control limits.

25.2.16 Condition of samples at receipt including temperature. This may be accomplished in a narrative or by attaching sample login sheets (Refer to Sec. 25.2.4 – Item 3 regarding additional addenda).

25.2.17 A statement expressing the validity of the results, that the source methodology was followed and all results were reviewed for error.

25.2.18 A statement to the effect that the results relate only to the items tested and the sample as received by the laboratory.

25.2.19 A statement that the report shall not be reproduced except in full, without prior express written approval by the laboratory coordinator.

25.2.20 A signature and title of the person(s) accepting responsibility for the content of the report and date of issue. Authorized signatories are qualified Project Managers appointed by the Manager of Project Managers.

25.2.21 When TNI accreditation is required, the lab shall certify that the test results meet all requirements of TNI or provide reasons and/or justification if they do not.

25.2.22 The laboratory includes a cover letter.

25.2.23 Where applicable, a narrative to the report that explains the issue(s) and corrective action(s) taken in the event that a specific accreditation or certification requirement was not met.

25.2.24 When soil samples are analyzed, a specific identification as to whether soils are reported on a “wet weight” or “dry weight” basis.

25.2.25 Appropriate laboratory certification number for the state of origin of the sample, if applicable.

25.2.26 If only part of the report is provided to the client (client requests some results before all of it is complete), it must be clearly indicated on the report (e.g., partial report). A complete report must be sent once all of the work has been completed.

25.2.27 Any non-TestAmerica subcontracted analysis results are provided as a separate report on the official letterhead of the subcontractor. All TestAmerica subcontracting is clearly identified on the report as to which laboratory performed a specific analysis.

25.2.28 A Certification Summary Report, where required, will document that, unless otherwise noted, all analytes tested and reported by the laboratory were covered by the noted certifications.

Note: Refer to the Corporate SOP on Electronic Reporting and Signature Policy (No. CA-I-P-002) for details on internally applying electronic signatures of approval.

25.3 Reporting Level or Report Type

The laboratory offers four levels of quality control reporting. Each level, in addition to its own specific requirements, contains all the information provided in the preceding level. The packages provide the following information in addition to the information described above:

- Level I is a report with the features described in Section 25.2 above.
- Level II (also called 'Results/QA) is a Level I report plus summary information, including results for the method blank reported to the laboratory MDL, percent recovery for laboratory control samples and matrix spike samples, and the RPD values for all MSD and sample duplicate analyses.
- NJDEP Reduced Deliverables Format which contains, at minimum, the elements listed in the current NJDEP Technical Requirements for Site Remediation, N.J.A.C. 7:26E.
- NJDEP Full Deliverables Format (Non-USEPA CLP Methods) which contains, at minimum, the elements listed in the current NJDEP Technical Requirements for Site Remediation, N.J.A.C. 7:26E.
- NJDEP Full Deliverables Format (USEPA CLP Methods) which contains, at minimum, the elements listed in the current NJDEP Technical Requirements for Site Remediation, N.J.A.C. 7:26E.
- NYSDEC ASP 'A' and 'B' Deliverables Format which contain, at minimum, the elements listed in the current *New York State Department of Environmental Conservation Analytical Services Protocol*.

In addition to the various levels of QC packaging, the laboratory also provides reports in diskette deliverable form. Initial reports may be provided to clients by facsimile. Procedures used to ensure client confidentiality are outlined in Section 25.6.

25.3.1 Electronic Data Deliverables (EDDs)

EDDs are routinely offered as part of TestAmerica's services in addition to the test report as described in Section 25.2. When NELAP accreditation is required and both a test report and EDD are provided to the client, the official version of the test report will be the combined information of the report and the EDD. TestAmerica Edison offers a variety of EDD formats including NJ Hazsite Deliverables, Excel, Dbase, GISKEY, and Text Files.

EDD specifications are submitted to the IT department by the PM for review and undergo the contract review process. Once the facility has committed to providing data in a specific electronic format, the coding of the format may need to be performed. This coding is documented and validated. The validation of the code is retained by the IT staff coding the EDD.

EDDs shall be subject to a review to ensure their accuracy and completeness. If EDD generation is automated, review may be reduced to periodic screening if the laboratory can demonstrate that it can routinely generate that EDD without errors. Any revisions to the EDD format must be reviewed until it is demonstrated that it can routinely be generated without errors. If the EDD can be reproduced accurately and if all subsequent EDDs can be produced error-free, each EDD does not necessarily require a review.

25.4 Supplemental Information for Test

The lab identifies any unacceptable QC analyses or any other unusual circumstances or observations such as environmental conditions and any non-standard conditions that may have affected the quality of a result. This is typically in the form of a footnote or a qualifier and/or a narrative explaining the discrepancy in the front of the report.

Numeric results with values outside of the calibration range, either high or low are qualified as 'estimated'.

Where quality system requirements are not met, a statement of compliance/non-compliance with requirements and/or specifications is required, including identification of test results derived from any sample that did not meet TNI sample acceptance requirements such as improper container, holding time, or temperature.

Where applicable, a statement on the estimated uncertainty of measurements; information on uncertainty is needed when a client's instructions so require.

Opinions and Interpretations - The test report contains objective information, and generally does not contain subjective information such as opinions and interpretations. If such information is required by the client, the Laboratory Director will determine if a response can be prepared. If so, the Laboratory Director will designate the appropriate member of the management team to prepare a response. The response will be fully documented, and reviewed by the Laboratory Director, before release to the client. There may be additional fees charged to the client at this time, as this is a non-routine function of the laboratory.

Note: Review of data deliverable packages for submittal to regulatory authorities requires responses to non-conforming data concerning potential impact on data quality. This

necessitates a limited scope of interpretation, and this work is performed by the QA Department. This is the only form of "interpretation" of data that is routinely performed by the laboratory.

When opinions or interpretations are included in the report, the laboratory provides an explanation as to the basis upon which the opinions and interpretations have been made. Opinions and interpretations are clearly noted as such and where applicable, a comment should be added suggesting that the client verify the opinion or interpretation with their regulator.

25.5 Environmental Testing Obtained From Subcontractors

If the laboratory is not able to provide the client the requested analysis, the samples would be subcontracted following the procedures outlined in the Corporate SOP on Subcontracting (SOP No. CA-L-S-002).

Data reported from analyses performed by a subcontractor laboratory are clearly identified as such on the analytical report provided to the client. Results from a subcontract laboratory outside of TestAmerica are reported to the client on the subcontract laboratory's original report stationary and the report includes any accompanying documentation.

25.6 Client Confidentiality

In situations involving the transmission of environmental test results by telephone, facsimile or other electronic means, client confidentiality must be maintained.

TestAmerica will not intentionally divulge to any person (other than the Client or any other person designated by the Client in writing) any information regarding the services provided by TestAmerica or any information disclosed to TestAmerica by the Client. Furthermore, information known to be potentially endangering to national security or an entity's proprietary rights will not be released.

Note: This shall not apply to the extent that the information is required to be disclosed by TestAmerica under the compulsion of legal process. TestAmerica will, to the extent feasible, provide reasonable notice to the client before disclosing the information.

Note: Authorized representatives of an accrediting authority are permitted to make copies of any analyses or records relevant to the accreditation process, and copies may be removed from the laboratory for purposes of assessment.

Report deliverable formats are discussed with each new client. If a client requests that reports be faxed or e-mailed, the reports are to meet all requirements of this document, include cover letter.

25.7 Format of Reports

The format of reports is designed to accommodate each type of environmental test carried out and to minimize the possibility of misunderstanding or misuse.

25.8 Amendments to Test Reports

Corrections, additions, or deletions to reports are only made when justification arises through supplemental documentation. Justification is documented using the laboratory's corrective action system (refer to Section 12).

The revised report is retained on the Archive data server, as is the original report. The revised report is stored in the Archive data server under the sample number followed by "Rev (n)" where 'n' is the revision number. The revised report will have the words "Revision (n)" on the report cover page beneath the report date. Additionally, a section entitled"Revised Report" will appear on the Case Narrative page. A brief explanation of the reasons for the re-issue will be included in this section.

When the report is re-issued, a notation of "report re-issue "is placed on the cover/signature page of the report *or at the top of the narrative page* with a brief explanation of reason for the re-issue and a reference back to the last final report generated. *For Example*: *Report was revised on 11/3/08 to include toluene in sample NQA1504 per client's request. This final report replaces the final report generated on 10/27/08 at 10:47am.*

25.9 Policies on Client Requests for Amendments

25.9.1 Policy on Data Omissions or Reporting Limit Increases

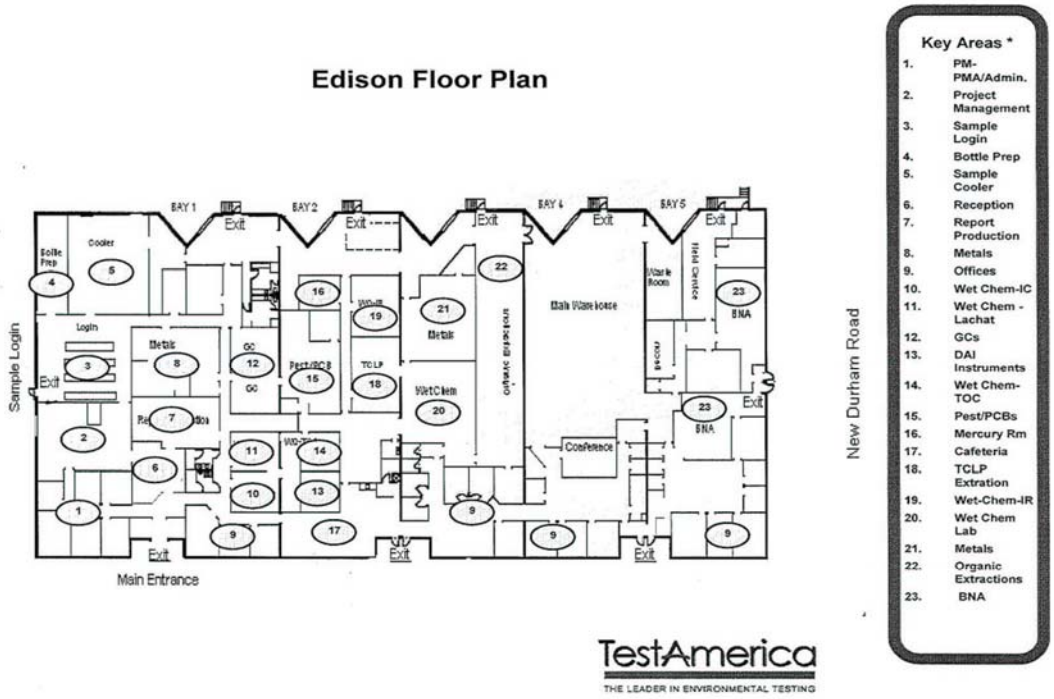
Fundamentally, our policy is simply to not omit previously reported results (including data qualifiers) or to not raise reporting limits and report sample results as ND. This policy has few exceptions. Exceptions are:

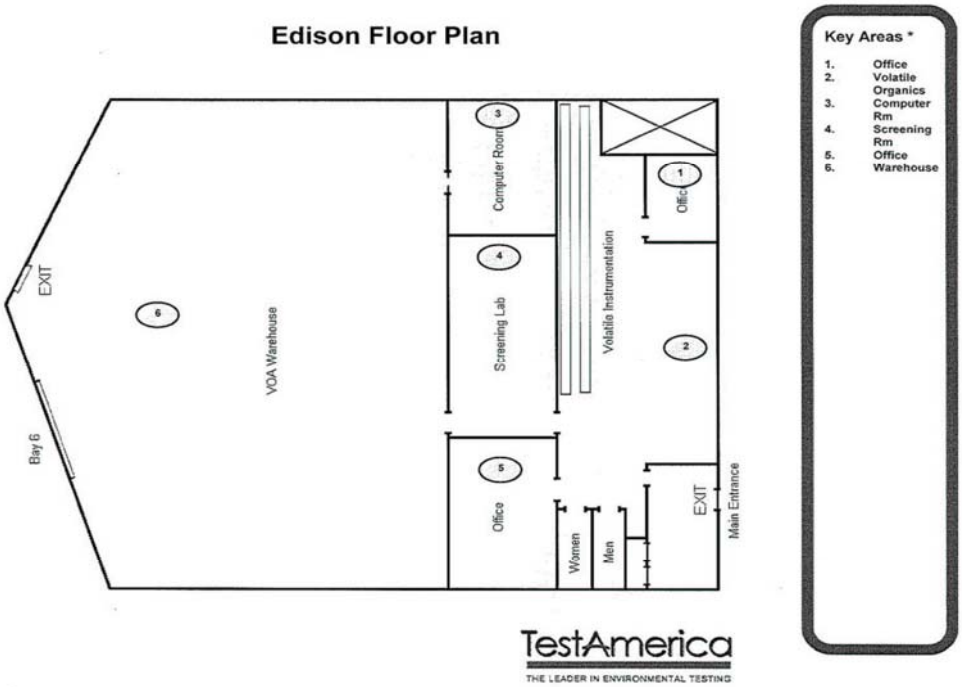
- Laboratory error.
- Sample identification is indeterminate (confusion between COC and sample labels).
- An incorrect analysis (not analyte) was requested (e.g., COC lists 8315 but client wanted 8310). A written request for the change is required.
- Incorrect limits reported based on regulatory requirements.
- The requested change has absolutely *no possible* impact on the interpretation of the analytical results and there is *no possibility* of the change being interpreted as misrepresentation by anyone inside or outside of our company.

25.9.2 Multiple Reports

TestAmerica does not issue multiple reports for the same work order where there is different information on each report (this does not refer to copies of the same report) unless required to meet regulatory needs and approved by QA.

Appendix 1. Laboratory Floor Plan





Appendix 2. Glossary/Acronyms (EL-V1M2 Sec. 3.1)

Glossary:

Acceptance Criteria: Specified limits placed on characteristics of an item, process, or service defined in requirement documents. (ASQC)

Accreditation: The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory.

Accuracy: The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (QAMS)

Analyst: The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.

Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis. (TNI)

Anomaly: A condition or event, other than a deficiency, that may affect the quality of the data, whether in the laboratory's control or not.

Assessment: The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of laboratory accreditation). (TNI)

Audit: A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives. (TNI)

Batch: Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one (1) to twenty (20) environmental samples of the same quality systems matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be twenty-four (24) hours. An **analytical batch** is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various quality system matrices and can exceed twenty (20) samples. (TNI)

Bias: The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value). (TNI)

Blank: A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. (ASQC)

Calibration: A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. (TNI)

1) In calibration of support equipment the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI).

2) In calibration according to methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications.

Calibration Curve: The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (TNI)

Calibration Standard: A substance or reference material used to calibrate an instrument (QAMS)

Certified Reference Material (CRM): A reference material accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute. (TNI)

Chain of Custody (COC) Form: Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; the collector; time of collection; preservation; and requested analyses. (TNI)

Compromised Samples: Those samples which are improperly sampled, insufficiently documented (chain of custody and other sample records and/or labels), improperly preserved, collected in improper containers, or exceeding holding times when delivered to a laboratory. Under normal conditions, compromised samples are not analyzed. If emergency situation require analysis, the results must be appropriately qualified.

Confidential Business Information (CBI): Information that an organization designates as having the potential of providing a competitor with inappropriate insight into its management, operation or products. TNI and its representatives agree to safeguard identified CBI and to maintain all information identified as such in full confidentiality.

Confirmation: Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to Second Column Confirmation; Alternate wavelength; Derivatization; Mass spectral interpretation; Alternative detectors or Additional Cleanup procedures. (TNI)

Conformance: An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements. (ANSI/ASQC E4-1994)
Correction: Actions necessary to correct or repair analysis specific non-conformances. The acceptance criteria for method specific QC and protocols as well as the associated corrective actions. The analyst will most frequently be the one to identify the need for this action as a result of calibration checks and QC sample analysis**.** No significant action is taken to change behavior, process or procedure.

Corrective Action: The action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO 8402)

Data Audit: A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data re of acceptable quality (i.e., that they meet specified acceptance criteria).

Data Reduction: The process of transforming the number of data items by arithmetic or statistical calculations, standard curves, and concentration factors, and collation into a more useable form. (TNI)

Deficiency: An unauthorized deviation from acceptable procedures or practices, or a defect in an item (ASQC), whether in the laboratory's control or not.

Demonstration of Capability: A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision. (TNI)

Document Control: The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly, and controlled to ensure use of the correct version at the location where the prescribed activity if performed. (ASQC)

Duplicate Analyses: The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. (EPA-QAD)

Equipment Blank: Sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures.

External Standard Calibration: Calibrations for methods that do not utilize internal standards to compensate for changes in instrument conditions.

Field Blank: Blank prepared in the field by filing a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken (EPA OSWER)

Field of Accreditation: Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.

Holding Times: The maximum time that samples may be held prior to analyses and still be considered valid or not compromised. (40 CFR Part 136)

Internal Standard: A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical test method. (TNI)

Internal Standard Calibration: Calibrations for methods that utilize internal standards to compensate for changes in instrument conditions.

Instrument Blank: A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. (EPA-QAD)

Instrument Detection Limit (IDL): The minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific instrument. The IDL is associated with the instrumental portion of a specific method only, and sample preparation steps are not considered in its derivation. The IDL is a statistical estimation at a specified confidence interval of the concentration at which the relative uncertainty is $\pm$ 100%. The IDL represents a range where qualitative detection occurs on a specific instrument. Quantitative results are not produced in this range.

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes, taken through all preparation and analysis steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

An LCS shall be prepared at a minimum of 1 per batch of 20 or less samples per matrix type per sample extraction or preparation method except for analytes for which spiking solutions are not available such as total suspended solids, total dissolved solids, total volatile solids, total solids, pH, color, odor, temperature, dissolved oxygen or turbidity. The results of these samples shall be used to determine batch acceptance.

Least Squares Regression (1st Order Curve): The least squares regression is a mathematical calculation of a straight line over two axes. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The regression calculation will generate a correlation coefficient (r) that is a measure of the "goodness of fit" of the regression line to the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r must be greater than or equal to 0.99 for organics and 0.995 for inorganics.

Limit(s) of Detection (LOD) [a.k.a., Method Detection Limit (MDL)]: A laboratory's estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect in their facility. (TNI)

LOD Verification [a.k.a., MDL Verification]: A processed QC sample in the matrix of interest, spiked with the analyte at no more than 3X the LOD for single analyte tests and 4X the LOD for multiple analyte tests and processed through the entire analytical procedure.

Limit(s) of Quantitation (LOQ) [a.k.a., Reporting Limit]: The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. (TNI)

(QS) Matrix: The component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions shall be used:

Aqueous: Any aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine. Includes surface water, groundwater effluents, and TCLP or other extracts.

Drinking Water: Any aqueous sample that has been designated as a potable or potential potable water source.

Saline/Estuarine: Any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.

Non-Aqueous Liquid: Any organic liquid with <15% settleable solids.

Biological Tissue: Any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Solids: Includes soils, sediments, sludges, and other matrices with >15% settleable solids.

Chemical Waste: A product or by-product of an industrial process that results in a matrix not previously defined.

Air & Emissions: Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbent tube, impinger solution, filter, or other device. (TNI)

Matrix Spike (spiked sample or fortified sample): A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test

result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Matrix Spike Duplicate (spiked sample or fortified sample duplicate): A replicate matrix spike prepared and analyzed to obtain a measure of the precision of the recovery for each analyte.

Method Blank: A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.

Method Detection Limit: The minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40 CFR Part 136, Appendix B)

Negative Control: Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results.

Non-conformance: An indication, judgment, or state of not having met the requirements of the relevant specifications, contract, or regulation.

Observation: A record of phenomena that (1) may assist in evaluation of the sample data; (2) may be of importance to the project manager and/or the client, and yet not at the time of the observation have any known effect on quality.

Performance Audit: The routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory.

Positive Control: Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects.

Precision: The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. (TNI)

Preservation: Any conditions under which a sample must be kept in order to maintain chemical and/or biological integrity prior to analysis. (TNI)

Proficiency Testing: A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (TNI)

Proficiency Testing Program: The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories. (TNI)

Proficiency Test Sample (PT): A sample, the composition of which is unknown to the laboratory and is provided to test whether the laboratory can produce analytical results within specified acceptance criteria. (TNI)

Quality Assurance: An integrated system of management activities involving planning, implementation, assessment, reporting and quality improvement to ensure that a process, item or service is of the type of quality needed and expected by the client. (TNI)

Quality Assurance [Project] Plan (QAPP): A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. (EAP-QAD)

Quality Control: The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality. (TNI)

Quality Control Sample: A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control. (TNI)

Quality Manual: A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. (TNI)

Quality System: A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC activities. (TNI)

Raw Data: The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records. (TNI)

Record Retention: The systematic collection, indexing and storing of documented information under secure conditions.

Reference Material: Material or substance one or more properties of which are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (TNI)

Reference Standard: Standard used for the calibration of working measurement standards in a given organization or a given location. (TNI)

Sampling: Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.

Second Order Polynomial Curve (Quadratic): The 2nd order curves are a mathematical calculation of a slightly curved line over two axis. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The 2nd order regression will generate a coefficient of determination (COD or r^2) that is a measure of the "goodness of fit" of the quadratic curvature the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r^2 must be greater than or equal to 0.99.

Selectivity: The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system. (TNI)

Sensitivity: The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (TNI)

Spike: A known mass of target analyte added to a blank, sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.

Standard: The document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies. (TNI)

Standard Operating Procedures (SOPs): A written document which details the method for an operation, analysis, or action, with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks. (TNI)

Storage Blank: A blank matrix stored with field samples of a similar matrix (volatiles only) that measures storage contribution to any source of contamination.

Surrogate: A substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes.

Surrogate compounds must be added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. Poor surrogate recovery may indicate a problem with sample composition and shall be reported to the client whose sample produced poor recovery. (QAMS)

Systems Audit (also Technical Systems Audit): A thorough, systematic, qualitative on-site assessment of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system. (EPA-QAD)

Technical Manager: A member of the staff of an environmental laboratory who exercises actual day-to-day supervision of laboratory operations for the appropriate fields of accreditation and reporting of results

Technology: A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.

Traceability: The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project. (TNI)

Trip Blank: A blank matrix placed in a sealed container at the laboratory that is shipped, held unopened in the field, and returned to the laboratory in the shipping container with the field samples.

Uncertainty: A parameter associated with the result of a measurement that characterizes the dispersion of the value that could reasonably be attributed to the measured value.

Acronyms:

CAR – Corrective Action Report
CCV – Continuing Calibration Verification
CF – Calibration Factor
CFR – Code of Federal Regulations

COC – Chain of Custody
DOC – Demonstration of Capability
DQO – Data Quality Objectives
DUP - Duplicate
EHS – Environment, Health and Safety
EPA – Environmental Protection Agency
GC - Gas Chromatography
GC/MS - Gas Chromatography/Mass Spectrometry
HPLC - High Performance Liquid Chromatography
ICP - Inductively Coupled Plasma Atomic Emission Spectroscopy
ICP/MS – ICP/Mass Spectrometry
ICV – Initial Calibration Verification
IDL – Instrument Detection Limit
IH – Industrial Hygiene
IS – Internal Standard
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
LIMS – Laboratory Information Management System
LOD – Limit of Detection
LOQ – Limit of Quantitation
MDL – Method Detection Limit
MDLCK – MDL Check Standard
MDLV – MDL Verification Check Standard
MRL – Method Reporting Limit Check Standard
MS – Matrix Spike
MSD – Matrix Spike Duplicate
SDS - Safety Data Sheet
NELAP - National Environmental Laboratory Accreditation Program
PT – Performance Testing
TNI – The NELAC Institute
QAM – Quality Assurance Manual
QA/QC – Quality Assurance / Quality Control
QAPP – Quality Assurance Project Plan
RF – Response Factor
RPD – Relative Percent Difference
RSD – Relative Standard Deviation
SD – Standard Deviation
SOP – Standard Operating Procedure
TAT – Turn-Around-Time
VOA – Volatiles
VOC – Volatile Organic Compound

Appendix 3. Laboratory Certifications, Accreditations, Validations

TestAmerica Edison maintains accreditations, certifications, and approvals with numerous state and national entities. Programs vary but may include on-site audits, reciprocal agreements with another entity, performance testing evaluations, review of the QA Manual, Standard Operating Procedures, Method Detection Limits, training records, etc.

. At the time of this QA Manual revision, the TestAmerica Edison laboratory has accreditation/certification/licensing with the following organizations:

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Certifications

Laboratory	Program	Authority	Identification	Expiration Date
TestAmerica Edison	Federal	USDA	NJCA-003-08	06/13/2020
TestAmerica Edison	NELAP	New Jersey	12028	06/30/2018
TestAmerica Edison	NELAP	New York	11452	04/01/2018
TestAmerica Edison	NELAP	Pennsylvania	68-00522	02/28/2018
TestAmerica Edison	State Program	Connecticut	PH-0200	09/30/2018
TestAmerica Edison	State Program	DE Haz. Subst. Cleanup Act (HSCA)	N/A	12/31/2017
TestAmerica Edison	State Program	Rhode Island	LAO00132	12/30/2017

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* Certification Valid - Laboratory is Pending Renewal with the Program Authority

For more information, or to contact a local TestAmerica representative nearest you, please visit our website at www.testamericainc.com

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The certificates and accredited parameter lists are available for each State/Program at www.testamericainc.com under Analytical Services Search – Certifications.

Quality Assurance Manual

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Quality Assurance Manual
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SECTION 2

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CA-L-P-002	Contract Compliance Policy
CW-L-S-004	Subcontracting Procedures
CA-Q-M-002	Corporate Quality Management Plan
CA-Q-S-001	Acid and Solvent Lot Testing and Approval
CA-Q-S-002	Acceptable Manual Integration Practices
CA-Q-S-006	Detection Limits
CA-Q-S-009	Root Cause Analysis
CA-T-P-001	Qualified Products List
CW-E-M-001	Corporate Environmental Health and Safety Manual
CW-F-P-002	Company Wide Authorization Matrix
CW-F-P-004	Procurement and Contracts Policy
CW-F-S-007	Capital Expenditure Controlled Purchases
CW-L-P-001	Record Retention
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KNOX-QA-0004	Control Limits and Control Charting (Sec. 5.5, 5.6.1, 24.6.4.1)
KNOX-QA-0005	Balance Calibration and Weight Verification (Sec. 9.5, 20.3.1)
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KNOX-QA-0018	Preparation and Management of Standard Operating Procedures (Sec. 6.3, 19.2)
KNOX-QA-0019	Estimation of Measurement Uncertainty (Sec. 19.12.4)
KNOX-QA-0021	Department of Defense Quality Systems Manual Program Requirements (Sec 24.6.5.3.1, 24.6.5.3.2, 25.2.8)
KNOX-QA0023	Detection Limits (Sec. 19.7.1)
KNOX-AD-0003	Documenting Project Requirements (Sec. 7.3.1)
KNOX-AD-0004	Data Reporting (Sec. 14.1.1, 25.3)
KNOX-IT-0001	Good Automated Laboratory Practices (Sec. 9.4, 19.13.1)
KNOX-IT-0002	Electronic Data And Software Backup (Sec. 19.13.1)
KNOX-MS-0014	Tentatively Identified Compounds (TICS) (Sec. 20.5)
KNOX-SC-0003	Sample Receipt and Login (Sec. 23.2.1)
KNOX-SC-0005	Sample Disposal, Return and Archive (Sec. 23.7)

SECTION 3

INTRODUCTION, SCOPE AND APPLICABILITY

3.1 INTRODUCTION AND COMPLIANCE REFERENCES

TestAmerica Knoxville's Quality Assurance Manual (QAM) is a document prepared to define the overall policies, organization objectives and functional responsibilities for achieving TestAmerica's data quality goals. The laboratory maintains a local perspective in its scope of services and client relations and maintains a national perspective in terms of quality.

The QAM has been prepared to assure compliance the NELAC Institute (TNI) Standard dated 2009, Volume 1 Modules 2 and 4, and ISO/IEC Guide 17025:2005(E). In addition, the policies and procedures outlined in this manual are compliant with TestAmerica's Corporate Quality Management Plan (CA-Q-M-002; CQMP) and the various accreditation and certification programs listed in Appendix 3. The CQMP provides a summary of TestAmerica's quality and data integrity system. It contains requirements and general guidelines under which all TestAmerica facilities conduct their operations.

The QAM has been prepared to be consistent with the requirements of the following documents:

- ANSI/ASQC, E4-1994, "Specifications and Guidelines for Quality Management Systems for Environmental Data Collection and Environmental Technology Programs" (American National Standard, January 5, 1995, or most recent version)
- "EPA Requirements for Quality Management Programs" (QA/R-2) (EPA/240/B-01/002, May 31, 2006).
- EPA 600/4-79-019, *Handbook for Analytical Quality Control in Water and Wastewater Laboratories,* EPA, March 1979.
- Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008. Final Update V, August 2015.
- Federal Register, 40 CFR Parts 136, 141, and 261.
- Manual for the Certification of Laboratories Analyzing Drinking Water (EPA 815-R-05-004, January 2005).
- APHA, *Standard Methods for the Examination of Water and Wastewater,* 18th Edition, 19th, 20th , 21st , and on-line Editions.
- *U.S. Department of Energy* Order 414.1B, *Quality Assurance*, Approved April 29, 2004, and/or 414.1C, *Quality Assurance*, Approved June 17, 2005; and/or *U.S. Department of Energy* Order 414.1D, *Quality Assurance,* Approved April 25, 2011.
- U.S. Department of Defense, Quality Systems Manual for Environmental Laboratories, Version 4.2, October 2010.
- U.S. Department of Defense (DoD)/Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0, July 2013.

3.2 TERMS AND DEFINITIONS

A Quality Assurance Program is a company-wide system designed to ensure that data produced by the laboratory conforms to the standards set by state and/or federal regulations. The program functions at the management level through company goals and management policies, and at the analytical level through Standard Operating Procedures (SOPs) and quality control. The TestAmerica program is designed to minimize systematic error, encourage constructive, documented problem solving, and provide a framework for continuous improvement within the organization.

Refer to Appendix 2 for the Glossary/Acronyms.

3.3 SCOPE / FIELDS OF TESTING

The laboratory analyzes a broad range of environmental and industrial samples every month. Sample matrices vary among air (source and ambient), drinking water, effluent water, groundwater, soils, sediment, biological, hazardous waste, and sludge. The Quality Assurance Program contains specific procedures and methods to test samples of differing matrices for chemical and physical parameters. The Program also contains guidelines on maintaining documentation of analytical processes, reviewing results, servicing clients and tracking samples through the laboratory. The technical and service requirements of all analytical requests are thoroughly evaluated before commitments are made to accept the work. Measurements are made using published reference methods or methods developed and validated by the laboratory.

The methods covered by this manual include the most frequently requested methodologies needed to provide analytical services in the United States and its territories. The specific list of test methods used by the laboratory can be found in Table 19-1. The approach of this QAM is to define the minimum level of quality assurance and quality control necessary to meet these requirements. All methods performed by the laboratory meet these criteria as appropriate. In some instances, quality assurance project plans (QAPPs), project specific data quality objectives (DQOs) or local regulations may require criteria other than those contained in this QAM. In these cases, the laboratory abides by the requested criteria following review and acceptance of the requirements by the Laboratory Director and the Quality Assurance (QA) Manager. In some cases, QAPPs and DQOs may specify less stringent requirements. The Laboratory Director and the QA Manager must determine if it is in the lab's best interest to follow the less stringent requirements.
Note: TestAmerica Knoxville must comply with the information provided in its VAP approved QA Manual and SOPs.

3.4 MANAGEMENT OF THE MANUAL

3.4.1 Review Process

The template on which this manual is based is reviewed annually by Corporate Quality Management Personnel to assure that it remains in compliance with Section3.1. This QAM itself is reviewed annually by the senior laboratory management to assure that it reflects current practices and meets the requirements of the laboratory's clients and regulators as well as the CQMP. Occasionally, the manual may need changes in order to meet new or changing regulations and operations. The QA Manager reviews the changes in the normal course of

business and incorporates changes into revised sections of the document. All updates are reviewed by the senior laboratory management staff. The laboratory updates and approves such changes according to our document control and distribution procedures (refer to SOP No. KNOX-QA-0011).

Laboratory-specific QAM changes are initiated through the TestAmerica Knoxville Quality Assurance Manager. Each revision to the QAM is approved by the same authorized signatories as shown on the cover page of the QAM. Changes to the Laboratory Specific QAM must also be reviewed and approved by Ohio EPA VAP prior to implementation.

SECTION 4

MANAGEMENT REQUIREMENTS

4.1 OVERVIEW

TestAmerica Knoxville is a local operating unit of TestAmerica Laboratories, Inc. The organizational structure, responsibilities and authorities of the corporate staff of TestAmerica Laboratories, Inc. are presented in the CQMP. The laboratory has day-to-day independent operational authority overseen by corporate officers (e.g., President and Chief Executive Officer, Chief Operating Officer (COO), Executive VP Operations, Corporate Quality Assurance, etc.). The TestAmerica Knoxville laboratory operational and support staff work under the direction of the Laboratory Director. The organizational structure for both Corporate & TestAmerica Knoxville is presented in Figure 4-1.

4.2 ROLES AND RESPONSIBILITIES

In order for the Quality Assurance Program to function properly, all members of the staff must clearly understand and meet their individual responsibilities as they relate to the quality program. The following descriptions briefly define each role in its relationship to the Quality Assurance Program. More detailed laboratory job descriptions are maintained by management and human resources on the company intranet.

4.2.1 Additional Requirements for Laboratories

The responsibility for quality resides with every employee of the laboratory. All employees have access to the QAM, are trained to this QAM, and are responsible for upholding the standards therein. Each person carries out his/her daily tasks in a manner consistent with the goals and in accordance with the procedures in this manual and the laboratory's SOPs. Role descriptions for Corporate personnel are defined in the CQMP. This manual is specific to the operations of TestAmerica's Knoxville laboratory.

4.2.2 Laboratory Director

TestAmerica Knoxville's Laboratory Director is responsible for the overall quality, safety, financial, technical, human resource and service performance of the laboratory and reports directly to the General Manager. The Laboratory Director provides the resources necessary to implement and maintain an effective and comprehensive Quality Assurance and Data Integrity Program.

Specific responsibilities include, but are not limited to:

- Implementing and ensuring adherence to the Quality System as described in this QAM and in the supporting laboratory policies and procedures.
- Providing one or more technical managers for the appropriate fields of testing. If the Technical Manager is absent for a period of time exceeding 15 consecutive calendar days, the Laboratory Director must designate another full time staff member meeting the qualifications of the Technical Manager to temporarily perform this function. If the absence

exceeds 65 consecutive calendar days, the primary accrediting authority must be notified in writing.

- Ensuring that all laboratory analysts and group leaders have the appropriate education and training to properly carry out the duties assigned to them and ensuring that this training has been documented.
- Ensuring that personnel are free from any undue pressures, including inappropriate commercial or financial concerns which may adversely affect the quality of their work.
- Annually assessing the effectiveness of the Quality System within the operation.
- Maintaining adequate trained staff to supervise and perform the work of the laboratory.
- Ensuring that appropriate corrective actions are taken to address analyses identified as requiring such actions by internal and external performance or procedural audits. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs may be temporarily suspended by the Laboratory Director.
- Having signature authority for the QAM, laboratory policies, SOPs, and contracts.
- Having the authority and responsibility to halt work, withhold final reports, or suspend an analysis for due cause as well as authorize the resumption of work

4.2.3 Quality Assurance (QA) Manager or Designee

The QA Manager is able to evaluate data objectively and perform assessments without outside (i.e., managerial) influence. Authorities and responsibilities include:

- Reporting directly to the Laboratory Director and to the Quality Director to maintain independence of QA oversight.
- Maintaining, approving, communicating and implementing the QAM.
- Having joint signature authority, with the Laboratory Director and Technical Manager for approval of quality documents.
- Directing controlled distribution of laboratory quality documents.
- Monitoring and communicating regulatory changes that may affect the laboratory to management.
- Having documented training and/or experience in QA/QC procedures and the laboratory's Quality System.
- Training and advising the laboratory staff on quality assurance/quality control procedures that are pertinent to their daily activities.
- Conducting Ethics and Data Integrity Training and conducting new employee Ethics and QA orientation.
- Ensuring that all personnel understand their contribution to the quality system.
- Evaluating the thoroughness and effectiveness of training.
- Reviewing and approving documentation of analyst training records.
- Serving as a focal point for QA and QC issues, reviewing corrective actions and recommending resolution for recurring nonconformances within the laboratory.

- Notifying laboratory management of deficiencies in the quality system and ensuring corrective actions are implemented and effective. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs shall be investigated following the procedures outlined in Section 12 and if deemed necessary may be temporarily suspended during the investigation.
- Assisting the laboratory in maintaining regulatory analytical compliance, including maintaining certifications.
- Having a general knowledge of the analytical test methods for which data audit/review is performed.
- Monitoring data quality measures via statistical methods to verify that the laboratory routinely meets stated quality goals.
- Using available tools, such as audit results, control charts, proficiency testing results, data analysis, corrective and preventive actions, customer feedback, and management reviews in efforts to monitor trends and continually improve the quality system.
- Scheduling proficiency test samples.
- Performing annual quality systems audits, and periodic data audits.
- Hosting external audits conducted by outside agencies.
- Approving quality control reference data changes in the LIMS.
- Preparing monthly QA Reports to management providing Quality System Metrics.
- Having the final authority to accept or reject data and to stop work in progress in the event that procedures or practices compromise the validity and integrity of analytical data. The QA Manager also has the responsibility to authorize the resumption of work if a stop work order was issued.
- Having responsibility and authority to ensure the continuous implementation of the quality system based on ISO 17025.
- Ensuring communication & monitoring standards of performance to ensure that systems are in place to produce the level of quality as defined in this document.
- Ensuring compliance with ISO 17025.
- Ensuring compliance with the DoD/ DOE Consolidated Quality Systems Manual (QSM).

4.2.4 Technical Manager or Designee

The Technical Manager is responsible for the technical operation of the laboratory and reports directly to the Laboratory Director. The Technical Manager is responsible for compliance with the ISO 17025 Standard. Specific responsibilities include, but are not limited to:

- Monitoring standards of performance in quality control and quality assurance.
- Monitoring the validity of the analyses performed and the data generated in the laboratory to assure reliable data.
- Exercising day to day supervision of laboratory operations and data reporting.
- Coordinating the development and implementation of SOPs.

- Having joint signature authority for QAM, SOPs, and training records.
- Performing technical training in area(s) of expertise.
- Interfacing with management on technical needs and solving day-to-day technical issues.
- Determining qualifications required for technical positions and evaluating job candidates against those requirements.
- Investigating technical issues related to projects as directed by QA.
- Evaluating new methods, technical proposals, and statements of work.
- Certifying technical laboratory personnel based on education and background to ensure that staff has demonstrated capability in the activities for which they are responsible.
- Meeting the requirements specified in the Section 4.1.1.1 of the NELAC standards.
- Ensuring compliance with ISO 17025.
- Ensuring compliance with the DoD/DOE QSM.

4.2.5 Operations Manager

The Operations Manager reports directly to the Laboratory Director and supervises the daily activities of the analytical groups. Responsibilities include, but are not limited to:

- Scheduling analytical operations.
- Supervising QC activities performed as a part of routine analytical operations.
- Implementing data review procedures.
- Supervising the preparation and maintenance of laboratory records.
- Supervising maintenance of instruments and scheduling of repairs.
- Supervising the daily activities of the Report Production Group.
- Working with the Project Managers and Group Leaders to assure the requirements of projects are met in a timely manner.
- Ensuring that corrective actions are implemented and effective.

4.2.6 Report Production Staff

The Report Production Staff reports to the Operations Manager. Responsibilities include, but are not limited to:

- Accurately generating and compiling analytical reports and associated deliverables for delivery to the client.
- Producing deliverables that meet NELAC requirements, as required.

4.2.7 Environmental Health and Safety Coordinator and Radiation Safety Officer

The Environmental Health and Safety Coordinator reports directly to the Laboratory Director. Responsibilities include, but are not limited to:

- Staying current with the hazardous waste regulations.
- Continuing training on hazardous waste issues.
- Reviewing and updating annually the Hazardous Waste Contingency Plan.
- Auditing the staff with regard to compliance with the TestAmerica Knoxville Specific Emergency Contingency Plan and the Corporate Environmental Health and Safety Manual (CW-E-M-001).
- Contacting the hazardous waste subcontractors for review of procedures and opportunities for minimization of waste.
- Conducting ongoing, necessary safety training and conduct new employee safety orientation.
- Assisting in developing and maintaining the Chemical Hygiene/Safety Manual.
- Administering dispersal of all Material Safety Data Sheet (MSDS) information.
- Performing regular chemical hygiene and housekeeping instruction.
- Giving instruction on proper labeling and practice; Serving as chairman of the laboratory safety committee.
- Overseeing the inspection and maintenance of general safety equipment – fire extinguishers, safety showers, eyewash fountains, etc. and ensure prompt repairs as needed.
- Supervising and scheduling fire drills and emergency evacuation drills.

As Radiation Safety Officer (RSO), responsibilities include but are not limited to:

- Ensuring that all uses of radioactive materials and radiation sources are conducted safely, in accordance with the conditions of the license and applicable regulations, and result in exposures to personnel which are as low as reasonably achievable (ALARA).

- Apprising and informing management of the radiation safety status of the facility and for keeping them aware of their responsibility in maintaining an adequate radiation protection program.

4.2.8 Group (Area) Leader, Team Leader or Laboratory Supervisor

Laboratory Supervisors report directly to the Operations Manager or the Laboratory Director. Responsibilities include, but are not limited to:

- Supervising daily activities of analyses within the group ensuring that the laboratory analysts adhere to the appropriate SOPs and the QAM.
- Supervising QC activities performed as a part of routine analytical operations.
- Implementing data review procedures.
- Supervising the preparation and maintenance of laboratory records.
- Evaluating instrument performance and supervising the calibration, preventive maintenance, and scheduling of repairs.

- Overseeing or performing review and approval of all analytical data.
- Reporting nonconformances to the appropriate managers.
- Ensuring that corrective actions are implemented and effective
- Providing written corrective action responses to audit findings
- Generating and reviewing SOPs for their section.

4.2.9 Laboratory Analysts

Laboratory analysts are responsible for conducting analysis and performing all tasks assigned to them by the group leader. Responsibilities include, but are not limited to:

- Performing analytical methods and data recording in accordance with documented procedures.
- Performing and documenting calibration and preventive maintenance.
- Performing data processing and data review procedures.
- Reporting nonconformances to the Group Leader, Technical Manager and QA Manager.
- Ensuring sample and data integrity by adhering to internal chain-of-custody procedures.

4.2.10 Data Reviewer

Laboratory Data Reviewers are responsible for review of analytical data. Laboratory Analysts also perform data reviews as noted above. Responsibilities include, but are not limited to:

- Performing data review procedures.
- Reporting nonconformances to the Group Leader, Technical Manager and QA Manager.

4.2.11 Sample Receiving Group Leader

The Sample Receiving Group Leader reports to the Customer Service Manager. Responsibilities include, but are not limited to:

- Ensuring implementation of proper sample receipt procedures, including maintenance of chain-of-custody.
- Reporting variances associated with condition-upon-receipt of samples.
- Logging samples into the LIMS.
- Ensuring that all samples are stored in the proper environment.
- Assisting Environmental Health and Safety staff with sample disposal.

4.2.12 Laboratory Client Relations Manager

The Client Relations Manager reports directly to the Laboratory Director and serves as the interface between the laboratory's technical departments and the laboratory's clients. The staff consists of the Project Management team. Responsibilities include, but are not limited to:

- Supervising the daily activities of the Project Management and Sample Control groups.
- Working with the Operations Manager and/or Group Leaders to ensure the requirements of projects are met in a timely manner.
- Having signature authority for laboratory reports.
- Defining customer requirements through project definition.
- Assessing and assuring customer satisfaction.
- Providing feedback to management on changing customer needs.
- Bringing together resources necessary to ensure customer satisfaction.

4.2.13 Project Manager

The Project Manager reports directly to the Customer Service Manager. Responsibilities include, but are not limited to:

- Monitoring analytical and quality assurance project requirements for a specified project.
- Acting as a liaison between the client and the laboratory staff.
- Preparing Quality Assurance Summary (QAS) or equivalent summary form and communicates project-specific requirements to all parties involved.
- Assisting the laboratory staff with interpretation of work plans, contracts, and QAPP requirements.
- Reviewing project data packages for completeness and compliance to client needs.
- Having signature authority for final report.
- Keeping the laboratory and client informed of project status.
- Together with the QA Manager, approving customer requested variances to methods and to standard laboratory protocols.
- Monitoring, reviewing, and evaluating the progress and performance of projects.
- Reporting client inquiries involving data quality issues or data acceptability to the facility QA Manager and to the operations staff.
- Preparing reissue requests for project data.

4.3 DEPUTIES

The following table defines who assumes the responsibilities of key personnel in their absence:

Key Personnel	Deputy
Laboratory Director: Christopher Rigell	Robyn Wagner
QA Manager: Kevin McGee	Annette Ribet
Technical Manager: Robyn Wagner	David Wiles
Technical Manager: Bruce Wagner	Melissa Davidson
Client Relations Manager: John Reynolds	Jamie McKinney

Key Personnel	Deputy
EHS Coordinator: Lewis Osborne	Mike Patty
Radiation Safety Officer (RSO): Lewis Osborne	James Cochran

The laboratory operational and support staff work under the direction of the Laboratory Director. The organizational structure for both Corporate & TestAmerica Knoxville is presented in Figure 4-1. Employee names are provided to demonstrate range and size of departments however the actual staff members may vary over time. The most current Organization Chart may be obtained from Quality Assurance Manager or Laboratory Director.

Figure 4-1.

Corporate and Laboratory Organization Charts

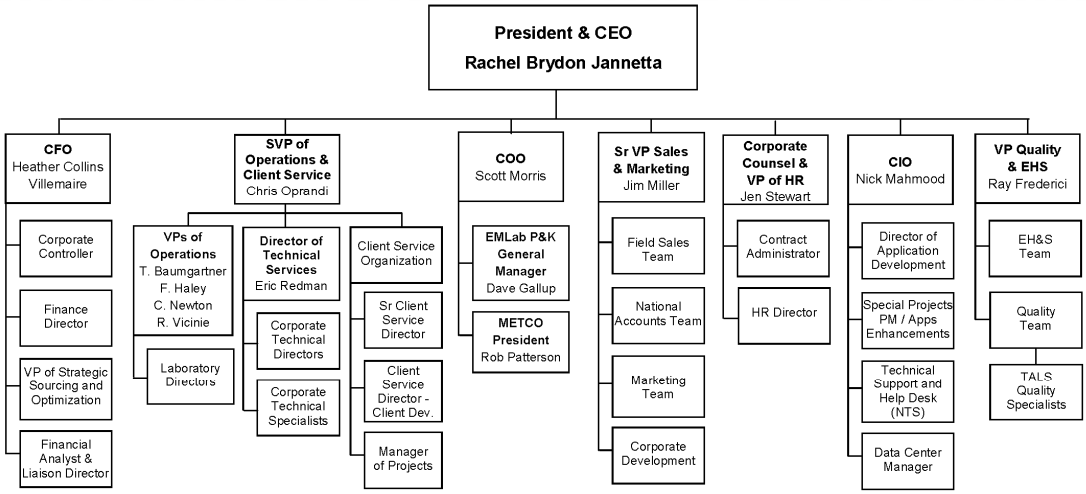

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Figure 4-1.

Corporate and Laboratory Organization Charts (continued)

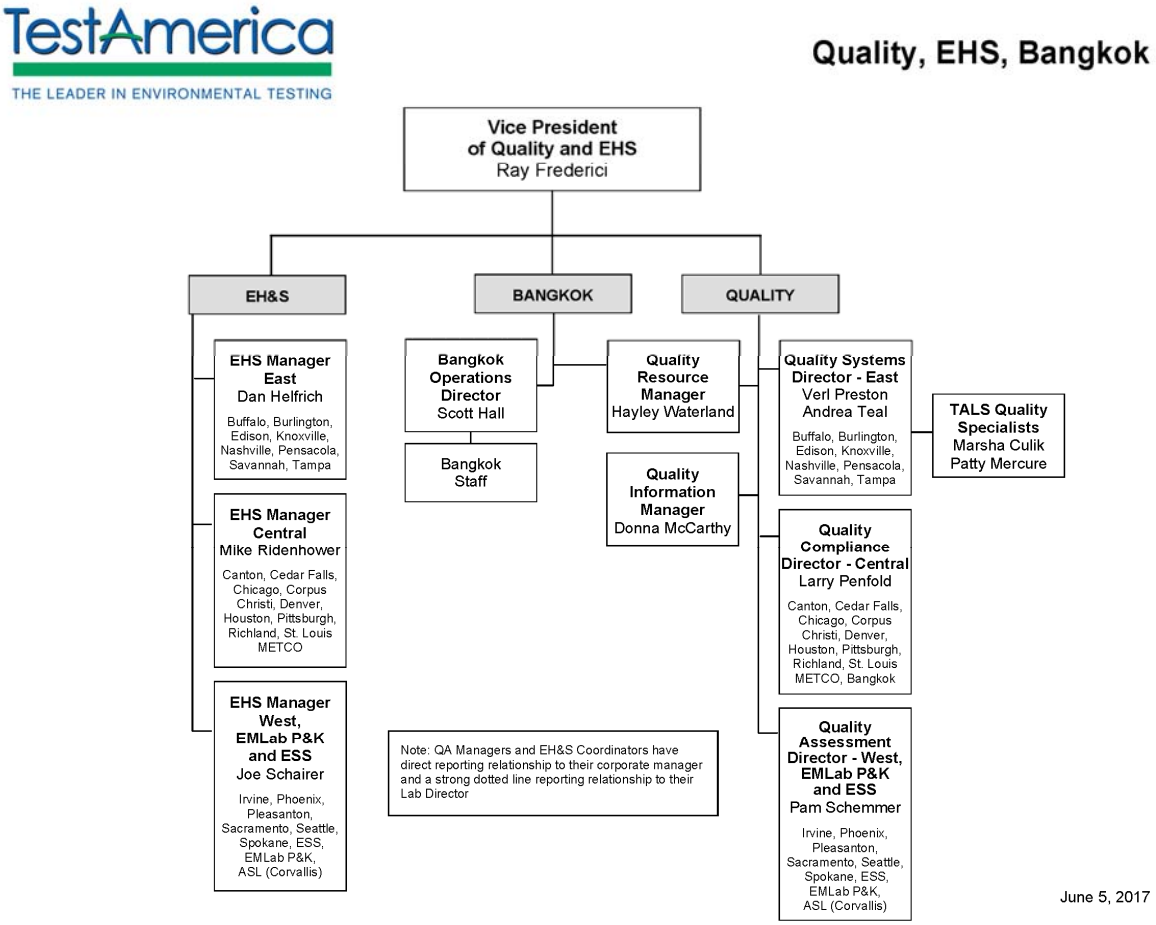
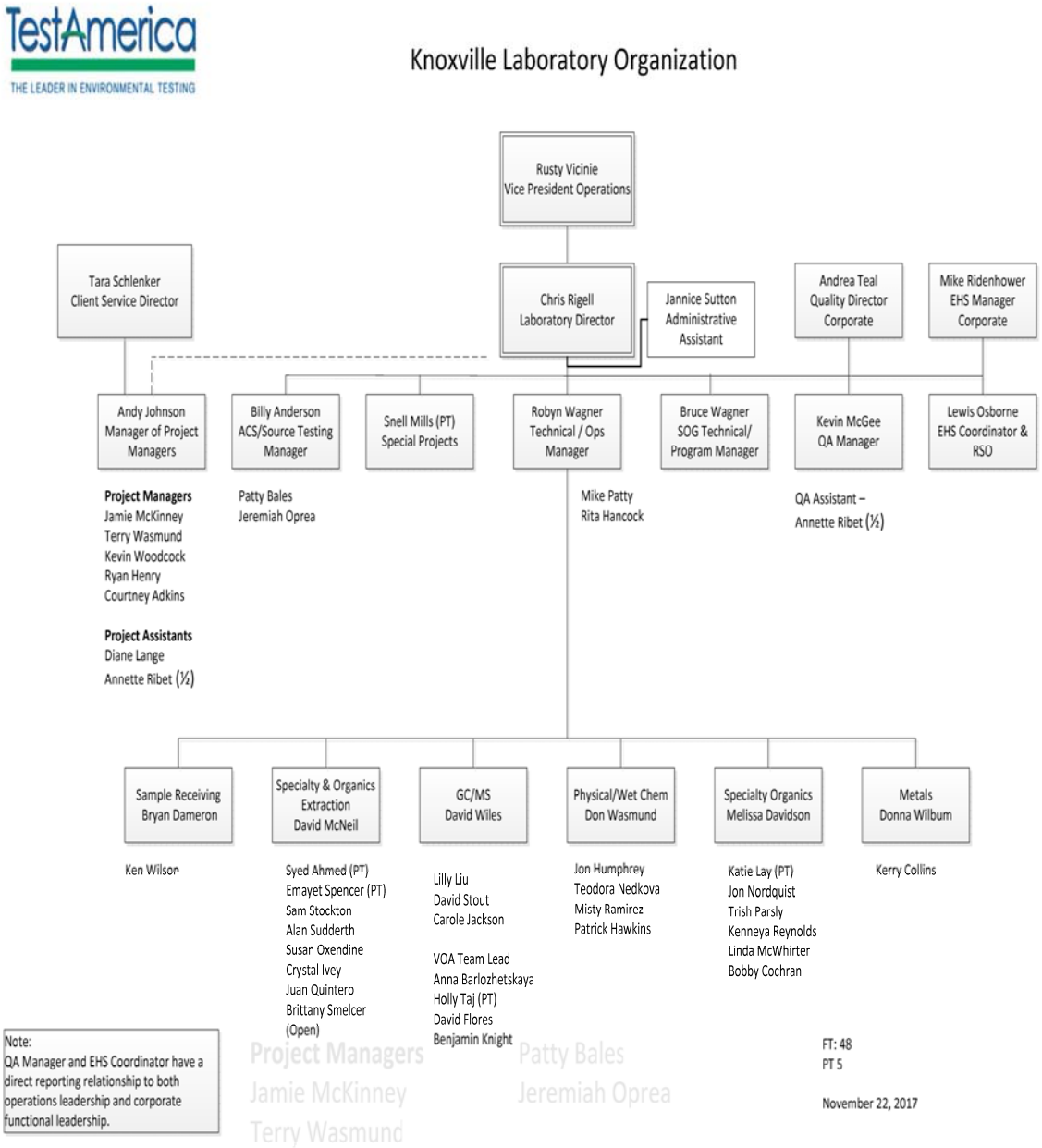


Figure 4-1.

Corporate and Laboratory Organization Charts (continued)



SECTION 5

QUALITY SYSTEM

5.1 QUALITY POLICY STATEMENT

It is TestAmerica's Policy to:

- ❖ Provide data of known quality to its clients by adhering to approved methodologies, regulatory requirements and the QA/QC protocols.
- ❖ Effectively manage all aspects of the laboratory and business operations by the highest ethical standards.
- ❖ Continually improve systems and provide support to quality improvement efforts in laboratory, administrative and managerial activities. TestAmerica recognizes that the implementation of a quality assurance program requires management's commitment and support as well as the involvement of the entire staff.
- ❖ Provide clients with the highest level of professionalism and the best service practices in the industry.
- ❖ To comply with the NELAC Standards (2003), ISO/IEC 17025:2005(E) International Standard, the 2009 TNI Standard and to continually improve the effectiveness of the management system.

Every staff member at the laboratory plays an integral part in quality assurance and is held responsible and accountable for the quality of their work. It is, therefore, required that all laboratory personnel are trained and agree to comply with applicable procedures and requirements established by this document.

5.2 ETHICS AND DATA INTEGRITY

TestAmerica is committed to ensuring the integrity of its data and meeting the quality needs of its clients. The elements of TestAmerica's Ethics and Data Integrity Program include:

- An Ethics Policy (Company-Wide Ethics Policy No. CW-L-P-004) and Employee Ethics Statements.
- Ethics and Compliance Officers (ECOs).
- A Training program.
- Self-governance through disciplinary action for violations.
- A Confidential mechanism for anonymously reporting alleged misconduct and a means for conducting internal investigations of all alleged misconduct (Corporate SOP No. CW-L-S-002).
- Procedures and guidance for recalling data if necessary (Corporate SOP No. CA-Q-S-005).
- Effective external and internal monitoring system that includes procedures for internal audits (Section 15).

Produce results which are accurate and include QA/QC information that meets client pre-defined Data Quality Objectives (DQOs).

- Present services in a confidential, honest and forthright manner.
- Provide employees with guidelines and an understanding of the Ethical and Quality Standards of our Industry.
- Operate our facilities in a manner that protects the environment and the health and safety of employees and the public.
- Obey all pertinent federal, state and local laws and regulations and encourage other members of our industry to do the same.
- Educate clients as to the extent and kinds of services available.
- Assert competency only for work for which adequate personnel and equipment are available and for which adequate preparation has been made.
- Promote the status of environmental laboratories, their employees, and the value of services rendered by them.

5.3 QUALITY SYSTEM SUPPORTING DOCUMENTATION

The laboratory's Quality System is communicated through a variety of documents.

- Quality Assurance Manual – Each laboratory has a lab specific quality assurance manual.
- Corporate SOPs and Policies - Corporate SOPs and Policies are developed for use by all relevant laboratories. They are incorporated into the laboratory's normal SOP distribution, training and tracking system. Corporate SOPs may be general or technical.
- Work Instructions - A subset of procedural steps, tasks or forms associated with an operation of a management system (e.g., checklists, preformatted bench sheets, forms).
- Laboratory SOPs – General and Technical.

5.3.1 Order of Precedence

In the event of a conflict or discrepancy between policies, the order of precedence is as follows:

- Corporate Quality Management Plan (CQMP)
- Corporate SOPs and Policies
- Laboratory QA/QC Policy Memorandum
- Laboratory Quality Assurance Manual (QAM)
- Laboratory SOPs and Policies
- Other (Work Instructions (WI), memos, flow charts, etc.)

Note: The laboratory has the responsibility and authority to operate in compliance with regulatory requirements of the jurisdiction in which the work is performed. Where the CQMP conflicts with those regulatory requirements, the regulatory requirements of the jurisdiction hold primacy. The laboratory's QAM takes precedence over the CQMP in those cases. Any regulatory requirements (e.g.; Ohio EPA VAP, CT RCP, etc) provided in the laboratory specific

documents (i.e., QAM and SOPs) take precedence over any policies provided in corporate documents.

5.4 QA/QC OBJECTIVES FOR THE MEASUREMENT OF DATA

Quality Assurance (QA) and Quality Control (QC) are activities undertaken to achieve the goal of producing data that accurately characterize the sites or materials that have been sampled. Quality Assurance is generally understood to be more comprehensive than Quality Control. Quality Assurance can be defined as the integrated system of activities that ensures that a product or service meets defined standards.

Quality Control is generally understood to be limited to the analyses of samples and to be synonymous with the term *"analytical quality control"*. QC refers to the routine application of statistically based procedures to evaluate and control the accuracy of results from analytical measurements. The QC program includes procedures for estimating and controlling precision and bias and for determining reporting limits.

Request for Proposals (RFPs) and Quality Assurance Project Plans (QAPP) provide a mechanism for the client and the laboratory to discuss the data quality objectives in order to ensure that analytical services closely correspond to client needs. The client is responsible for developing the QAPP. In order to ensure the ability of the laboratory to meet the Data Quality Objectives (DQOs) specified in the QAPP, clients are advised to allow time for the laboratory to review the QAPP before being finalized. Additionally, the laboratory provides support to the client for developing the sections of the QAPP that concern laboratory activities.

Note: TestAmerica Knoxville must comply with the information provided in its VAP approved QAM and SOPs.

Historically, laboratories have described their QC objectives in terms of precision, accuracy, representativeness, comparability, completeness, selectivity and sensitivity (PARCCSS). Equations to derive relevant QC objectives can be found in the method specific SOPs.

5.4.1 Precision

The laboratory objective for precision is to meet the performance for precision demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Precision is defined as the degree of reproducibility of measurements under a given set of analytical conditions (exclusive of field sampling variability). Precision is documented on the basis of replicate analysis, usually duplicate or matrix spike (MS) duplicate samples.

5.4.2 Accuracy

The laboratory objective for accuracy is to meet the performance for accuracy demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Accuracy is defined as the degree of bias in a measurement system. Accuracy may be documented through the use of laboratory control samples (LCS) and/or MS. A statement of accuracy is expressed as an interval of acceptance recovery about the mean recovery.

5.4.3 Representativeness

The laboratory objective for representativeness is to provide data which is representative of the sampled medium. Representativeness is defined as the degree to which data represent a characteristic of a population or set of samples and is a measurement of both analytical and field sampling precision. The representativeness of the analytical data is a function of the procedures used in procuring and processing the samples. The representativeness can be documented by the relative percent difference between separately procured, but otherwise identical samples or sample aliquots.

The representativeness of the data from the sampling sites depends on both the sampling procedures and the analytical procedures. The laboratory may provide guidance to the client regarding proper sampling and handling methods in order to assure the integrity of the samples.

5.4.4 Comparability

The comparability objective is to provide analytical data for which the accuracy, precision, representativeness and reporting limit statistics are similar to these quality indicators generated by other laboratories for similar samples, and data generated by the laboratory over time.

The comparability objective is documented by inter-laboratory studies carried out by regulatory agencies or carried out for specific projects or contracts, by comparison of periodically generated statements of accuracy, precision and reporting limits with those of other laboratories.

5.4.5 Completeness

The completeness objective for data is 90% (or as specified by a particular project), expressed as the ratio of the valid data to the total data over the course of the project. Data will be considered valid if they are adequate for their intended use. Data usability is defined in a QAPP, project scope or regulatory requirement. Data validation is the process for reviewing data to determine its usability and completeness. If the completeness objective is not met, actions will be taken internally and with the data user to improve performance. This may take the form of an audit to evaluate the methodology and procedures as possible sources for the difficulty or may result in a recommendation to use a different method.

5.4.6 Selectivity

Selectivity is defined as the capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. Target analytes are separated from non-target constituents and subsequently identified/detected through one or more of the following, depending on the analytical method: extractions (separation), digestions (separation), interelement corrections (separation), use of matrix modifiers (separation), specific retention times (separation and identification), confirmations with different columns or detectors (separation and identification), specific wavelengths (identification), specific mass spectra (identification), specific electrodes (separation and identification), etc..

5.4.7 Sensitivity

Sensitivity refers to the amount of analyte necessary to produce a detector response that can be reliably detected (Method Detection Limit, Estimated Detection Limit, or Limit of Detection) or quantified (Reporting Limit, Minimum Level, or Limit of Quantitation).

5.5 CRITERIA FOR QUALITY INDICATORS

The laboratory can prepare upon request a Quality Control Limit Summary from the Laboratory Information Management System (LIMS) that summarize the precision and accuracy acceptability limits for performed analyses. This summary includes an effective date, is updated each time new limits are generated and is located in the LIMS. Current limits are controlled through the LIMS. The limits in effect for a given date are archived in the LIMS with the associated sample data. Unless otherwise noted, limits within these tables are laboratory generated. Some acceptability limits are derived from US EPA methods when they are required. Where US EPA method limits are not required, the laboratory has developed limits from evaluation of data from similar matrices. Criteria for development of control limits is contained in SOP KNOX-QA-0004.

5.6 STATISTICAL QUALITY CONTROL

Statistically-derived precision and accuracy limits are required by selected methods (such as SW-846). The laboratory routinely utilizes statistically-derived limits to evaluate method performance and determine when corrective action is appropriate. The laboratory analysts are instructed to use the current limits in the laboratory (dated and approved by the Technical Manager/Group Leader and QA Manager) and entered into the LIMS. The Quality Assurance department maintains an archive of all limits used within the laboratory. These limits are maintained in the LIMS as part of the analytical historical record. If a method defines the QC limits, the method limits are used.

If a method requires the generation of historical limits, the lab develops such limits from recent data in the QC database of the LIMS following the guidelines described in Section 25. All calculations and limits are documented and dated when approved and effective. On occasion, a client requests contract-specified limits for a specific project.

Current QC limits are entered and maintained in the LIMS analyte database. As sample results and the related QC are entered into LIMS, the sample QC values are compared with the limits in LIMS to determine if they are within the acceptable range. The laboratory analyst then evaluates if the sample needs to be rerun or re-extracted/rerun or if a comment should be added to the report explaining the reason for the QC outlier.

5.6.1 QC Charts

The generation and use of QC Charts (Control Charts) are described in the laboratory SOP KNOX-QA-0004.

5.7 QUALITY SYSTEM METRICS

In addition to the QC parameters discussed above, the entire Quality System is evaluated on a monthly basis through the use of specific metrics (refer to Section 16). These metrics are used to drive continuous improvement in the laboratory's Quality System.

SECTION 6

DOCUMENT CONTROL

6.1 OVERVIEW

The QA Department is responsible for the control of documents used in the laboratory to ensure that approved, up-to-date documents are in circulation and out-of-date (obsolete) documents are archived or destroyed. The following documents, at a minimum, must be controlled at each laboratory Facility:

- Laboratory Quality Assurance Manual
- Laboratory Standard Operating Procedures (SOP)
- Laboratory Policies
- Work Instructions and Forms
- Corporate Policies and Procedures distributed outside the intranet

The Corporate Quality staff posts Corporate Manuals, SOPs, Policies, Work Instructions, White Papers and Training Materials on the company intranet site. These Corporate documents are only considered controlled when they are read on the intranet site. Printed copies are considered uncontrolled unless the laboratory physically distributes them as controlled documents. A detailed description of the procedure for issuing, authorizing, controlling, distributing, and archiving Corporate documents is found in Corporate SOP No. CW-Q-S-001, Corporate Document Control and Archiving. The laboratory's internal document control procedure is defined in KNOX-QA-0011, Document Control and Distribution.

The laboratory QA Department also maintains access to various references and document sources integral to the operation of the laboratory. This includes reference methods and regulations. Instrument manuals (hard or electronic copies) are also maintained by the laboratory.

The laboratory maintains control of records for raw analytical data and supporting records such as audit reports and responses, logbooks, standard logs, training files, MDL studies, Proficiency Testing (PT) studies, certifications and related correspondence, and nonconformance memos (NCMs). Raw analytical data consists of bound logbooks, instrument printouts, any other notes, magnetic media, electronic data and final reports.

6.2 DOCUMENT APPROVAL AND ISSUE

The pertinent elements of a document control system for each document include a unique document title and number, pagination, the total number of pages of the item or an 'end of document' page, the effective date, revision number and the laboratory's name. The QA personnel are responsible for the maintenance of this system.

Controlled documents are authorized by the QA Department and other laboratory management. In order to develop a new document, an employee submits a draft to the QA Department by way of the group leader/Technical Manager. Upon approval, QA personnel add the identifying version information to the document and retains that document as the official document on file.

That document is then provided to all applicable operational units (may include electronic access). Controlled documents are identified as such and records of their distribution are kept by the QA Department. Document control may be achieved by either electronic or hardcopy distribution.

The QA Department maintains a list of the official versions of controlled documents.

Quality System Policies and Procedures are reviewed at a minimum of every two years and revised as appropriate. Technical procedures used in support of work done for the Department of Defense (DOD) and Department of Energy (DOE), and the TestAmerica Knoxville Quality Assurance Manual must be reviewed at a one year frequency. Changes to documents occur when a procedural change warrants a revision of the document.

6.3 PROCEDURES FOR DOCUMENT CONTROL POLICY

For changes to the QAM, requests for change or revision may be made to the TestAmerica QA Manager. Changes affecting the text of the Corporate Quality Management Plan are forwarded to the Corporate QA Director for review and approval. If the proposed changes are accepted, they are incorporated into the next revision of the appropriate section of the QAM. Each revision to the QAM is approved by the same authorized signatories as shown on the cover page of the QAM. Uncontrolled copies must not be used within the laboratory. Previous revisions are archived by the QA department.

For changes to SOPs, refer to SOP No. KNOX-QA-0018, Preparation and Management of Standard Operating Procedures.

Forms, worksheets, work instructions and information are organized by form number and revision number on the QAQC shared directory on a local area network server.

6.4 OBSOLETE DOCUMENTS

All invalid or obsolete documents are removed, or otherwise prevented from unintended use. The laboratory has specific procedures as described above to accomplish this. In general, obsolete documents are collected from employees according to distribution lists and are marked obsolete on the cover or destroyed. At least one copy of the obsolete document is archived as described in Section 14.

SECTION 7

SERVICE TO THE CLIENT

7.1 OVERVIEW

The laboratory has established procedures for the review of work requests and contracts, oral or written. The procedures include evaluation of the laboratory's capability and resources to meet the contract's requirements within the requested time period. All requirements, including the methods to be used, must be adequately defined, documented and understood. For many environmental sampling and analysis programs, testing design is site or program specific and does not necessarily "fit" into a standard laboratory service or product. It is the laboratory's intent to provide both standard and customized environmental laboratory services to our clients.

A thorough review of technical and QC requirements contained in contracts is performed to ensure project success. The appropriateness of requested methods, and the lab's capability to perform them must be established. Projects, proposals and contracts are reviewed for adequately defined requirements and the laboratory's capability to meet those requirements. Alternate test methods that are capable of meeting the clients' requirements may be proposed by the lab. A review of the lab's capability to analyze non-routine analytes is also part of this review process.

All projects, proposals and contracts are reviewed for the client's requirements in terms of compound lists, test methodology requested, sensitivity (detection and reporting levels), accuracy, and precision requirements (% Recovery and RPD). The reviewer ensures that the laboratory's test methods are suitable to achieve these requirements and that the laboratory holds the appropriate certifications and approvals to perform the work. The laboratory and any potential subcontract laboratories must be certified, as required, for all proposed tests.

The laboratory must determine if it has the necessary physical, personnel and information resources to meet the contract, and if the personnel have the expertise needed to perform the testing requested. Each proposal is checked for its impact on the capacity of the laboratory's equipment and personnel. As part of the review, the proposed turnaround time is checked for feasibility.

Electronic or hard copy deliverable requirements are evaluated against the laboratory's capacity for production of the documentation.

If the laboratory cannot provide all services but intends to subcontract such services, whether to another TestAmerica facility or to an outside firm, this is documented and discussed with the client prior to contract approval. (Refer to Section 8 for Subcontracting Procedures.)

The laboratory informs the client of the results of the review if it indicates any potential conflict, deficiency, lack of accreditation, or inability of the lab to complete the work satisfactorily. Any discrepancy between the client's requirements and the laboratory's capability to meet those requirements is resolved in writing before acceptance of the contract. It is necessary that the contract be acceptable to both the laboratory and the client. Amendments initiated by the client and/or TestAmerica, are documented in writing.

All contracts, QAPPs, Sampling and Analysis Plans (SAPs), contract amendments, and documented communications become part of the project record.

The same contract review process used for the initial review is repeated when there are amendments to the original contract by the client, and the participating personnel are informed of the changes.

7.2 REVIEW SEQUENCE AND KEY PERSONNEL

The contract review process is outlined in SOP No. CA-L-P-002**,** Contract Compliance Policy.

This review encompasses all facets of the operation. The scope of work is distributed to the appropriate personnel, as needed based on scope of contract, to evaluate all of the requirements. Appropriate personnel may include:

- Contract Administrator
- VP of Operations
- Laboratory Manager of Project Managers
- The Laboratory Operations Manager
- Laboratory and/or Corporate Technical Managers / Directors
- Laboratory and/or Corporate Information Technology Managers/Directors
- Account Executives
- Laboratory and/or Corporate Quality
- Laboratory and/or Corporate Environmental Health and Safety Managers/Directors
- The Laboratory Director reviews the formal laboratory quote and makes final acceptance for their facility.

For routine projects and other simple tasks, a review by the Project Manager (PM) is considered adequate. The PM confirms that the laboratory has any required certifications, that it can meet the clients' data quality and reporting requirements and that the lab has the capacity to meet the clients turn around needs.

The Sales Director, Contract Administrator, Account Executive, or local account representative then submits the final proposal to the client.

In the event that one of the above personnel is not available to review the contract, his or her back-up fulfills the review requirements.

The Contracts Department maintains copies of all signed contracts*.* The Project Manager also maintains a copy.

7.3 DOCUMENTATION

Appropriate records are maintained for every contract or work request. All stages of the contract review process are documented and include records of any significant changes. This information is archived in the project files.

The contract is distributed to and maintained by the appropriate sales/marketing personnel and the Regional Account Manager. A copy of the contract and formal quote is filed with the Laboratory Project Manager and/or the Laboratory Director.

Records are maintained of pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract. The PM keeps a phone log of conversations with the client. This information is archived in the project file or in the lot folder as appropriate.

7.3.1 Project-Specific Quality Planning

Communication of contract specific technical and QC criteria is an essential activity in ensuring the success of site specific testing programs. To achieve this goal, the laboratory assigns a PM to each client. The PM is the first point of contact for the client. It is the PMs responsibility to ensure that project specific technical and QC requirements are effectively evaluated and communicated to the laboratory personnel before and during the project. QA department involvement may be needed to assist in the evaluation of custom QC requirements.

PMs are the primary client contact and they ensure resources are available to meet project requirements. Although PMs do not have direct reports or staff in production, they coordinate opportunities and work with laboratory management and supervisory staff to ensure available resources sufficient to perform work for the client's project. Project management is positioned between the client and laboratory resources.

Project specific instructions are communicated to the laboratory through the use of the Client Requirements Checklist in the LIMS or by a Quality Assurance Summary. Further details regarding the communication and documentation of project requirements are found in SOP KNOX-AD-0003, Documenting Project Requirements.

The laboratory strongly encourages client visits to the laboratory and for formal/informal information sharing session with employees in order to effectively communicate ongoing client needs as well as project specific details for customized testing programs.

7.4 SPECIAL SERVICES

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. It is the laboratory's goal to meet all client requirements in addition to statutory and regulatory requirements. The laboratory has procedures to ensure confidentiality to clients (Section 15 and 25).

The laboratory's standard procedures for reporting data are described in Section 25. Special services are also available and provided upon request. These services include:

- Reasonable access for our clients or their representatives to the relevant areas of the laboratory for the witnessing of tests performed for the client.
- Assist client-specified third party data validators as specified in the client's contract.

- Supplemental information pertaining to the analysis of their samples. Note: An additional charge may apply for additional data/information that was not requested prior to the time of sample analysis or previously agreed upon.

7.5 CLIENT COMMUNICATION

PMs are the primary communication link to the clients. They inform their clients of any delays in project completion as well as any non-conformances in either sample receipt or sample analysis. Project management maintains ongoing client communication throughout the entire client project.

Technical Managers are available to discuss any technical questions or concerns that the client may have.

7.6 REPORTING

The laboratory works with our clients to produce any special communication reports required by the contract.

7.7 CLIENT SURVEYS

The laboratory assesses both positive and negative client feedback. The results are used to improve overall laboratory quality, client service, and testing activities.

TestAmerica's Sales and Marketing teams periodically develops lab and client specific surveys to assess client satisfaction.

SECTION 8

SUBCONTRACTING OF TESTS

8.1 OVERVIEW

For the purpose of this quality manual, the phrase subcontract laboratory refers to a laboratory external to the TestAmerica laboratories. The phrase "work sharing" refers to internal transfers of samples between the TestAmerica laboratories. The term outsourcing refers to the act of subcontracting tests.

When contracting with our clients, the laboratory makes commitments regarding the services to be performed and the data quality for the results to be generated. When the need arises to outsource testing for our clients because project scope, changes in laboratory capabilities, capacity or unforeseen circumstances, we must be assured that the subcontractors or work sharing laboratories understand the requirements and meet the same commitments we have made to the client. Refer to TestAmerica's Corporate SOPs on Subcontracting Procedures (CW-L-S-004) and the Work Sharing Process (CA-C-S-001).

When outsourcing analytical services, the laboratory assures, to the extent necessary, that the subcontract or work sharing laboratory maintains a program consistent with the requirements of this document, the requirements specified in TNI/ISO 17025 and/or the client's Quality Assurance Project Plan (QAPP). All QC guidelines specific to the client's analytical program are transmitted to the subcontractor and agreed upon before sending the samples to the subcontract facility. Additionally, work requiring accreditation is placed with an appropriately accredited laboratory. The laboratory performing the subcontracted work is identified in the final report, as is non-TNI accredited work where required.

Project Managers (PMs), Client Relations Managers, or Account Executives for the Export Lab are responsible for obtaining client approval prior to subcontracting any samples. The laboratory advises the client of a subcontract arrangement in writing and when possible approval from the client is retained in the project folder. Standard TestAmerica Terms & Conditions include the flexibility to subcontract samples within the TestAmerica laboratories. Therefore, additional advance notification to clients for intra-laboratory subcontracting is not necessary unless specifically required by a client contract.

Note: In addition to the client, some regulating agencies (e.g., USDA) or contracts (e.g., DoD and DOE projects) require notification prior to placing such work. Unless the work is done directly for the USDA, this notification is made to the client who is responsible for ensuring notification of the regulating agency.

8.2 QUALIFYING AND MONITORING SUBCONTRACTORS

Whenever a PM, Account Executive (AE) or Client Relations Manager (CSM) becomes aware of a client requirement or laboratory need where samples must be outsourced to another laboratory, the other laboratory(s) are selected based on the following:

- Subcontractors specified by the client - In these circumstances, the client assumes responsibility for the quality of the data generated from the use of a subcontractor.

- Subcontractors reviewed by TestAmerica – Firms which have been reviewed by the company and are known to meet standards for accreditations (e.g., State, TNI and DoD/DOE); technical specifications; legal and financial information.

A listing of vendors is available on the TestAmerica intranet site.

All TestAmerica laboratories are pre-qualified for work sharing provided they hold the appropriate accreditations, can adhere to the project/program requirements, and the client approved sending samples to that laboratory. The client must provide acknowledgement that the samples can be sent to that facility (an e-mail is sufficient documentation or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented). The originating laboratory is responsible for communicating all technical, quality, and deliverable requirements as well as other contract needs. (Corporate SOP No. CA-C-S-001, Work Sharing Process).

8.2.1 When the potential subcontract laboratory has not been previously approved, PMs may nominate a laboratory as a subcontractor based on need. The decision to nominate a laboratory must be approved by the Laboratory Director. The Laboratory Director requests that the PM begin the process of approving the subcontract laboratory as outlined in Corporate SOP No. CW-L-S-004, Subcontracting Procedures.

Once the appropriate accreditation and legal information is received by the laboratory, it is evaluated for acceptability (where applicable) and forwarded to the Corporate Quality Information Manager (QIM) for review. After the Corporate QIM reviews the documents for completeness, the Corporate QIM will forward the documents to the Finance Department for formal signature and contracting with the laboratory. The approved vendor will be added to the approved subcontractor list on the intranet site and the finance group is concurrently notified for JD Edwards.

The client will assume responsibility for the quality of the data generated from the use of a subcontractor they have requested the lab to use. The qualified subcontractors on the intranet site are known to meet minimal standards. TestAmerica does not certify laboratories. The subcontractor is on our approved list and can only be recommended to the extent that we would use them.

8.3 OVERSIGHT AND REPORTING

8.3.1 The status and performance of qualified subcontractors will be monitored by the Corporate Quality department. Any problems identified will be brought to the attention of TestAmerica's Corporate Finance, Legal and Corporate Quality personnel.

- Complaints shall be investigated. Documentation of the complaint, investigation and corrective action will be maintained in the subcontractor's file on the intranet site. Complaints are posted using the Vendor Performance Report.
- Information shall be updated on the intranet when new information is received from the subcontracted laboratories.
- Subcontractors in good standing will be retained on the intranet listing. CSO personnel will notify all TestAmerica laboratories, Corporate Quality and Corporate Contracts if any laboratory requires removal from the intranet site. This notification will be posted on the

intranet site and e-mailed to all CSO Personnel, Laboratory Directors, QA Managers and Sales Personnel.

Prior to initially sending samples to the subcontracted laboratory, the PM confirms their certification status to determine if it's current and scope-inclusive. The information is documented within the project records.

8.3.2 For continued use of a subcontractor, verification of certification is placed upon the subcontractor for the defined project. Samples are subcontracted under Chain of Custody with the program defined as 'Accreditation Required' and the following statement for verification upon sample receipt:

Note: Since laboratory accreditations are subject to change, TestAmerica Laboratories, Inc. places the ownership of method, analyte & accreditation compliance upon our subcontract laboratories. This sample shipment is forwarded under Chain of Custody. If the laboratory does not currently maintain accreditation in the State of Origin listed above for analytes/tests/matrix being analyzed, the samples must be shipped back to the TestAmerica laboratory or other instructions will be provided. Any changes to accreditation status should be brought to TestAmerica Laboratories, Inc. attention immediately. If all requested accreditations are current to date, return the signed Chain of Custody attesting to said compliance to TestAmerica Laboratories, Inc.

For TestAmerica laboratories, certifications can be viewed on the company's TotalAccess Database.

8.3.3 All subcontracted samples must be accompanied by a TestAmerica Chain of Custody (COC). A copy of the original COC sent by the client must be available in TALS for all samples workshared within TestAmerica. Client COCs are only forwarded to external subcontractors when samples are shipped directly from the project site to the subcontractor lab. Under routine circumstances, client COCs are not provided to external subcontractors.

Through communication with the subcontracted laboratory, the PM monitors the status of the subcontracted analyses, facilitates successful execution of the work, and ensures the timeliness and completeness of the analytical report.

Non-TNI accredited work must be identified in the subcontractor's report as appropriate. If TNI accreditation is not required, the report does not need to include this information.

Reports submitted from subcontractor laboratories are not altered and are included in their original form in the final project report. This clearly identifies the data as being produced by a subcontractor facility. If subcontract laboratory data is incorporated into the laboratories EDD (i.e., imported), the report must explicitly indicate which lab produced the data for which methods and samples.

Note: The results submitted by a TestAmerica work sharing laboratory may be transferred electronically and the results reported by the TestAmerica work sharing lab are identified on the final report. The report must explicitly indicate which lab produced the data for which methods and samples. The final report must include a copy of the completed COC for all work sharing reports.

8.4 CONTINGENCY PLANNING

The full qualification of a subcontractor may be waived to meet emergency needs; however, this decision & justification must be documented in the project files, and the 'Purchase Order Terms And Conditions For Subcontracted Laboratory Services' must be sent with the samples and Chain-of-Custody.

In the event this provision is utilized, the laboratory (e.g., PM) will be required to verify and document the applicable accreditations of the subcontractor. All other quality and accreditation requirements will still be applicable, but the subcontractor need not have signed a subcontract with TestAmerica at this time.

The use of any emergency subcontractor will require the PM to complete a JDE New Vendor Add Form in order to process payment to the vendor and add them to TALS. This form requires the user to define the subcontractor's category/s of testing and the reason for testing.

SECTION 9

PURCHASING SERVICES AND SUPPLIES

9.1 OVERVIEW

Evaluation and selection of suppliers and vendors is performed, in part, on the basis of the quality of their products, their ability to meet the demand for their products on a continuous and short term basis, the overall quality of their services, their past history, and competitive pricing. This is achieved through evaluation of objective evidence of quality furnished by the supplier, which can include certificates of analysis, recommendations, and proof of historical compliance with similar programs for other clients. To ensure that quality critical consumables and equipment conform to specified requirements, all purchases from specific vendors are approved by a member of the supervisory or management staff. Capital expenditures are made in accordance with the TestAmerica's Capital Expenditure, Controlled Purchase Requests and Fixed Asset Capitalization, SOP No. CW-F-S-007.

Contracts are signed in accordance with the TestAmerica's Company Wide Authorization Policy, CW-F-P-002. (RFP's) are issued where more information is required from the potential vendors than just price. Process details are available in TestAmerica's Corporate Procurement and Contracts Policy (Policy No. CW-F-P-004). RFP's allow TestAmerica to determine if a vendor is capable of meeting requirements such as supplying all of the TestAmerica facilities, meeting required quality standards and adhering to necessary ethical and environmental standards. The RFP process also allows potential vendors to outline any additional capabilities they may offer.

Records for services and supplies that may affect the quality of environmental tests must include the following where applicable: date of receipt, expiration date, source, lot or serial number, calibration and verification records and certifications. See the SOPs referenced in Sections 9.3.3, and 9.5, and Section 22.2 for more details.

9.2 GLASSWARE

Glassware used for volumetric measurements must be Class A or verified for accuracy according to laboratory procedure. Pyrex (or equivalent) glass is used where possible. For safety purposes, thick-wall glassware is used where available and appropriate.

9.3 REAGENTS, STANDARDS & SUPPLIES

Purchasing guidelines for equipment, consumables and reagents must meet with the requirements of the specific method and testing procedures for which they are being purchased. Solvents and acids are pre-tested in accordance with TestAmerica's Corporate SOP on Solvent & Acid Lot Testing & Approval, SOP No. CA-Q-S-001. Approval information for the solvents and acids tested under SOP CA-Q-S-001 is stored on the TestAmerica Sharepoint, under Solvent Approvals. A master list of all tested materials, as well as the certificates of analysis for the materials, is stored in the same location.

9.3.1 Purchasing

Chemical reagents, solvents, glassware, and general supplies are ordered as needed to maintain sufficient quantities on hand. Materials used in the analytical process must be of a known quality. The wide variety of materials and reagents available makes it advisable to specify recommendations for the name, brand, and grade of materials to be used in any determination. This information is contained in the method SOP.

Many consumable items are maintained in an on-site consignment system, where the items in inventory have been pre-approved for laboratory use. On-site consignment is an inventory of commonly used items maintained at the laboratory by a laboratory supply company where they track the supply of items and restock as needed. If an item is not included in the on-site consignment system but is needed for laboratory operations, the group leader or designee enters the request into the JD Edwards system. The vendor item catalogue number is entered into the system to specify the required quality. Each request is reviewed and approved by the Laboratory Director or the Technical Manager (or designee) prior to purchase.

9.3.2 Receiving

It is the responsibility of the laboratory associate (typically sample receiving personnel) to receive the shipment. Once the ordered reagents or materials are received, the analyst compares the information on the label or packaging to the original order to ensure that the purchase meets the quality level specified and documents the date the materials were received. Refer to SOP KNOX-QA-0001 for further details.

The laboratory associate verifies the lot numbers of received solvents and acids against the pre-approval lists. If a received material is listed as unapproved, or is not listed, it is sequestered and returned to the vendor. Alternatively, the laboratory may test the material for the intended use, and if it is acceptable, document the approval on the approval list. Records of any testing performed locally are maintained on the shared “public” folder on the computer network.

Materials may not be released for use in the laboratory until they have been inspected, verified as suitable for use, and the inspection/verification has been documented

Safety Data Sheets (SDSs) are available online through the Company’s intranet website. Anyone may review these for relevant information on the safe handling and emergency precautions of on-site chemicals.

9.3.3 Specifications

Methods in use in the laboratory specify the grade of reagent that must be used in the procedure. If the quality of the reagent is not specified, analytical reagent grade will be used. It is the responsibility of the laboratory analyst to check the procedure carefully for the suitability of grade of reagent.

Chemicals are not to be used past the manufacturer’s expiration date and must not be used past the expiration time noted in a method SOP. If expiration dates are not provided, the laboratory may contact the manufacturer to determine an expiration date.

The laboratory assumes a five year expiration date on inorganic dry chemicals and solvents unless noted otherwise by the manufacturer or by the reference source method.

Chemicals/solvents are not to be used past the manufacturer's or SOPs expiration date unless 'verified' (refer to item 3 listed below).

- An expiration date cannot be extended if the dry chemical/solvent is discolored or appears otherwise physically degraded; the dry chemical must be discarded.

- Expiration dates can be extended if the dry chemical/solvent is found to be satisfactory based on acceptable performance of quality control samples (Continuing Calibration Verification (CCV), Method Blanks, Laboratory Control Sample (LCS), etc.).

- If the dry chemical/solvent is used for the preparation of standards, the expiration dates can be extended 6 months if the dry chemical/solvent is compared to an unexpired independent source in performing the method and the performance of the dry chemical/solvent is found to be satisfactory. The comparison must show that the dry chemical/solvent meets CCV limits. The comparison studies are maintained electronically in the group share on the local area network with the associated scanned calibration files.

Wherever possible, standards must be traceable to national or international standards of measurement or to national or international reference materials. Records to that effect are available to the user.

Compressed gases in use are checked for pressure and secure positioning daily. To prevent a tank from going to dryness or introducing potential impurities, the pressure should be closely watched as it decreases to approximately 15% of the original reading, at which point it should be replaced. For example, a standard sized laboratory gas cylinder containing 3,000 psig of gas should be replaced when it drops to approximately 500 psig. The quality of the gases must meet method or manufacturer specification or be of a grade that does not cause any analytical interference.

Water used in the preparation of standards or reagents must have a specific conductivity of less than 1μmho/cm (or resistivity of greater than 1.0 megaohm-cm) at 25°C. The specific conductivity is checked and recorded daily. If the water's conductivity is greater than the specified limit, the Technical Manager must be notified immediately in order to notify all departments, decide on cessation (based on intended use) of activities, and make arrangements for correction.

The laboratory may purchase reagent grade (or other similar quality) water for use in the laboratory. This water must be certified "clean" by the supplier for all target analytes or otherwise verified by the laboratory prior to use. This verification is documented.

Standard lots are verified before first time use if the laboratory switches manufacturers or has historically had a problem with the type of standard. Spiking standards are verified before use and instrument calibration standards are verified with a second source calibration verification standard. (Note: For Ohio EPA VAP, the continuing calibration verification standard must be from the same source used to prepare the standards used for the calibration curve, unless the analytical method states otherwise.)

Purchased bottleware used for sampling must be certified clean and the certificates must be maintained. If uncertified sampling bottleware is purchased, all lots must be verified clean prior

to use. For trace level analyses where vendors do not provide certification of cleanliness, periodic monitoring of uncertified bottleware is conducted with QA Manager approval instead of checking all bottleware lots. This verification must be maintained.

Tedlar bags purchased by the laboratory must be certified clean and the certificates must be maintained. Tedlar bags are not recommended for trace level analyses as the lab default reporting limits are 20x higher for Tedlar bags than for Summa Canisters.

Required records for solvents and standards are specified in the laboratory SOP KNOX-QA-0001, "Standard/Reagent Labeling and Documentation."

9.3.4 Storage

Reagent and chemical storage is important from the aspects of both integrity and safety. Light-sensitive reagents may be stored in brown-glass containers. Storage conditions are per the Corporate Environmental Health & Safety Manual (Corp. Doc. No. CW-E-M-001) and method SOPs or manufacturer instructions.

9.4 PURCHASE OF EQUIPMENT/INSTRUMENTS/SOFTWARE

When a new piece of equipment is needed, either for additional capacity or for replacing inoperable equipment, the analyst or supervisor makes a supply request to the Technical Manager and/or the Laboratory Director. If they agree with the request the procedures outlined in TestAmerica's Corporate Policy No. CA-T-P-001, Qualified Products List, are followed. A decision is made as to which piece of equipment can best satisfy the requirements. The appropriate written requests are completed and purchasing places the order.

Upon receipt of a new or used piece of equipment, it is given an instrument name in the LIMS, (e.g. MX), and added to the equipment list described in Section 20 maintained by the QA Department. Its capability is assessed to determine if it is adequate or not for the specific application. For instruments, a calibration curve is generated, followed by MDLs, Demonstration of Capabilities (DOCs), and other relevant criteria (refer to Section 19). For software, its operation must be deemed reliable and evidence of instrument verification must be retained by the IT Department as specified in the laboratory's procedure for software verification KNOX-IT-0001. Software certificates supplied by the vendors are filed with IT Department. The manufacturer's operation manual is retained at or near the bench.

9.5 SERVICES

Service to analytical instruments (except analytical balances) is performed on an as needed basis. Routine preventative maintenance is discussed in Section 20. The need for service is determined by laboratory analysts and/or Group Leaders. The service providers that perform the services are approved by the Group Leaders/Technical Manager.

Analytical balances are serviced and calibrated annually in accordance with SOP KNOX-QA-0005, "Balance Calibration and Weight Verification." The calibration and maintenance services are performed on-site, and the balances are returned to use immediately following successful calibration. When the calibration certificates are received (usually within two weeks of the service), they are reviewed, and documentation of the review is filed with the certificates. If the

calibration was unsuccessful, the balance is immediately removed from service and segregated pending either further maintenance or disposal.

Calibration services for support equipment such as thermometers, weight sets, autopipettors, etc, are obtained from vendors with current and valid ISO 17025 accreditation for calibration of the specific piece of equipment. Prior to utilizing the vendor's services, the vendor's accreditation status is verified. Once the equipment has been calibrated, the calibration certificates are reviewed by the QA department, and documentation of the review is filed with the calibration certificates. The equipment is then returned to service within the laboratory

9.6 SUPPLIERS

TestAmerica selects vendors through a competitive proposal / bid process, strategic business alliances or negotiated vendor partnerships (contracts). This process is defined in the Procurement & Contracts Policy (Policy No. CW-F-P-004). The level of control used in the selection process is dependent on the anticipated spending amount and the potential impact on TestAmerica business. Vendors that provide test and measuring equipment, solvents, standards, certified containers, instrument related service contracts or subcontract laboratory services are subject to more rigorous controls than vendors that provide off-the-shelf items of defined quality that meet the end use requirements. The JD Edwards purchasing system includes all suppliers/vendors that have been approved for use.

Evaluation of suppliers is accomplished by ensuring the supplier ships the product or material ordered and that the material is of the appropriate quality. This is documented by signing off on packing slips or other supply receipt documents. The purchasing documents contain the data that adequately describe the services and supplies ordered.

Any issues of vendor performance are to be reported immediately by the laboratory staff to the Corporate Purchasing Group by completing a Vendor Performance Report.

The Corporate Purchasing Group works through the appropriate channels to gather the information required to clearly identify the problem and contacts the vendor to report the problem and to make any necessary arrangements for exchange, return authorization, credit, etc.

As deemed appropriate, the Vendor Performance Reports are summarized and reviewed to determine corrective action necessary, or service improvements required by vendors

The laboratory has access to a listing of all approved suppliers of critical consumables, supplies and services. This information is provided through the JD Edwards purchasing system.

9.6.1 New Vendor Procedure

TestAmerica employees who wish to request the addition of a new vendor must complete a J.D. Edwards Vendor Add Request Form.

New vendors are evaluated based upon criteria appropriate to the products or services provided as well as their ability to provide those products and services at a competitive cost. Vendors are

also evaluated to determine if there are ethical reasons or potential conflicts of interest with TestAmerica employees that would make it prohibitive to do business with them as well as their financial stability. The QA Department and/or the Technical Manager are consulted with vendor and product selection that have an impact on quality.

SECTION 10

COMPLAINTS

10.1 OVERVIEW

The laboratory considers an effective client complaint handling process to be of significant business and strategic value. Listening to and documenting client concerns captures 'client knowledge' that enables our operations to continually improve processes and improve client satisfaction. An effective client complaint handling process also provides assurance to the data user that the laboratory will stand behind its data, service obligations and products.

A client complaint is any expression of dissatisfaction with any aspect of our business services, (e.g., communications, responsiveness, data, reports, invoicing and other functions) expressed by any party, whether received verbally or in written form. Client inquiries, complaints or noted discrepancies are documented, communicated to management, and addressed promptly and thoroughly.

The laboratory has procedures for addressing both external and internal complaints with the goal of providing satisfactory resolution to complaints in a timely and professional manner.

The nature of the complaint is identified, documented and investigated, and an appropriate action is determined and taken. In cases where a client complaint indicates that an established policy or procedure was not followed, the QA Department must evaluate whether a special audit must be conducted to assist in resolving the issue. A written confirmation or letter to the client, outlining the issue and response taken is recommended as part of the overall action taken.

The process of complaint resolution and documentation utilizes the procedures outlined in Section 12 (Corrective Actions) and is documented following the procedure for Nonconformance and Corrective Action System (SOP KNOX-QA-0008). Client complaints are recorded as a type of nonconformance memo (NCM) in TestAmerica LIMS (i.e., TALS), and are summarized in the monthly QA Reports to Management. It is the laboratory's goal to provide a satisfactory resolution to complaints in a timely and professional manner.

10.2 EXTERNAL COMPLAINTS

An employee that receives a complaint initiates the complaint resolution process and the documentation of the complaint.

Complaints fall into two categories: correctable and non-correctable. An example of a correctable complaint would be one where a report re-issue would resolve the complaint. An example of a non-correctable complaint would be one where a client complains that their data was repeatedly late. Non-correctable complaints are reviewed for preventive action measures to reduce the likelihood of future occurrence and mitigation of client impact.

The general steps in the complaint handling process are:

- Receiving and Documenting Complaints
- Complaint Investigation and Service Recovery

- Process Improvement

The laboratory informs the initiator of the complaint of the results of the investigation and the corrective action taken, if any.

10.3 INTERNAL COMPLAINTS

Internal complaints include, but are not limited to: errors and non-conformances, training issues, internal audit findings, and deviations from methods. Corrective actions may be initiated by any staff member who observes a nonconformance and follow the procedures outlined in Section 12. In addition, Corporate Management, Sales and Marketing and Information Technology (IT) may initiate a complaint by contacting the laboratory or through the corrective action system described in Section 12.

10.4 MANAGEMENT REVIEW

The number and nature of client complaints is reported by the QA Manager to the laboratory and QA Director in the QA Monthly report. Monitoring and addressing the overall level and nature of client complaints and the effectiveness of the solutions is part of the Annual Management Review (Section 16).

SECTION 11

CONTROL OF NON-CONFORMING WORK

11.1 OVERVIEW

When data discrepancies are discovered or deviations and departures from laboratory standard procedures, policies and/or client requests have occurred, corrective action is taken immediately. First, the laboratory evaluates the significance of the nonconforming work. Then, a corrective action plan is initiated based on the outcome of the evaluation. If it is determined that the nonconforming work is an isolated incident, the plan could be as simple as adding a qualifier to the final results and/or making a notation in the case narrative. If it is determined that the nonconforming work is a systematic or improper practices issue, the corrective action plan could include a more in depth investigation and a possible suspension of an analytical method. In all cases, the actions taken are documented using the laboratory's corrective action system (refer to Section 12).

Due to the frequently unique nature of environmental samples, sometimes departures from documented policies and procedures are needed. When a laboratory analyst encounters such a situation, the problem is typically discussed with the group leader. The group leader or laboratory analyst may elect to discuss it with the Technical Manager or have the Project Manager contact the client to decide on a logical course of action. Once an approach is agreed upon, the laboratory analyst documents it using the laboratory's corrective action system described in Section 12. This information is supplied to the client in the form of a case narrative with the report.

Note: For Ohio EPA VAP work, the laboratory must implement corrective action procedures to resolve the deviation and limit qualification of the final results. The laboratory is not permitted to deviate from its VAP approved SOP for nonconformances under the laboratory's control if it intends to attest under affidavit that the "results" are VAP certified. When all corrective actions listed in the SOP have been exhausted for nonconformances under the laboratory's control, data still considered qualified is noted as not VAP certified on the affidavit. The SOPs must include exceptions to taking corrective actions for situations outside the laboratory's control. For example, this includes but is not limited to samples prepared or analyzed outside holding times due to no fault of the laboratory and insufficient sample amount. The positive or negative bias associated with the situation outside the laboratory's control must be narrated as described in the SOP and the data is reported as VAP certified on the affidavit.

Project Managers may encounter situations where a client may request that a special procedure be applied to a sample that is not standard lab practice. Based on a technical evaluation, the lab may accept or opt to reject the request based on technical or ethical merit. If accepted, such a request is documented in project specific instructions to the laboratory.

11.2 RESPONSIBILITIES AND AUTHORITIES

Under certain circumstances the Laboratory Director, Technical Manager, Group Leader or the QA Manager may exceptionally authorize departures from documented procedures or policies depending on the nature and extent of the departure. The departures may be a result of

procedural changes due to the nature of the sample; a one-time procedure for a client; QC failures with insufficient sample to reanalyze, etc. In most cases, the client is informed of the departure prior to the reporting of the data. Any departures must be well documented using the laboratory's corrective action procedures. This information may also need to be documented on data review checklists as appropriate. Any impacted data must be referenced in a case narrative and/or flagged with an appropriate data qualifier.

Any misrepresentation or possible misrepresentation of analytical data discovered by any laboratory staff member must be reported to facility Senior Management within 24-hours. The Senior Management staff is comprised of the Laboratory Director, the QA Manager, the Client Relations Manager, the Technical Manager(s) and the Operations Manager. The Laboratory Director and QA Manager must be included in the notification. The reporting of issues involving alleged violations of the company's Data Integrity or Manual Integration procedures must be conveyed to an Ethics and Compliance Officer (ECO), (e.g., the VP QA/EHS) and the laboratory's Quality Director within 24 hours of discovery.

Whether an inaccurate result was reported due to calculation or quantitation errors, data entry errors, improper practices, or failure to follow SOPs, the data must be evaluated to determine the possible effect.

The Laboratory Director, QA Manager, ECOs, VP of Operations and the Quality Directors have the authority and responsibility to halt work, withhold final reports, or suspend an analysis for due cause as well as authorize the resumption of work.

11.3 EVALUATION OF SIGNIFICANCE AND ACTIONS TAKEN

For each nonconforming issue reported, an evaluation of its significance and the level of management involvement needed is made. This includes reviewing its impact on the final data, whether or not it is an isolated or systematic issue, and how it relates to any special client requirements.

Corporate SOP entitled Data Recalls (CW-Q-S-005) is the procedure to be followed when it is discovered that erroneous or biased data may have been reported to clients or regulatory agencies.

Corporate SOP entitled Internal Investigations (CW-L-S-002) is the procedure to be followed for investigation and correction of situations that involved alleged incidents of misconduct or violation of the company's ethics policy.

Laboratory level decisions are documented and approved using the laboratory's standard nonconformance/corrective action reporting (Section 13) in lieu of the data recall determination form contained in TestAmerica's Corporate SOP No. CW-Q-S-005.

11.4 PREVENTION OF NONCONFORMING WORK

If it is determined that the nonconforming work could recur, further corrective actions must be made following the laboratory's corrective action system. On a monthly basis, the QA Department evaluates non-conformances to determine if any nonconforming work has been repeated multiple times. If so, the laboratory's corrective action process may be followed.

11.5 METHOD SUSPENSION/RESTRICTION (STOP WORK PROCEDURES)

In some cases it may be necessary to suspend/restrict the use of a method or target compound which constitutes significant risk and/or liability to the laboratory. Suspension/restriction procedures can be initiated by any of the persons noted in Section 11.2, Paragraph 5.

Prior to suspension/restriction, confidentiality is respected, and the problem with the required corrective and preventive action is stated in writing and presented to the Laboratory Director.

The Laboratory Director arranges for the appropriate personnel to meet with the QA Manager as needed. This meeting is held to confirm that there is a problem, that suspension/restriction of the method is required and is concluded with a discussion of the steps necessary to bring the method/target or test fully back on line. In some cases that may not be necessary if all appropriate personnel have already agreed there is a problem and there is agreement on the steps needed to bring the method, target or test fully back on line. The QA Manager also initiates a corrective action report as described in Section 12 if one has not already been started. A copy of any meeting notes and agreed upon steps must be faxed or e-mailed by the laboratory to the appropriate General Manager and member of Corporate QA. This fax/e-mail acts as notification of the incident.

After suspension/restriction, the lab will hold all reports to clients pending review. No faxing, mailing or distributing through electronic means may occur. The report must not be posted for viewing on the internet. It is the responsibility of the Laboratory Director to hold all reporting and to notify all relevant laboratory personnel regarding the suspension/restriction (i.e., Project Management, Log-in, etc.). Clients are NOT generally be notified at this time. Analysis may proceed in some instances depending on the nonconformance issue.

Within 72 hours, the QA Manager determines if compliance is now met and reports can be released, OR determine the plan of action to bring work into compliance, and release work. A team, with all principals involved (Laboratory Director, Technical Manager, QA Manager, Project Manager, Group Leader) devises a start-up plan to cover all steps from client notification through compliance and release of reports. Project Management and the Directors of Client Services and Sales and Marketing must be notified if clients must be notified or if the suspension/restriction affects the laboratory's ability to accept work. The QA Manager must approve start-up or elimination of any restrictions after all corrective action is complete. This approval is given by final signature on the completed corrective action report.

SECTION 12

CORRECTIVE ACTION

12.1 OVERVIEW

A major component of TestAmerica's Quality Assurance (QA) Program is the problem investigation and feedback mechanism designed to keep the laboratory staff informed on quality related issues and to provide insight to problem resolution. When nonconforming work or departures from policies and procedures in the quality system or technical operations are identified, the corrective action procedure provides a systematic approach to assess the issues, restore the laboratory's system integrity, and prevent reoccurrence. Corrective actions are documented using Nonconformance Memos (NCMs) and Corrective Action Reports (CARs) (refer to Figure 12-1). Corrective actions for internal or external systems audit findings are documented using the corrective action responses to each audit.

12.2 GENERAL

Problems within the quality system or within analytical operations may be discovered in a variety of ways, such as QC sample failures, internal or external audits, proficiency testing (PT) performance, client complaints, staff observation, etc.

The purpose of a corrective action system is to:

- Identify non-conformance events and assign responsibility for investigation.
- Resolve non-conformance events and assign responsibility for any required corrective action.
- Identify systematic problems before they become serious.
- Identify and track Client complaints and provide resolution (see more on client complaints in Section 11).

12.2.1 Nonconformance Memo (NCM) - is used to document the following types of corrective actions:

- Deviations from an established procedure or SOP.
- QC outside of limits (non matrix related).
- Isolated Reporting / Calculation Errors.
- Client Complaints.
- Equipment Failures (Equipment Tag-out)
- Discrepancies in materials / goods received vs. manufacturer packing slips.

See SOP KNOX-QA-0008, Nonconformance and Corrective Action System, current revision, for details.

12.2.2 Corrective Action Report (CAR) - is used to document the following types of corrective actions:

- Questionable trends that are found in the review of NCMs.
- Issues found while reviewing NCMs that warrant further investigation.
- Internal and external audit findings.
- Failed or Unacceptable PT results.
- Corrective actions that cross multiple departments in the laboratory.
- Systematic Reporting / Calculation Errors.
- Excessive revised reports.
- Identified poor process or method performance trends.

This will provide background documentation to enable root cause analysis and preventive action. Data Recall Investigations, and Client Complaints are tracked as part of the laboratory's corrective action tracking system.

12.3 CLOSED LOOP CORRECTIVE ACTION PROCESS

Any employee in the company can initiate a corrective action. There are four main components to a closed-loop corrective action process once an issue has been identified: Cause Analysis, Selection and Implementation of Corrective Actions (both short and long term), Monitoring of the Corrective Actions, and Follow-up.

12.3.1 Cause Analysis

- Upon discovery of a non-conformance event, the event must be defined and documented. A CAR or NCM must be initiated, someone is assigned to investigate the issue and the event is investigated for cause. Table 12-1 provides some general guidelines on determining responsibility for assessment.
- The cause analysis step is the key to the process as a long term corrective action cannot be determined until the cause is determined.
- If the cause is not readily obvious, the Group Leader, Technical Manager, or QA Manager (or QA designee) is consulted.

12.3.2 Selection and Implementation of Corrective Actions

- Where corrective action is needed, the laboratory identifies potential corrective actions. The action(s) most likely to eliminate the problem and prevent recurrence are selected and implemented. Responsibility for implementation is assigned.
- Corrective actions are to a degree appropriate to the magnitude of the problem identified through the cause analysis.
- Whatever corrective action is determined to be appropriate, the laboratory documents and implements the changes. The CAR or NCM is used for this documentation.

12.3.3 Root Cause Analysis

Root Cause Analysis is a class of problem solving (investigative) methods aimed at identifying the basic or causal factor(s) that underlie variation in performance or the occurrence of a significant failure. At first glance, the immediate response is typically directed at a symptom and

not the cause. Typically, root cause analysis works best with three or more incidents to triangulate a weakness. Corporate SOP Root Cause Analysis (No. CA-Q-S-009) describes the procedure.

Systematically analyze and document the Root Causes of the more significant problems that are reported. Identify, track, and implement the corrective actions required to reduce the likelihood of recurrence of significant incidents. Trend the root cause data from these incidents to identify root causes that, when corrected, can lead to dramatic improvements in performance by eliminating entire classes of problems.

Identify the one event associated with problem and ask why this event occurred. Brainstorm the root causes of failures; for example, by asking why events occurred or conditions existed; and then why the cause occurred 5 consecutive times until you get to the root cause. For each of these sub events or causes, ask why it occurred. Repeat the process for the other events associated with the incident.

Root cause analysis does not mean the investigation is over. Look at technique, or other systems outside the normal indicators. Often creative thinking finds root causes that ordinarily would be missed, and continue to plague the laboratory or operation.

12.3.4 Monitoring of the Corrective Actions

- The Group Leaders, Operation Manager and QA Manager are responsible to ensure that the corrective action taken was effective.
- Ineffective actions are documented and re-evaluated until acceptable resolution is achieved. Group Leaders are accountable to the Laboratory Director to ensure final acceptable resolution is achieved and documented appropriately.
- Each NCM is entered into a database for tracking purposes and a monthly summary of all NCMs is printed out for review to aid in ensuring that the appropriate corrective actions have taken effect. CARs are also compiled and reviewed monthly.
- TestAmerica laboratories began using the Incident/Corrective Action Tracker (iCAT) database developed by the company in 2015. (Previously, a local database served this purpose.) An incident is an event triggering the need for one or more corrective actions as distinct from a corrective action, a potential deficiency stemming from an incident that requires investigation and possibly fixing. The database is independent of TALS, available to all local and corporate managers, and capable of notifying and tracking multiple corrective actions per event, dates, and personnel. iCAT allows associated document upload, categorization (such as, external/internal audit, client service concerns, data quality issues, proficiency testing, etc.), and trend analysis. Refer to Figure 12-1.
- The QA Manager reviews monthly NCMs for trends. Highlights are included in the QA monthly report (refer to Section 16). If a significant trend develops that adversely affects quality, an audit of the area is performed and corrective action implemented.
- Any out-of-control situations that are not addressed acceptably at the laboratory level may be reported to the Corporate Quality Director by the QA Manager, indicating the nature of the out-of-control situation and problems encountered in solving the situation.

12.3.5 Follow-up Audits

- Follow-up audits may be initiated by the QA Manager and are performed as soon as possible when the identification of a nonconformance casts doubt on the laboratory's compliance with its own policies and procedures, or on its compliance with state or federal requirements. (Section 15 includes additional information regarding internal audit procedures.)
- These audits often follow the implementation of the corrective actions to verify effectiveness. An additional audit would only be necessary when a critical issue or risk to business is discovered.

12.4 TECHNICAL CORRECTIVE ACTIONS

In addition to providing acceptance criteria and specific protocols for technical corrective actions in the method SOPs, the laboratory has general procedures to be followed to determine when departures from the documented policies and procedures and quality control have occurred (refer to Section 11 for information regarding the control of non-conforming work). The documentation of these procedures is through the use of an NCM.

Table 12-1 includes examples of general technical corrective actions. For specific criteria and corrective actions refer to specific method SOPs.

Table 12-1 provides some general guidelines for identifying the individual(s) responsible for assessing each QC type and initiating corrective action. The table also provides general guidance on corrective actions if associated QC measurements are unacceptable. Specific procedures are included in Method SOPs, and QAM Sections 19 and 20. All corrective actions are reviewed monthly, at a minimum, by the QA Manager and highlights are included in the QA monthly report.

To the extent possible, samples are reported only if all quality control measures are acceptable. If the deficiency does not impair the usability of the results, data are reported with an appropriate data qualifier and/or the deficiency is noted in the case narrative. Where sample results may be impaired, the Project Manager is notified by NCM and appropriate corrective action (e.g., reanalysis) is taken and documented**.**

12.5 BASIC CORRECTIONS

When mistakes occur in records, each mistake is crossed-out, [not obliterated (e.g. no white-out)], and the correct value entered alongside. All such corrections are initialed (or signed) and dated by the person making the correction. In the case of records stored electronically, the original "uncorrected" file must be maintained intact and a second "corrected" file is created.

This same process applies to adding additional information to a record. All additions made later than the initial must also be initialed (or signed) and dated.

When corrections are due to reasons other than obvious transcription errors, the reasons for the corrections (or additions) are also documented.

Figure 12-1.
Example – Corrective Action Report

TestAmerica Knoxville - Quality Assurance

Corrective Action 7035

Incident 2591: CAR 2017#1 SSAS failure for Hydrogen Chloride
Incident Status: Closed
Response Due to Client: Friday, Feb 17, 2017

Created By:	Kevin McGee	Created On:	Thursday, Feb 9, 2017
Laboratory Function:	Method Performance Studies and On-Going Cks	Date Follow-up Due:	Tuesday, Feb 28, 2017
Corrective Action Type:	Bias and precision studies	Date Follow-up Done:	Wednesday, Mar 1, 2017
Department:		Response Due to QA:	Friday, Feb 17, 2017
Finding Number:		Planned Closure Date:	Tuesday, Feb 28, 2017
Is Repeat Finding?:	No	Date Closed:	Wednesday, Mar 1, 2017
Finding Reference:			
Assigned To/Lead:	Donald Wasmund		
Priority:	3 (Normal Importance)		
Follow-up Assigned To:	Kevin McGee		
C.A. Status:	Closed		

Issue Requiring Corrective Action:
Hydrogen Chloride in impinger solution for lot # 120116P was outside of acceptance limits. The reported value for Hydrogen Chloride was 5.39 mg/L with an assigned value of 6.06 mg/L. The acceptance range was 5.45-6.67 mg/L.

Investigation/Response:
a) The acceptance limits of +/- 10% for the source air audit sample is narrow. b) The CCV for the original analysis was -5%.and c) the assigned value was approximately 7 to 8% lower than claimed by the manufacturer. The instrument was recalibrated and the results for CCV/LCS data were within 99-100%. The original run had CCVs at 94-95%. The retest result passed at 103% recovery. However, the retest of the original audit sample passed at 94%. The group leader believes the source air audit sample was 7 – 8 % lower than claimed by the manufacturer. The client's data was accepted within HT and there was no adverse effect except extra costs associated with the reanalysis with a new source air audit sample.

Root Cause:
a) The acceptance limits of +/- 10% for the source air audit sample is narrow. b) The CCV for the original analysis was -5%.and c) the assigned value was approximately 7 to 8% lower than claimed by the manufacturer. The instrument was recalibrated and the results for CCV/LCS data were within 99-100%. The original run had CCVs at 94-95%. The retest result passed at 103% recovery. However, the retest of the original audit sample passed at 94%. The group leader believes the source air audit sample was 7 – 8 % lower than claimed by the manufacturer. The client's data was accepted within HT and there was no adverse effect except extra costs associated with the reanalysis with a new source air audit sample.

Corrective Action Plan:
1. Recalibrate instrument. Reanalyze the original samples along with a new audit sample, within holding time. 2. Reissue deliverable including the new audit results. 3. Review audit results when received.

Corrective Action Documents (0)

No documents.

For QA Use Only

QA Comments	Follow Up
Enter a QA Comment	*Enter Follow Up*

Notifications

Location QA (notification required)

Name	Title
Kevin McGee	QA Manager
Annette Ribet	Project Management Assistant II
Hayley Waterland	

Additional Notifications

Name	Title
Annette Ribet	Project Management Assistant II
Donald Wasmund	Senior Analytical Consultant
Kevin McGee	QA Manager
Robyn Wagner	Operations Manager

Table 12-1.

Example – General Corrective Action Procedures

QC Activity ***(Individual Responsible for Initiation/Assessment)***	**Acceptance Criteria**	**Recommended Corrective Action**
Initial Instrument Blank *(Analyst)*	- Instrument response < Reporting Limit (RL)[1].	- Prepare another instrument blank. - If same response, determine cause of contamination: reagents, environment, instrument equipment failure, etc.
Initial Calibration Standards *(Analyst, Group Leader)*	- Correlation coefficient r≥0.990 for organics and r≥0.995 for inorganics or - %RSD within acceptance range. - See details in Method SOP.	- Reanalyze standards. - If still unacceptable, remake standards and recalibrate instrument.
Tuning (GC/MS Methods) (Analyst)	- Refer to Method SOP for specific ion criteria.	- Retune instrument and verify. (Samples may not be run without valid tune)
Independent Calibration Verification (Second Source) *(Analyst, Group Leader)*	- % Recovery within acceptance limits.	- Remake and reanalyze standard. - If still unacceptable, then remake calibration standards or use new primary standards and recalibrate instrument.
Continuing Calibration Standards *(Analyst, Data Reviewer)*	% Difference (or %Drift) within acceptance limits.	- Reanalyze standard. - If still unacceptable, then recalibrate and rerun affected samples.
Matrix Spike / Matrix Spike Duplicate (MS/MSD) *(Analyst, Data Reviewer)*	- % Recovery within limits documented in TALS.	- If the acceptance criteria for duplicates or matrix spikes are not met because of matrix interferences, the acceptance of the analytical batch is determined by the validity of the LCS. - If the LCS is within acceptable limits the batch is acceptable. - The results of the duplicates, matrix spikes and the LCS are reported with the data set. - For matrix spike or duplicate results outside criteria the data for that sample shall be reported with qualifiers.
Laboratory Control Sample (LCS) and LCSD (where applicable) *(Analyst, Data Reviewer)*	- % Recovery within limits specified in QuantIMS. This includes any allowable marginal exceedance (Marginal Exceedances are not allowed for Ohio VAP).	- Batch must be re-prepared and re-analyzed. **Note:** See Method SOPs for further details. For example, if there is insufficient sample or the holding time cannot be met, contact client and report with flags.

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Surrogates *(Analyst, Data Reviewer)*	- % Recovery within limits specified in TALS.	- Individual sample must be repeated. - Surrogate results outside criteria shall be reported with qualifiers. **Note:** See Method SOPs for further details. For example, if there is insufficient sample or the holding time cannot be met, contact client and report with flags.
Method Blank (MB) *(Analyst, Data Reviewer)*	< Reporting Limit [1]	- Reanalyze Method Blank. - If still positive, determine source of contamination. If necessary, reprocess (i.e. digest or extract) entire sample batch. Report Method blank results. - Qualify the result(s) if the concentration of a targeted analyte in the Method Blank is at or above the reporting limit AND is > 1/10 of the amount measured in the sample.

Note:
1. See specific method SOPs for acceptance criteria. Concentrations up to five times the reporting limit may be allowed for the common laboratory and reagent contaminants: methylene chloride, toluene, acetone, 2-butanone and phthalates. Some program requirements (e.g. DOD QSM and Ohio EPA VAP) have more stringent requirements that must be followed when performing work for those programs. For example, DOD QSM requires the Method Blanks < ½ Reporting Limit with common lab contaminants <Reporting Limit. (Note: Ohio EPA VAP requires all analytes of concern in Method Blanks to be less than the RL.)

SECTION 13

PREVENTIVE ACTION / IMPROVEMENT

13.1 OVERVIEW

The laboratory's preventive action programs improve or eliminate potential causes of nonconforming product and/or nonconformance to the quality system. This preventive action process is a proactive and continuous process of improvement activities that can be initiated through feedback from clients, employees, business providers, and affiliates. The QA Department has the overall responsibility to ensure that the preventive action process is in place, and that relevant information on actions is submitted for management review.

Dedicating resources to an effective preventive action system emphasizes the laboratory's commitment to its Quality Program. It is beneficial to identify and address negative trends before they develop into complaints, problems and corrective actions. Additionally, the laboratory continually strives to improve customer service and satisfaction through continuous improvements to laboratory systems.

Opportunities for improvement may be discovered through any of the following:

- review of the monthly QA Metrics Report,
- trending NCMs,
- review of control charts and QC results,
- trending proficiency testing (PT) results,
- performance of management system reviews,
- trending client complaints,
- review of processing operations, or
- staff observations.

The monthly QA Metrics Report shows performance indicators in all areas of the laboratory and quality system. These areas include revised reports, corrective actions, audit findings, internal auditing and data authenticity audits, client complaints, PT samples, holding time violations, SOPs, ethics training, etc. The metrics report is reviewed monthly by the laboratory management, Corporate QA and TestAmerica's Executive Committee. These metrics are used in evaluating the management and quality system performance on an ongoing basis and provide a tool for identifying areas for improvement.

Items identified as continuous improvement opportunities to the management system may be issued as goals from the annual management systems review, recommendations from internal audits, white papers, Lesson Learned, Technical Services audit report, Technical Best Practices, or as Corporate or management initiatives.

The laboratory's corrective action process is integral to implementation of preventive actions. A critical piece of the corrective action process is the implementation of actions to prevent further

occurrence of a non-compliance event. Historical review of corrective action and non-conformances provides a valuable mechanism for identifying preventive action opportunities.

13.1.1 The following elements are part of a preventive action/ process improvement system:

- Identification of an opportunity for preventive action or process improvement.
- Process for the preventive action or improvement.
- Define the measurements of the effectiveness of the process once undertaken.
- Execution of the preventive action or improvement.
- Evaluation of the plan using the defined measurements.
- Verification of the effectiveness of the preventive action or improvement.
- Close-Out by documenting any permanent changes to the Quality System as a result of the Preventive Action or Process Improvement. Documentation of Preventive Action/ process improvement is incorporated into the monthly QA reports, corrective action process, management review, and through the review and revision of the QAM and/or laboratory SOPs.

13.1.2 Any Preventive Actions/Process Improvements undertaken or attempted are taken into account during the Annual Management Systems Review (Section 16). A highly detailed report is not required; however, a summary of successes and failures within the preventive action program is sufficient to provide management with a measurement for evaluation.

13.2 MANAGEMENT OF CHANGE

The Management of Change process is designed to manage significant events and changes that occur within the laboratory. This is routinely managed by the Laboratory Director with input from the General Manager, the QA Manager, Operations Manager, Technical Managers, Group Leaders, and IT support staff. The laboratory manages change by documenting and maintaining a history of organization/staffing, equipment, certifications, and procedures.

Section 14

CONTROL OF RECORDS

The laboratory maintains a records management system appropriate to its needs and that complies with applicable standards or regulations as required. The system produces unequivocal, accurate records that document all laboratory activities. The laboratory retains all original observations, calculations and derived data, calibration records and a copy of the analytical report for a minimum of five years after it has been issued. Refer to SOP KNOX-AD-0001, Record Retention and Document Storage for further details.

14.1 OVERVIEW

The laboratory has established procedures for identification, collection, indexing, access, filing, storage, maintenance and disposal of quality and technical records. A record index is listed in Table 14-1. Quality records are maintained by the QA department in a database, which is backed up as part of the regular network backup. Hardcopy quality records are stored in fireproof filing cabinets. Records are of two types; either electronic or hard copy paper formats depending on whether the record is computer or hand generated (some records may be in both formats). Technical records are maintained by Group Leaders and the local IT staff.

Table 14-1. Record Index[1]

	Record Types [1]:	Retention Time:
Technical Records	- Raw Data - Logbooks[2] - Standards - Certificates - Analytical Records - MDLs/IDLs/DOCs - Lab Reports	5 Years from analytical report issue*
Official Documents	- Quality Assurance Manual (QAM) - Work Instructions - Policies - SOPs - Policy Memorandums - Manuals - Published Methods	Indefinitely*
QA Records	-Certifications -Method and Software Validation/Verification Data	Indefinitely*
QA Records	- Internal & External Audits/Response - Corrective/Preventive Actions - Management Reviews - Data Investigation	5 Years from archival* **Data Investigation:** 5 years or the life of the affected raw data storage whichever is greater (beyond 5 years if ongoing project or pending investigation)

	Record Types [1]:	Retention Time:
Project Records	- Sample Receipt & COC Documentation - Contracts and Amendments - Correspondence - QAPP -SAP - Telephone Logbooks - Lab Reports	5 Years from analytical report issue*
Administrative Records	Finance and Business Operations	Refer to CW-L-WI-001
	EH&S Manual, Permits	Indefinitely
	Disposal Records	Indefinitely
	Employee Handbook	Indefinitely
	Personnel files, Employee Signature & Initials, Administrative Training Records (e.g., Ethics)	Refer to HR Manual
	Administrative Policies	Indefinitely
	Technical Training Records	7 years
	Legal Records	Indefinitely
	HR Records	Refer to CW-L-WI-001
	IT Records	Refer to CW-L-WI-001
	Corporate Governance Records	Refer to CW-L-WI-001
	Sales & Marketing	5 years
	Real Estate	Indefinitely

[1] Record Types encompass hardcopy or electronic records.
[2] Examples of Logbook types: Maintenance, Instrument Run, Preparation (standard and samples), Standard and Reagent Receipt, Archiving, Balance Calibration, Temperature (hardcopy or electronic records).
* Exceptions listed in Table 14-2.

14.1.1 All records are stored and retained in such a way that they are secure and readily retrievable at the laboratory facility or the Iron Mountain data storage facility that provides a suitable environment to prevent damage or deterioration and to prevent loss. All records are protected against fire, theft, loss, environmental deterioration, and vermin. In the case of electronic records, storage media are protected from deterioration caused by magnetic fields and/or electronic deterioration.

Access to the data is limited to laboratory and company employees and shall be documented with an access log. Records are maintained for a minimum of five years unless otherwise specified by a client or regulatory requirement.

Note: For the Ohio EPA VAP program the laboratory is required to notify Ohio EPA of its intent to dispose of any records.

For raw data and project records, record retention is calculated from the date the project report is issued. For other records, such as Controlled Documents, QA, or Administrative Records, the retention time is calculated from the date the record is formally retired. Records related to the

programs listed in Table 14-2 have lengthier retention requirements and are subject to the requirements in Section 14.1.3.

14.1.2 Programs with Longer Retention Requirements

Some regulatory programs have longer record retention requirements than the standard record retention time. These are detailed in Table 14-2 with their retention requirements. In these cases, the longer retention requirement is enacted. If special instructions exist such that client data cannot be destroyed prior to notification of the client, the container or box containing that data is marked as to who to contact for authorization prior to destroying the data. Refer to SOP KNOX-AD-0001, Record Retention and Document Storage for details on how records are retained for these programs.

Table 14-2. Special Record Retention Requirements

Program	[1]Retention Requirement
Drinking Water – All States	10 years (lab reports and raw data) 10 years – Radiochemistry (project records)
FIFRA – 40 CFR Part 160	Retain for life of research or marketing permit for pesticides regulated by EPA
Housing and Urban Development (HUD) Environmental Lead Testing	10 years
Alaska	10 years
Louisiana – All	10 years
Michigan Department of Environmental Quality – all environmental data	10 years
NY Potable Water NYCRR Part 55-2	10 years
Ohio EPA VAP	10 years and state contacted prior to disposal
TSCA - 40 CFR Part 792	10 years after publication of final test rule or negotiated test agreement
OSHA	30 years

[1]Note: Extended retention requirements must be noted with the archive documents or addressed in facility-specific records retention procedures.

The laboratory has procedures to protect and back-up records stored electronically and to prevent unauthorized access to or amendment of these records. All analytical data is maintained as hard copy or in a secure readable electronic format. For analytical reports that are maintained as copies in PDF format, refer to section 19.14.1 for more information.

The record keeping system allows for historical reconstruction of all laboratory activities that produced the analytical data, as well as rapid recovery of historical data. The history of the sample from when the laboratory took possession of the samples must be readily understood through the documentation. This includes inter-laboratory transfers of samples and/or extracts.

- The records include the identity of personnel involved in sampling, sample receipt, preparation, or testing. All analytical work contains the initials (at least) of the personnel involved. A copy of the chain of custody is stored with the invoice, associated data review checklists, and other lot specific documents as described in SOP KNOX-AD-0001. The chain of custody would indicate the name of the sampler.

- All information relating to the laboratory facilities equipment, analytical test methods, and related laboratory activities, such as sample receipt, sample preparation, or data verification are documented.

- The record keeping system facilitates the retrieval of all working files and archived records for inspection and verification purposes (e.g., set format for naming electronic files, set format for what is included with a given analytical data set). Instrument data is stored electronically with the Lot raw data for samples and the associated quality control samples. Instrument calibration data is stored electronically by analytical group, method, instrument and date. Run logs are maintained for each instrument; a copy of each day's run log or instrument sequence is stored to aid in reconstructing an analytical sequence. Where an analysis is performed without an instrument, bound logbooks or bench sheets are used to record and file data. Standard and reagent information is recorded in logbooks.

- Changes to hardcopy records follow the procedures outlined in Section 12 and 19. Changes to electronic records in LIMS or instrument data are recorded in audit trails.

- The reason for a signature or initials on a document is clearly indicated in the records such as "sampled by," "prepared by," "reviewed by", or "analyzed by".

- All generated data except those that are generated by automated data collection systems, are recorded directly, promptly and legibly in permanent dark ink.

- Hard copy data may be scanned into PDF format for record storage as long as the scanning process can be verified in order to ensure that no data is lost and the data files and storage media must be tested to verify the laboratory's ability to retrieve the information prior to the destruction of the hard copy that was scanned. The procedure for scanning the records is discussed in SOP KNOX-AD-0004, Data Reporting, and KNOX-AD-0001, Record Retention and Document Storage.

- Also refer to Section 19.13.1 'Computer and Electronic Data Related Requirements'**.**

14.2 TECHNICAL AND ANALYTICAL RECORDS

14.2.1 The laboratory retains records of original observations, derived data and sufficient information to establish an audit trail, calibration records, staff records and a copy of each analytical report issued, for a minimum of five years unless otherwise specified by a client or regulatory requirement (refer to Table 14-2). The records for each analysis contain sufficient information to enable the analysis to be repeated under conditions as close as possible to the original. The records include the identity of laboratory personnel responsible for performance of each analysis and reviewing results.

14.2.2 Observations, data and calculations are recorded real-time they are made and are

identifiable to the specific task.

14.2.3 Changes to hardcopy records follow the procedures outlined in Section 12 and 19. Changes to electronic records in LIMS or instrument data are recorded in audit trails.
The essential information to be associated with analysis, such as strip charts, tabular printouts, computer data files, analytical notebooks, and run logs, include:

- Laboratory sample ID code**;**
- Date of analysis; Time of analysis is also required if the holding time is seventy-two (72) hours or less, or when time critical steps are included in the analysis (e.g., drying times, incubations, etc.); instrumental analyses have the date and time of analysis recorded as part of their general operations. The date and time may also be recorded in the associated logbook or benchsheet.
- Instrumentation identification and instrument operating conditions/parameters. Operating conditions/parameters are typically recorded in instrument maintenance logs.
- Analysis type**;**
- All manual calculations and manual integrations**;**
- Laboratory Analyst's or operator's initials/signature**;**
- Sample preparation including cleanup, separation protocols, lab sample ID codes, volumes, weights, instrument printouts, calculations, and reagents**;**
- Test results**;**
- Standard and reagent origin, receipt, preparation, and use**;**
- Calibration criteria, frequency and acceptance criteria**;**
- Data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions**;**
- Quality control protocols and assessment**;**
- Electronic data security, software documentation and verification, software and hardware audits, backups, and records of any changes to automated data entries; and
- Method performance criteria including expected quality control requirements. These are indicated in the LIMS or in the associated analytical SOPs

14.2.4 All logbooks used during receipt, preparation, storage, analysis, and reporting of samples or monitoring of support equipment shall undergo a documented supervisory or peer review on a periodic basis.

14.3 LABORATORY SUPPORT ACTIVITIES

In addition to documenting all the above-mentioned activities, the following are retained QA records and project records (previous discussions in this section relate where and how these data are stored):

- All original raw data, whether hard copy or electronic, for calibrations, samples and quality control measures, including analysts' work sheets and data output records (chromatograms, strip charts, and other instrument response readout records)**;**

- A written description or reference to the specific test method used which includes a description of the specific computational steps used to translate parametric observations into a reportable analytical value**;**
- Copies of final reports**;**
- Archived SOPs**;**
- Correspondence relating to laboratory activities for a specific project**;**
- All corrective action reports, audits and audit responses**;**
- Proficiency test results and raw data; and
- Results of data review, verification, and crosschecking procedures.

14.3.1 Sample Handling Records

Records of all procedures to which a sample is subjected while in the possession of the laboratory are maintained. These include but are not limited to records pertaining to:

- Sample preservation including appropriateness of sample container and compliance with holding time requirement;
- Sample identification, receipt, acceptance or rejection and login;
- Sample storage and tracking including shipping receipts, sample transmittal / COC forms; and
- Procedures for the receipt and retention of samples, including all provisions necessary to protect the integrity of samples.

14.4 ADMINISTRATIVE RECORDS

The laboratory also maintains the administrative records in either electronic or hard copy form. See Table 14-1.

14.5 RECORDS MANAGEMENT, STORAGE AND DISPOSAL

14.5.1 All records (including those pertaining to test equipment), certificates and reports are safely stored, held secure and in confidence to the client. Certification related records are available upon request.

14.5.2 All information necessary for the historical reconstruction of data is maintained by the laboratory. Records that are stored only on electronic media must be supported by the hardware and software necessary for their retrieval.

14.5.3 Records that are stored or generated by computers or personal computers have hard copy, write-protected backup copies, or an electronic audit trail controlling access**.**

14.5.4 The laboratory has a record management system for control of laboratory notebooks, instrument logbooks, standards logbooks, and project records. Laboratory notebooks are sequentially numbered by QA and issued to the analytical group as needed. Bench sheets are

filed and archived with the project raw data. Completed logbooks are returned to QA for archive storage. Records are considered archived when moved to the archive server on the local area network or when logbooks are turned in to QA for storage. Access to archived hard-copy information is documented with in/out cards.

14.5.5 Transfer of Ownership

In the event that the laboratory transfers ownership or goes out of business, the laboratory ensures that the records are maintained or transferred according to client's instructions. Upon ownership transfer, record retention requirements must be addressed in the ownership transfer agreement and the responsibility for maintaining archives is clearly established. In addition, in cases of bankruptcy, appropriate regulatory and state legal requirements concerning laboratory records must be followed. In the event of the closure of the laboratory, all records will revert to the control of the corporate headquarters. Should the entire company cease to exist, as much notice as possible will be given to clients and the accrediting bodies who have worked with the laboratory during the previous 5 years of such action.

14.5.6 Records Disposal

14.5.6.1 Records are removed from the archive and destroyed after 5 years unless otherwise specified by a client or regulatory requirement. On a project specific or program basis, clients may need to be notified prior to record destruction. Records are destroyed in a manner that ensures their confidentiality such as shredding, mutilation or incineration.

14.5.6.2 Electronic copies of records must be destroyed by erasure or physically damaging off-line storage media so no records can be read.

14.5.6.3 If a third party records management company is hired to dispose of records, a "Certificate of Destruction" is required. [Refer to Policy No. CW-L-P-001 (Records Retention).]

SECTION 15

AUDITS

15.1 INTERNAL AUDITS

Internal audits are performed to verify that laboratory operations comply with the requirements of the lab's quality system and with the external quality programs under which the laboratory operates. Audits are planned and organized by the QA staff. Personnel conducting the audits should be independent of the area being evaluated. Auditors will have sufficient authority, access to work areas, and organizational freedom necessary to observe all activities affecting quality and to report the assessments to laboratory management and when requested to corporate management.

Audits are conducted and documented as described in the TestAmerica Corporate SOP on Internal Auditing, SOP No. CW-Q-S-003. The types and frequency of routine internal audits are described in Table 15-1. Special or ad hoc assessments may be conducted as needed under the direction of the QA staff.

Table 15-1. Types of Internal Audits and Frequency

Description	Performed by	Frequency
Quality Systems Audits	QA Department, QA approved designee, or Corporate QA	All areas of the laboratory annually
QA Technical Audits	Joint responsibility: a) QA Manager or designee b) Technical Manager or Designee (Refer to CW-Q-S-003)	Technical Audits Frequency: 50% of methods annually
SOP Method Compliance	Joint responsibility: a) QA Manager or designee b) Technical Manager or Designee (Refer to CW-Q-S-003)	SOP Compliance Review Frequency: • Every 2 years • 100% of SOPs annually (DoD/DOE Labs)
Special	QA Department or Designee	Surveillance or spot checks performed as needed, e.g., to confirm corrective actions from other audits.
Performance Testing	Laboratory Analysts with QA oversight	Two successful per year for each TNINELAC field of testing or as dictated by regulatory requirements

15.1.1 Annual Quality Systems Audit

An annual quality systems audit is required to ensure compliance to analytical methods and SOPs, TestAmerica's Data Integrity and Ethics Policies, TNI quality systems, client and state requirements, and the effectiveness of the internal controls of the analytical process, including

but not limited to data review, quality controls, preventive action and corrective action. The completeness of earlier corrective actions is assessed for effectiveness and sustainability. The audit is divided into sections for each operating or support area of the lab, and each section is comprehensive for a given area. The area audits may be performed on a rotating schedule throughout the year to ensure adequate coverage of all areas. This schedule may change as situations in the laboratory warrant

Note: Part of the quality systems audit relates to regulatory compliance. An assessment of the laboratory's compliance to regulatory requirements is performed by Corporate QA through monthly management reports, review of client and regulatory concerns and also through periodic on-site evaluations.

The annual quality systems audit must include a review of logbooks and benchsheets used in laboratory areas as well as the items listed in the Internal Audit Checklists as described in SOP CW-Q-S-003.

15.1.2 QA Technical Audits

QA technical audits assess data authenticity and analyst integrity. These audits are based on client projects, associated sample delivery groups, and the methods performed. Reported results are compared to raw data to verify the authenticity of results. The validity of calibrations and QC results are compared to data qualifiers, footnotes, and case narratives. Documentation is assessed by examining run logs and records of manual integrations. Manual calculations are checked. Where possible, electronic audit miner programs (e.g., MintMiner and Chrom AuditMiner) are used to identify unusual manipulations of the data deserving closer scrutiny. QA technical audits include all methods within a two-year period. All analysts should be reviewed over the course of a two year period through at least one QA Technical Audit.

The QA Technical Audits must include a review of raw sample data, calibration data and QC data records.

15.1.3 SOP Method Compliance

Compliance of all SOPs with the source methods and compliance of the operational groups with the SOPs are assessed by the Technical Manager or qualified designee at least every two years. (Annually for methods and administrative SOPs related to DoD and DOE programs.) It is also recommended that the work of each newly hired laboratory analyst is assessed within 3 months of working independently, (e.g., completion of method IDOC). In addition, as laboratory analysts add methods to their capabilities, (new IDOC) reviews of the laboratory analyst work products are performed within 3 months of completing the documented training.

15.1.4 Special Audits

Special audits are conducted on an as needed basis, generally as a follow up to specific issues such as client complaints, corrective actions, PT results, data audits, system audits, validation comments, regulatory audits or suspected ethical improprieties. Special audits are focused on a specific issue, and report format, distribution, and timeframes are designed to address the nature of the issue.

15.1.5 Performance Testing

The laboratory participates semi-annually in performance audits conducted through the analysis of PT samples provided by a third party. The laboratory generally participates in the following types of PT studies: Drinking Water, Nonpotable Water, Soil, and Air.

It is TestAmerica's policy that PT samples be treated as typical samples in the production process. Furthermore, where PT samples present special or unique problems, in the regular production process they may need to be treated differently, as would any special or unique request submitted by any client. The QA Manager must be consulted and in agreement with any decisions made to treat a PT sample differently due to some special circumstance.

Written responses to unacceptable PT results are required. In some cases it may be necessary for blind QC samples to be submitted to the laboratory to show a return to control.

15.2 EXTERNAL AUDITS

External audits are performed when certifying agencies or clients conduct on-site inspections or submit performance testing samples for analysis. It is TestAmerica's policy to cooperate fully with regulatory authorities and clients. The laboratory makes every effort to provide the auditors with access to personnel, documentation, and assistance. Group Leaders are responsible for providing corrective actions to the QA Manager who coordinates the response for any deficiencies discovered during an external audit. Audit responses are due in the time allotted by the client or agency performing the audit. When requested, a copy of the audit report and the lab's corrective action plan are forwarded to Corporate Quality.

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. The client may only view data and systems related directly to the client's work. All efforts are made to keep other client information confidential.

15.2.1 Confidential Business Information (CBI) Considerations

During on-site audits, on-site auditors may come into possession of information claimed as business confidential. A business confidentiality claim is defined as "a claim or allegation that business information is entitled to confidential treatment for reasons of business confidentiality or a request for a determination that such information is entitled to such treatment." When information is claimed as business confidential, the laboratory must place on (or attach to) the information at the time it is submitted to the auditor, a cover sheet, stamped or typed legend or other suitable form of notice, employing language such as "trade secret", "proprietary" or "company confidential". Confidential portions of documents otherwise non-confidential must be clearly identified. CBI may be purged of references to client identity by the responsible laboratory official at the time of removal from the laboratory. However, sample identifiers may not be obscured from the information. Additional information regarding CBI can be found in within the 2009 TNI standards.

15.3 AUDIT FINDINGS

Audits are documented in summary report(s) providing the findings for each laboratory area and recommended corrective actions to the appropriate Group Leader. The laboratory corrective action is compiled by QA and responses to external audits are signed by the QA Manager and the Laboratory Director. The laboratory's corrective action responses may include action plans

that could not be completed within a predefined timeframe. In these instances, a completion date must be set and agreed to by operations management and the QA Manager.

Developing and implementing corrective actions to findings is the responsibility of the Group Leader where the finding originated. Findings that are not corrected by specified due dates are reported monthly to management in the QA monthly report. When requested, a copy of the audit report and the labs corrective action is forwarded to Corporate Quality.

If any audit finding casts doubt on the effectiveness of the operations or on the correctness or validity of the laboratory's test results, the laboratory takes timely corrective action, and notifies clients in writing if the investigations show that the laboratory results have been affected. Once corrective action is implemented, a follow-up audit is scheduled to ensure that the problem has been corrected.

Clients must be notified promptly in writing, of any event such as the identification of defective measuring or test equipment that casts doubt on the validity of results given in any test report or amendment to a test report. The investigation must begin within 24-hours of discovery of the problem and all efforts are made to notify the client within two weeks after the completion of the investigation.

SECTION 16

MANAGEMENT REVIEWS

16.1 QUALITY ASSURANCE REPORT

A comprehensive QA Report is prepared each month by the laboratory's QA Department and forwarded to the Laboratory Director, Technical Managers, their Quality Director as well as the VP of Operations. All aspects of the QA system are reviewed to evaluate the suitability of policies and procedures. During the course of the year, the Laboratory Director, VP of Operations or Corporate QA may request that additional information be added to the report.

On a monthly basis, Corporate QA compiles information from all the monthly laboratory reports. The Corporate Quality Directors prepare a report that includes a compilation of all metrics and notable information and concerns regarding the QA programs within the laboratories. The report also includes a listing of new regulations that may potentially impact the laboratories. This report is presented to the Senior Management Team and VPs of Operations.

16.2 ANNUAL MANAGEMENT REVIEW

The senior lab management team (Laboratory Director, Technical Managers, QA Manager, and the Client Relations Manager) conducts a review annually of its quality systems and LIMS to ensure its continuing suitability and effectiveness in meeting client and regulatory requirements and to introduce any necessary changes or improvements. It will also provide a platform for defining goals, objectives, and action items that feed into the laboratory planning system. Corporate Operations and Corporate QA personnel are included in this meeting at the discretion of the Laboratory Director. The LIMS review consists of examining any audits, complaints or concerns that have been raised through the year that are related to the LIMS. The laboratory summarizes any critical findings that cannot be solved by the lab and reports them to Corporate IT.

This management systems review (Corporate SOP No. CA-Q-S-004 Management Systems Review & Work Instruction No. CW-Q-WI-003 uses information generated during the preceding year to assess the "big picture" by ensuring that routine quality actions taken and reviewed on a monthly basis are not components of larger systematic concerns. The monthly review keeps the quality systems current and effective, therefore, the annual review is a formal senior management process to review specific existing documentation. Significant issues from the following documentation are compiled or summarized by the QA Manager prior to the review meeting:

- Matters arising from the previous annual review.
- Prior Monthly QA Reports issues.
- Laboratory QA Metrics.
- Review of report reissue requests.
- Review of client feedback and complaints.

- Issues arising from any prior management or staff meetings.
- Minutes from prior senior lab management meetings. Issues that may be raised from these meetings include:
  - Adequacy of staff, equipment and facility resources.
  - Adequacy of policies and procedures.
  - Future plans for resources and testing capability and capacity.
- The annual internal double blind PT program sample performance (if performed),
- Compliance to the Ethics Policy and Data Integrity Plan. Including any evidence/incidents of inappropriate actions or vulnerabilities related to data Integrity.

A report is generated by the QA Manager and management. The report is distributed to the appropriate General Manager and the Quality Director. The report includes, but is not limited to:

- The date of the review and the names and titles of participants.
- A reference to the existing data quality related documents and topics that were reviewed.
- Quality system or operational changes or improvements that are made as a result of the review [e.g., an implementation schedule including assigned responsibilities for the changes (Action Table)].

Changes to the quality systems requiring update to the laboratory QAM are included in the next revision of the QAM.

16.3 POTENTIAL INTEGRITY RELATED MANAGERIAL REVIEWS

Potential integrity issues (data or business related) must be handled and reviewed in a confidential manner until such time as a follow-up evaluation, full investigation, or other appropriate actions have been completed and issues clarified. TestAmerica's Corporate Internal Investigation SOP is followed (SOP No. CW-L-S-002). All investigations that result in finding of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients.

TestAmerica's President and CEO, Executive VP of Operations, VP of Client & Technical Services, VP of Operations, and Quality Directors receive a monthly report from the VP-QA/EHS summarizing any current data integrity or data recall investigations. The VP's of Operations are also made aware of progress on these issues for their specific labs.

SECTION 17

PERSONNEL

17.1 OVERVIEW

The laboratory's management believes that its highly qualified and professional staff is the single most important aspect in assuring a high level of data quality and service. The staff consists of professionals and support personnel as outlined in the organization chart in Figure 4-1.

All personnel must demonstrate competence in the areas where they have responsibility. Staff that are undergoing training have appropriate supervision until they have demonstrated their ability to perform their job function on their own. Staff shall be qualified for their tasks based on appropriate education, training, experience and/or demonstrated skills as required.

The laboratory employs sufficient personnel with the necessary education, training, technical knowledge and experience for their assigned responsibilities.

All personnel are responsible for complying with all QA/QC requirements that pertain to the laboratory and their area of responsibility. Each staff member must have a combination of experience and education to adequately demonstrate a specific knowledge of their particular area of responsibility. Technical staff must also have a general knowledge of lab operations, test methods, QA/QC procedures and records management.

Laboratory management is responsible for formulating goals for lab staff with respect to education, training and skills and ensuring that the laboratory has a policy and procedures for identifying training needs and providing training of personnel. The training is relevant to the present and anticipated responsibilities of the lab staff.

The laboratory only uses personnel that are employed by or under contract to the laboratory. Contracted personnel, when used, must meet competency standards of the laboratory and work in accordance to the laboratory's quality system.

17.2 EDUCATION AND EXPERIENCE REQUIREMENTS FOR TECHNICAL PERSONNEL

The laboratory makes every effort to hire analytical staff that possess a college degree (AA, BA, BS) in an applied science with some chemistry in the curriculum. Exceptions may be made based upon the technical nature of the position and the individual's experience and abilities. Selection of qualified candidates for laboratory employment begins with documentation of minimum education, training, and experience prerequisites needed to perform the prescribed task. Minimum education and training requirements for TestAmerica employees are outlined in job descriptions and are generally summarized for analytical staff in the table below.

The laboratory maintains job descriptions for all personnel who manage, perform or verify work affecting the quality of the environmental testing the laboratory performs. Job Descriptions are

located on the TestAmerica intranet site's Human Resources web-page (also see Section 4 for position descriptions/responsibilities).

As a general rule for analytical staff:

Specialty	Education	Experience
Extractions, Digestions, some electrode methods (pH, DO, Redox, etc.), or Titrimetric and Gravimetric Analyses	H.S. Diploma	On the job training (OJT)
CVAA, Single component or short list Chromatography (e.g., Fuels, BTEX-GC, IC	A college degree in an applied science or 2 years of college and at least 1 year of college chemistry	Or 2 years prior analytical experience is required
ICP, ICPMS, Long List or complex chromatography (e.g., Pesticides, PCB, Herbicides, HPLC, etc.), GCMS	A college degree in an applied science or 2 years of college chemistry	Or 5 years of prior analytical experience
Spectra Interpretation	A college degree in an applied science or 2 years of college chemistry	And 2 years relevant experience or 5 years of prior analytical experience
Technical Managers/Department Managers – **General**	Bachelors Degree in an applied science or engineering with 24 semester hours in chemistry An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years experience in environmental analysis of representative analytes for which they will oversee

When an analyst does not meet these requirements, they can perform a task under the direct supervision of a qualified analyst, peer reviewer or Group Leader, and are considered an analyst in training. The person supervising an analyst in training is accountable for the quality of the analytical data and must review and approve data and associated corrective actions.

17.3 TRAINING

The laboratory is committed to furthering the professional and technical development of employees at all levels.

Orientation to the laboratory's policies and procedures, in-house method training, and employee attendance at outside training courses and conferences all contribute toward employee proficiency. Below are examples of various areas of required employee training:

Required Training	Time Frame	Employee Type
Environmental Health & Safety	Prior to lab work	All

Required Training	Time Frame	Employee Type
Ethics – New Hires	1 week of hire	All
Ethics - Comprehensive	90 days of hire	All
Data Integrity	30 days of hire	Technical and PMs
Quality Assurance	90 days of hire	All
Ethics – Comprehensive Refresher	Annually	All
Initial Demonstration of Capability (DOC)	Prior to unsupervised method performance	Technical

The laboratory maintains records of relevant authorization/competence, education, professional qualifications, training, skills and experience of technical personnel (including contracted personnel) as well as the date that approval/authorization was given. These records are kept on file at the laboratory. Also refer to “Demonstration of Capability” in Section 19.

The training of technical staff is kept up to date by:

- Each employee must have documentation in their training file that they have read, understood and agreed to follow the most recent version of the laboratory QAM and SOPs in their area of responsibility. This documentation is updated as SOPs are updated.
- Documentation from any training courses or workshops on specific equipment, analytical techniques or other relevant topics are maintained in their training file.
- Documentation of proficiency (refer to Section 19).
- An Ethics Agreement signed by each staff member (renewed each year) and evidence of annual ethics training.
- A Confidentiality Agreement signed by each staff member signed at the time of employment.
- Human Resources maintains documentation and attestation forms on employment status and records; benefit programs; timekeeping/payroll; and employee conduct (e.g., ethics). This information is maintained in the employee’s secured personnel file.

The QA Manager is responsible for QA and Ethics Orientation, Initial and On-Going Ethics and Data Integrity Training and QA training. The EH&S Coordinator is responsible for EH&S Orientation and Training. Group Leaders and Technical Managers are responsible for technical training.

The QA Manager evaluates the effectiveness of training through the review of demonstration of capability documentation, on-going proficiency test results, nonconformances and corrective action reports, and internal and external audit reports.

Further details of the laboratory's training program are described in the Personnel Orientation and Training SOP KNOX-QA-0009.

17.4 DATA INTEGRITY AND ETHICS TRAINING PROGRAM

Establishing and maintaining a high ethical standard is an important element of a Quality System. Ethics and data integrity training is integral to the success of TestAmerica and is provided for each employee at TestAmerica**.** It is a formal part of the initial employee orientation within 1 week of hire followed by technical data integrity training within 30 days, comprehensive training within 90 days, and an annual refresher for all employees. Senior management at each facility performs the ethics training for their staff.

In order to ensure that all personnel understand the importance TestAmerica places on maintaining high ethical standards at all times; TestAmerica has established a Company Wide Ethics Policy No. CW-L-P-004 and an Ethics Statement. All initial and annual training is documented by signature on the Ethics Statement demonstrating that the employee has participated in the training and understands their obligations related to ethical behavior and data integrity.

Violations of this Ethics Policy will not be tolerated. Employees who violate this policy will be subject to disciplinary actions up to and including termination. Criminal violations may also be referred to the Government for prosecution. In addition, such actions could jeopardize TestAmerica's ability to do work on Government contracts, and for that reason, TestAmerica has a Zero Tolerance approach to such violations.

Employees are trained as to the legal and environmental repercussions that result from data misrepresentation. Key topics covered in the presentation include:

- Organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting.
- Ethics Policy.
- How and when to report ethical/data integrity issues. Confidential reporting.
- Record keeping.
- Discussion regarding data integrity procedures.
- Specific examples of breaches of ethical behavior (e.g., peak shaving, altering data or computer clocks, improper macros, etc., accepting/offering kickbacks, illegal accounting practices, unfair competition/collusion).
- Internal monitoring. Investigations and data recalls.
- Consequences for infractions including potential for immediate termination, debarment, or criminal prosecution.
- Importance of proper written narration / data qualification by the analyst and project manager with respect to those cases where the data may still be usable but are in one sense or another partially deficient.

Additionally, a data integrity hotline (1-800-736-9407) is maintained by TestAmerica and administered by the Corporate Quality Department.

SECTION 18

ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS

18.1 OVERVIEW

The laboratory is a 28,000 ft^2 secure laboratory facility with controlled access and designed to accommodate an efficient workflow and to provide a safe and comfortable work environment for employees. All visitors sign in and are escorted by laboratory personnel. Access is controlled by various measures.

The laboratory is equipped with structural safety features. Each employee is familiar with the location, use, and capabilities of general and specialized safety features associated with their workplace. The laboratory provides and requires the use of protective equipment including safety glasses, protective clothing, gloves, etc. OSHA and other regulatory agency guidelines regarding required amounts of bench and fume hood space, lighting, ventilation (temperature and humidity controlled), access, and safety equipment are met or exceeded.

Traffic flow through sample preparation and analysis areas is minimized to reduce the likelihood of contamination. Adequate floor space and bench top area is provided to allow unencumbered sample preparation and analysis space. Sufficient space is also provided for storage of reagents and media, glassware, and portable equipment. Ample space is also provided for refrigerated sample storage before analysis and archival storage of samples after analysis. Laboratory HVAC and deionized water systems are designed to minimize potential trace contaminants.

The laboratory is separated into specific areas for sample receiving, sample preparation, volatile organic sample analysis, non-volatile organic sample analysis, specialty organics sample preparation, specialty organics analysis, metals sample preparation, metals analysis, inorganic sample analysis, and administrative functions.

18.2 ENVIRONMENT

Laboratory accommodation, test areas, energy sources, lighting are adequate to facilitate proper performance of tests. The facility is equipped with heating, ventilation, and air conditioning (HVAC) systems appropriate to the needs of environmental testing performed at this laboratory.

The environment in which these activities are undertaken does not invalidate the results or adversely affect the required accuracy of any measurements.

The laboratory provides for the effective monitoring, control and recording of environmental conditions that may affect the results of environmental tests as required by the relevant specifications, methods, and procedures. Such environmental conditions include humidity controls, temperature controls, and voltage conditioning with an uninterruptible backup power supply.

When any of the method or regulatory required environmental conditions change to a point where they may adversely affect test results, analytical testing is discontinued until the environmental conditions are returned to the required levels.

Environmental conditions of the facility housing the computer network and LIMS are regulated to protect against raw data loss.

18.3 WORK AREAS

There is effective separation between neighboring areas when the activities therein are incompatible with each other. For example:

- Volatile organic chemical handling areas, including sample preparation and waste disposal, and volatile organic chemical analysis areas.

Access to and use of all areas affecting the quality of analytical testing is defined and controlled by secure access to the laboratory building as described below in the Building Security section.

Adequate measures are taken to ensure good housekeeping in the laboratory and to ensure that any contamination does not adversely affect data quality. These measures include regular cleaning to control dirt and dust within the laboratory.

Work areas are available to ensure an unencumbered work area. Work areas include:

- Access and entryways to the laboratory.
- Sample receipt areas.
- Sample storage areas.
- Chemical and waste storage areas.
- Data handling and storage areas.
- Sample processing areas.
- Sample analysis areas.

18.4 FLOOR PLAN

A floor plan can be found in Appendix 1.

18.5 BUILDING SECURITY

Building access codes and alarm codes are distributed to employees as necessary.

Visitors to the laboratory sign in and out in a visitor's logbook. A visitor is defined as any person who visits the laboratory who is not an employee of the laboratory. In addition to signing into the laboratory, the Environmental, Health and Safety Manual contains requirements for visitors and vendors. There are specific safety forms that must be reviewed and signed.

Visitors (with the exception of company employees) are escorted by laboratory personnel at all times, or the location of the visitor is noted in the visitor's logbook.

SECTION 19

TEST METHODS AND METHOD VALIDATION

19.1 OVERVIEW

The laboratory uses methods that are appropriate to meet our clients' requirements and that are within the scope of the laboratory's capabilities. These include sampling, handling, transport, storage and preparation of samples, and, where appropriate, an estimation of the measurement of uncertainty as well as statistical techniques for analysis of environmental data.

Instructions are available in the laboratory for the operation of equipment as well as for the handling and preparation of samples. All instructions, Standard Operating Procedures (SOPs), reference methods and manuals relevant to the working of the laboratory are readily available to all staff. Deviations from published methods are documented (with justification) in the laboratory's approved SOPs. SOPs are submitted to clients for review at their request. Significant deviations from published methods require client approval and regulatory approval where applicable.

The list of test methods used by the laboratory can be found in Table 19-1.

19.2 STANDARD OPERATING PROCEDURES (SOPs)

The laboratory maintains SOPs that accurately reflect all phases of the laboratory such as assessing data integrity, corrective actions, handling customer complaints as well as all analytical methods and sampling procedures. The method SOPs are derived from the most recently promulgated/approved, published methods and are specifically adapted to the laboratory facility. Modifications or clarifications to published methods are clearly noted in the SOPs. All SOPs are controlled in the laboratory.

- All SOPs contain a revision number, effective date, and appropriate approval signatures. Controlled copies are available to all staff.
- Procedures for writing an SOP by reference to TestAmerica's Corporate SOP entitled 'Writing a Standard Operating Procedure (SOP)', No, CW-Q-S-002 or the laboratory's SOPs KNOX-QA-0018 "Preparation and Management of Standard Operating Procedures," and KNOX-QA-0011 "Document Control and Distribution."
- SOPs are reviewed at a minimum of every 2 years (annually for Drinking Water and DoD/DOE SOPs), and where necessary, revised to ensure continuing suitability and compliance with applicable requirements. (Note: The laboratory must ensure laboratory analysts comply with the procedures in its VAP approved SOPs.)

19.3 LABORATORY METHODS MANUAL

For each test method, the laboratory has available the published referenced method as well as the laboratory developed SOP.

Note: If more stringent standards or requirements are included in a mandated test method or regulation than those specified in this manual, the laboratory demonstrates that such requirements are met. If it is not clear which requirements are more stringent, the standard from

the method or regulation is to be followed. Any exceptions or deviations from the referenced methods or regulations are noted in the specific analytical SOP.

The laboratory maintains an SOP Index for both technical and non-technical SOPs. Technical SOPs are maintained to describe a specific test method. Non-technical SOPs are maintained to describe functions and processes not related to a specific test method.

19.4 SELECTION OF METHODS

Since numerous methods and analytical techniques are available, continued communication between the client and laboratory is imperative to assure the correct methods are utilized. Once client methodology requirements are established, this and other pertinent information is summarized by the Project Manager. These mechanisms ensure that the proper analytical methods are applied when the samples arrive for log-in. For non-routine analytical services (e.g., special matrices, non-routine compound lists, etc.), the method of choice is selected based on client needs and available technology. The methods selected must be capable of measuring the specific parameter of interest, in the concentration range of interest, and with the required precision and accuracy.

19.4.1 Sources of Methods

Routine analytical services are performed using standard EPA-approved methodology. In some cases, modification of standard approved methods may be necessary to provide accurate analyses of particularly complex matrices. When the use of specific methods for sample analysis is mandated through project or regulatory requirements, only those methods are used.

When clients do not specify the method to be used or methods are not required, the methods used are clearly validated and documented in an SOP and available to clients and/or the end user of the data.

The analytical methods used by the laboratory are those currently accepted and approved by the U. S. EPA and the state or territory from which the samples were collected. Reference methods include:

- *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, US EPA, January 1996.*
- *Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act, Analysis and Sampling Procedures; 40CFR Part 136 as amended by Method Update Rule; May 18, 2012, Methods for Chemical Analysis of Water and Wastes, EPA 600 (4-79-020), 1983.*
- *Methods for the Determination of Inorganic Substances in Environmental Samples, EPA-600/R-93/100, August 1993.*
- *Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91/010, June 1991. Supplement I: EPA-600/R-94/111, May 1994.*
- *Standard Methods for the Examination of Water and Wastewater, 18th/19th /20th edition; Eaton, A.D. Clesceri, L.S. Greenberg, A.E. Eds; American Water Works Association, Water Pollution Control Federation, American Public Health Association: Washington, D.C.*
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II,*

September 1994; Final Update IIB, January 1995; Final Update III, December 1996, Final Update IV, January 2008. Final Update V, August 2015

- *Annual Book of ASTM Standards, American Society for Testing & Materials (ASTM), Philadelphia, PA.*
- *National Status and Trends Program, National Oceanographic and Atmospheric Administration, Volume I-IV, 1985-1994.*
- *Manual for the Certification of Laboratories Analyzing Drinking Water (EPA 815-R-05-004, January 2005)*
- *Code of Federal Regulations (CFR) 40, Parts 136, 141, 172, 173, 178, 179 and 261*

The laboratory reviews updated versions to all the aforementioned references for adaptation based upon capabilities, instrumentation, etc., and implements them as appropriate. As such, the laboratory strives to perform only the latest versions of each approved method as regulations allow or require.

Other reference procedures for non-routine analyses may include methods established by specific states (e.g., Underground Storage Tank methods), ASTM or equipment manufacturers. Sample type, source, and the governing regulatory agency requiring the analysis will determine the method utilized.

The laboratory informs the client when a method proposed by the client may be inappropriate or out of date. After the client has been informed, and they wish to proceed contrary to the laboratory's recommendation, it is documented.

19.4.2 Demonstration of Capability

Before the laboratory may institute a new method and begin reporting results, the laboratory confirms that it can properly operate the method. In general, this demonstration does not test the performance of the method in real world samples, but in an applicable and available clean matrix sample. If the method is for the testing of analytes that are not conducive to spiking, demonstration of capability may be performed on quality control samples.

19.4.2.1 A demonstration of capability (DOC, Lab SOP# KNOX-QA-0009) is performed whenever there is a change in instrument type (e.g., new instrumentation), method or personnel (e.g., laboratory analyst has not performed the test within the last 12 months). Note: The laboratory shall have a DOC for all analytes included in the methods that the laboratory performs, and proficiency DOCs for each analyst shall include all analytes that the laboratory routinely performs. Addition of non-routine analytes does not require new DOCs for all analysts if those analysts are already qualified for routine analytes tested using identical chemistry and instrument conditions.

19.4.2.2 The initial demonstration of capability must be thoroughly documented and approved by the Technical Manager and QA Manager prior to independently analyzing client samples. All associated documentation must be retained in accordance with the laboratory's archiving procedures.

19.4.2.3 The laboratory must have an approved SOP, demonstrate satisfactory performance, and conduct a method detection limit study (when applicable). There may be other requirements as stated within the published method or regulations (e.g., retention time window study).

Note: In some instances, a situation may arise where a client requests that an unusual analyte be reported using a method where this analyte is not normally reported. If the analyte is being reported for regulatory purposes, the method must meet all procedures outlined within this QAM (SOP, MDL, and Demonstration of Capability). If the client states that the information is not for regulatory purposes, the result may be reported as long as the following criteria are met:

- The instrument is calibrated for the analyte to be reported using the criteria for the method and ICV/CCV criteria are met (unless an ICV/CCV is not required by the method or criteria are per project DQOs).
- The laboratory's nominal or default reporting limit (RL) is equal to the limit of quantitation (LOQ), must be at or above the lowest non-zero standard in the calibration curve and must be reliably determined. Project RLs are client specified reporting levels which may be higher than the LOQ. Results reported below the LOQ must be qualified as estimated values. Also see Section 19.6.1.3, Relationship of Limit of Detection (LOD) to Limit of Quantitation (LOQ).
- The client request is documented and the lab informs the client of its procedure for working with unusual compounds. The final report must be footnoted: (e.g., *Reporting Limit based on the low standard of the calibration curve.)*

19.4.3 Initial Demonstration of Capability (IDOC) Procedures

19.4.3.1 A quality control sample shall be obtained from an outside source. If not available, the QC sample may be prepared by the laboratory using stock standards that are prepared independently from those used in instrument calibration.

19.4.3.2 The analyte(s) shall be diluted in a volume of clean matrix sufficient to prepare four aliquots at the concentration specified by the method or the laboratory SOP.

19.4.3.3 At least four aliquots are prepared (including any applicable routine clean-up procedures) and analyzed according to the test method (either concurrently or over a period of days).

19.4.3.4 Using all of the results, calculate the mean recovery in the appropriate reporting units and the standard deviation for each parameter of interest.

19.4.3.5 When it is not possible to determine the mean and standard deviation, such as for presence, absence and logarithmic values, the laboratory will assess performance against criteria described in the laboratory SOP.

19.4.3.6 Compare the information obtained above to the corresponding acceptance criteria for precision and accuracy in the test method (if applicable) or in laboratory generated acceptance criteria (LCS or interim criteria) if there is no mandatory criteria established. If any one of the parameters do not meet the acceptance criteria, the performance is unacceptable for that parameter.

19.4.3.7 When one or more of the tested parameters fail at least one of the acceptance criteria, the analyst must proceed according to either option listed below:

- Locate and correct the source of the problem and repeat the test for all parameters of interest beginning with 19.4.3.3 above.
- Beginning with 19.4.3.3 above, repeat the test for all parameters that failed to meet criteria. Repeated failure, however, will confirm a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds of interest beginning with 19.4.3.1 above.

Note: Results of successive LCS analyses can be used to fulfill the DOC requirement.

19.4.3.8 Refer to SOP KNOX-QA-0009, Personnel Orientation and Training for further details.

A certification statement (see Figure 19-1 for an example) is used to document the completion of each initial demonstration of capability. A copy of the certification is archived in the analyst's training file.

19.5 LABORATORY DEVELOPED METHODS AND NON-STANDARD METHODS

Any new method developed by the laboratory must be fully defined in an SOP and validated by qualified personnel with adequate resources to perform the method. Method specifications and the relation to client requirements must be clearly conveyed to the client if the method is a non-standard method (not a published or routinely accepted method). The client must also be in agreement to the use of the non-standard method.

19.6 VALIDATION OF METHODS

Validation is the confirmation by examination and the provision of objective evidence that the particular requirements for a specific intended use are fulfilled.

All non-standard methods, laboratory designed/developed methods, standard methods used outside of their scope, and major modifications to published methods must be validated to confirm they are fit for their intended use. The validation will be as extensive as necessary to meet the needs of the given application. The results are documented with the validation procedure used and contain a statement as to the fitness for use.

19.6.1 Method Validation and Verification Activities for All New Methods

While method validation can take various courses, the following activities can be required as part of method validation. Method validation records are designated QC records and are archived accordingly.

19.6.1.1 Determination of Method Selectivity

Method selectivity is the demonstrated ability to discriminate the analyte(s) of interest from other compounds in the specific matrix or matrices from other analytes or interference. In some

cases to achieve the required selectivity for an analyte, a confirmation analysis is required as part of the method.

19.6.1.2 Determination of Method Sensitivity

Sensitivity can be both estimated and demonstrated. Whether a study is required to estimate sensitivity depends on the level of method development required when applying a particular measurement system to a specific set of samples. Estimations and/or demonstrations of sensitivity are performed as required by regulation or client agreement, such as the procedure in 40 CFR Part 136 Appendix B, under the Clean Water Act.

19.6.1.3 Relationship of Limit of Detection (LOD) to the Limit of Quantitation (LOQ)

An important characteristic of expression of sensitivity is the difference in the LOD and the QL. The LOD is the minimum level at which the presence of an analyte can be reliably concluded. The QL is the minimum concentration of analyte that can be quantitatively determined with acceptable precision and bias. For most instrumental measurement systems, there is a region where semi-quantitative data is generated around the LOD (both above and below the estimated MDL or LOD) and below the QL. In this region, detection of an analyte may be confirmed but quantification of the analyte is unreliable within the accuracy and precision guidelines of the measurement system. When an analyte is detected below the QL, and the presence of the analyte is confirmed by meeting the qualitative identification criteria for the analyte, the analyte can be reliably reported, but the amount of the analyte can only be estimated. If data is to be reported in this region, it must be done so with a qualification that denotes the semi-quantitative nature of the result.

19.6.1.4 Determination of Interferences

A determination that the method is free from interferences in a blank matrix is performed.

19.6.1.5 Determination of Range

Where appropriate to the method, the quantitation range is determined by comparison of the response of an analyte in a curve to established or targeted criteria. Generally the upper quantitation limit is defined by highest acceptable calibration concentration. The lower Limit of Quantitation or LOQ cannot be lower than the lowest non-zero calibration level (QL check standard level for ICP), and can be constrained by required levels of bias and precision.

19.6.1.6 Determination of Accuracy and Precision

Accuracy and precision studies are generally performed using replicate analyses, with a resulting percent recovery and measure of reproducibility (standard deviation, relative standard deviation) calculated and measured against a set of target criteria.

19.6.1.7 Documentation of Method

The method is formally documented in an SOP. If the method is a minor modification of a standard laboratory method that is already documented in an SOP, an SOP Attachment describing the specific differences in the new method is acceptable in place of a separate SOP.

19.6.1.8 Continued Demonstration of Method Performance

Continued demonstration of Method Performance is addressed in the SOP. Continued demonstration of method performance is generally accomplished by batch specific QC samples such as LCS, method blanks or PT samples.

19.7 METHOD DETECTION LIMITS (MDL)/ LIMITS OF DETECTION (LOD)

Method detection limits (MDL) are initially determined in accordance with 40 CFR Part 136, Appendix B or alternatively by other technically acceptable practices that have been accepted by regulators. MDL is also sometimes referred to as Limit of Detection (LOD). The MDL theoretically represents the concentration level for each analyte within a method at which the analyst is 99% confident that the true value can be differentiated from blanks. The MDL is determined for each analyte initially during the method validation process and updated as required in the analytical methods, whenever there is a significant change in the procedure or equipment, or based on project specific requirements (refer to 20.7.10). Generally, the analyst prepares at least seven replicates of solution spiked at one to five times the estimated method detection limit (most often at the lowest standard in the calibration curve) into the applicable matrix with all the analytes of interest. Each of these aliquots is extracted (including any applicable clean-up procedures) and analyzed in the same manner as the samples. Where possible, the seven replicates should be analyzed over 2-4 days to provide a more realistic MDL. The replicates may be prepared and analyzed over a period of time (e.g. over multiple batches) or they may be performed within the same batch. If more than seven replicates are used, care must be taken to ensure the appropriate t-value multiplier is applied. MDL studies for work in support of Ohio EPA VAP must be spiked at or below the reporting limit.

19.7.1 Refer to the Corporate SOP No. CA-Q-S-006 and SOP KNOX-QA-0023 for details on the laboratory's MDL process.

19.8 INSTRUMENT DETECTION LIMITS (IDL)

19.8.1 The IDL is sometimes used to assess the reasonableness of the MDLs or in some cases required by the analytical method or program requirements. IDLs are most used in metals analyses but may be useful in demonstration of instrument performance in other areas.

19.8.2 IDLs are calculated to determine an instrument's sensitivity independent of any preparation method. IDLs are calculated either using 7 replicate spike analyses, like MDL but without sample preparation, or by the analysis of 10 instrument blanks and calculating 3 x the absolute value of the standard deviation.

19.8.3 If IDL is > than the MDL, it may be used as the reported MDL.

19.9 VERIFICATION OF DETECTION AND REPORTING LIMITS

19.9.1 Once an MDL is established, it must be verified, on each instrument, by analyzing a quality control sample (prepared as a sample) at no more than 3 times the calculated MDL for single analyte analyses (e.g., most wet chemistry methods) and no more than 4 times the calculated MDL for multiple analyte methods (e.g., GC, GCMS, ICP, etc.). The analytes must be qualitatively identified. This verification does not apply to methods that are not readily spiked (e.g. pH, turbidity, etc.) or where the lab does not report to the MDL. If the MDL does not verify, then the lab redevelops their MDL or use the level where qualitative identification is established. MDLs must be verified at least annually.

The following applies to methods specified on the laboratory's DoD ELAP scope of accreditation. Once the MDL is determined, it must be verified on each instrument used for the given method to analyze DoD/DOE samples. TestAmerica defines the DoD/DOE Quality System Manual (QSM) Detection Limit (DL) as being equal to the MDL. TestAmerica also defines the DoD/DOE QSM Limit of Detection (LOD) as being equal to the lowest concentration standard that successfully verifies the MDL, also referred to as the MDLV standard. MDL and MDLV standards are extracted/digested and analyzed through the entire analytical process. The MDL and MDLV determinations do not apply to methods that are not readily spiked (e.g. pH, turbidity, etc.) or where the lab does not report to the MDL. If the MDLV standard is not successful, then the laboratory will redevelop their MDL or perform and pass two consecutive MDLVs at a higher concentration and set the LOD at the higher concentration. Initial and quarterly verification is required for all methods listed in the laboratory's DoD ELAP Scope of Accreditation. Refer to the laboratory SOP CA-Q-S-006 and the laboratory attachment for further details.

19.9.2 When the laboratory establishes a quantitation limit, it must be initially verified by the analysis of a low level standard or QC sample at 1-2 times the reporting limit and annually thereafter. The annual requirement is waved for methods that have an annually verified MDL.

The following applies to methods specified on the laboratory's DoD ELAP scope of accreditation. The laboratory quantitation limit is equivalent to the DoD/DOE Limit of Quantitation (LOQ), which is at a concentration equal to or greater than the lowest non-zero calibration standard. The DoD/DOE QSM requires the laboratory to perform an initial characterization of the bias and precision at the LOQ and quarterly LOQ verifications thereafter. If the quarterly verification results are not consistent with three-standard deviation confidence limits established initially, then the bias and precision will be reevaluated and clients contacted for any on-going projects where the bias and precision at the LOQ has been specified in the project planning documents. For DoD/DOE projects, TestAmerica makes a distinction between the Reporting Limit (RL) and the LOQ. The RL is a level at or above the LOQ that is used for specific project reporting purposes, as agreed to between the laboratory and the client. The RL cannot be lower than the LOQ concentration, but may be higher.

19.10 RETENTION TIME WINDOWS

Most organic analyses and some inorganic analyses use chromatography techniques for qualitative and quantitative determinations. For every chromatography analysis each analyte will have a specific time of elution from the column to the detector. This is known as the analyte's retention time. The variance in the expected time of elution is defined as the retention time window. As the key to analyte identification in chromatography, retention time windows must be

established on every column for every analyte used for that method. These records are kept with the files associated with each instrument as applicable. Complete details are available in the laboratory SOPs.

19.11 EVALUATION OF SELECTIVITY

The laboratory evaluates selectivity by following the checks within the applicable analytical methods, which include mass spectral tuning, mass resolution, second column confirmation, ICP interelement interference checks, chromatography retention time windows, and method blanks.

19.12 ESTIMATION OF UNCERTAINTY OF MEASUREMENT

19.12.1 Uncertainty is "a parameter associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand" (as defined by the International Vocabulary of Basic and General Terms in Metrology, ISO Geneva, 1993, ISBN 92-67-10175-1). Knowledge of the uncertainty of a measurement provides additional confidence in a result's validity. Its value accounts for all the factors which could possibly affect the result, such as adequacy of analyte definition, sampling, matrix effects and interferences, climatic conditions, variances in weights, volumes, and standards, analytical procedure, and random variation. Some national accreditation organizations require the use of an "expanded uncertainty": the range within which the value of the measurand is believed to lie within at least a 95% confidence level with the coverage factor k=2.

19.12.2 Uncertainty is not error. Error is a single value, the difference between the true result and the measured result. On environmental samples, the true result is never known. The measurement is the sum of the unknown true value and the unknown error. Unknown error is a combination of systematic error, or bias, and random error. Bias varies predictably, constantly, and independently from the number of measurements. Random error is unpredictable, assumed to be Gaussian in distribution, and reducible by increasing the number of measurements.

19.12.3 The minimum uncertainty associated with results generated by the laboratory can be determined by using the Laboratory Control Sample (LCS) accuracy range for a given analyte. The LCS limits are used to assess the performance of the measurement system since they take into consideration all of the laboratory variables associated with a given test over time (except for variability associated with the sampling and the variability due to matrix effects). The percent recovery of the LCS is compared either to the method-required LCS accuracy limits or to the statistical, historical, in-house LCS accuracy limits.

19.12.4 Refer to SOP KNOX-QA-0019 "Estimation of Measurement Uncertainty" for details regarding calculations that may be used to estimate measurement uncertainty associated with laboratory results.

19.12.5 In the case where a well recognized test method specifies limits to the values of major sources of uncertainty of measurement (e.g. 524.2, 525, etc) and specifies the form of presentation of calculated results, no further discussion of uncertainty is required.

19.13 CONTROL OF DATA

The laboratory has policies and procedures in place to ensure the authenticity, integrity, and accuracy of the analytical data generated by the laboratory.

19.13.1 Computer and Electronic Data Related Requirements

The three basic objectives of our computer security procedures and policies are shown below. More detail is outlined in the laboratory SOPs KNOX-IT-0001, 'Good Automated Laboratory Practices' and KNOX-IT-0002, 'Electronic Data and Software Backup.' The laboratory is currently running TALS which is a TestAmerica developed LIMS system that has been highly customized to meet the needs of TestAmerica Knoxville. It is referred to as LIMS for the remainder of this section. The LIMS utilizes a SQL Server Enterprise Addition-SQL2008-SP3 which is an industry standard relational database platform. It is referred to as Database for the remainder of this section.

19.13.1.1 Maintain the Database Integrity: Assurance that data is reliable and accurate through data verification (review) procedures, password-protecting access, anti-virus protection, data change requirements, as well as an internal LIMS permissions procedure.

- LIMS Database Integrity is achieved through data input validation, internal user controls, and data change requirements.
- Spreadsheets and other software developed in-house must be verified with documentation through hand calculations prior to use. Cells containing calculations must be lock-protected.
- Instrument hardware and software adjustments are safeguarded through maintenance logs, audit trails, and controlled access.

19.13.1.2 Ensure Information Availability: Protection against loss of information or service through scheduled back-ups, stable file server network architecture, secure storage of media, line filter, Uninterruptible Power Supply (UPS), and maintaining older versions of software as revisions are implemented.

19.13.1.3 Maintain Confidentiality: Ensure data confidentiality through physical access controls such as password protection or controlled website access approval.

19.13.2 Data Reduction

The complexity of the data reduction depends on the analytical method and the number of discrete operations involved (e.g., extractions, dilutions, instrument readings and concentrations). The laboratory analyst calculates the final results from the raw data or uses appropriate computer programs to assist in the calculation of final reportable values.

Manual integration of peaks will be documented and reviewed and the raw data will be flagged in accordance with the TestAmerica Corporate SOP CA-Q-S-002, "*Acceptable Manual Integration Practices"* and SOP KNOX-QA-0022.

Analytical results are reduced to appropriate concentration units specified by the analytical method, taking into account factors such as dilution, sample weight or volume, etc. Method Blank correction is not performed unless it is specifically required by the method. Calculations are independently verified by appropriate laboratory staff. Calculations and data reduction steps for the methods are summarized in the respective analytical SOPs.

In general, data will be processed by a laboratory analyst in one of the following ways:

- Manual computation of results directly on the data sheet or on calculation pages attached to the data sheets.
- Input of raw data for computer processing.
- Direct acquisition and processing of raw data by a computer.

19.13.2.1 If data are manually processed by a laboratory analyst, all steps in the computation are provided including equations used and the source of input parameters such as response factors (RFs), dilution factors, and calibration constants. If calculations are not performed directly on the data sheet, they may be attached to the data sheets. (Note: This section does not apply to the Ohio VAP as all computations are done by the instrument data system and by the LIMS.)

19.13.2.2 For data that are input by a laboratory analyst and processed using a computer, a copy of the input is kept and uniquely identified with the project number and other information as needed. The samples analyzed must be clearly identified.

19.13.2.3 If data are directly acquired from instrumentation and processed, the laboratory analyst must verify that the following are correct:

- Project and sample numbers
- Calibration constants/RFs
- Units
- Numerical values used for reporting limits.

19.13.2.4 In general, sample results are reported to 2 significant figures on the final report.

19.13.3 Logbook / Worksheet Use Guidelines

Logbooks and worksheets are filled out ‘real time’ and have enough information on them to trace the events of the applicable analysis/task. (e.g. calibrations, standards, analyst, sample ID, date, time on short holding time tests, temperatures when applicable, calculations are traceable, etc.).

- Corrections are made following the procedures outlined in Section 12.
- Logbooks are controlled by the QA department. A record is maintained of all logbooks in the lab.
- Unused portions of pages must be “Z”’d out, signed and dated.
- Worksheets are created with the approval of the Technical Director/QA Manager at the facility. The QA Manager or designee controls all worksheets following the procedures in Section 6.

19.13.4 Review / Verification Procedures

A minimum of three levels of review are performed before final sample data is reported to the client.

- First level technical review.
- Second level technical review.
- Third level project management completeness review.

19.13.4.1 The initial first level technical review ensures that:

- Sample preparation information is correct and complete including documentation of standard identification, sample amounts, etc.
- Analysis information is correct and complete including proper identification of analysis output (charts, chromatograms, mass spectra, etc.).
- Analytical results are correct and complete including calculation or verification of instrument calibration, QC results, and qualitative and quantitative sample results with appropriate qualifiers.
- The appropriate SOPs have been followed and are identified in the project records.
- Proper documentation procedures have been followed.
- All nonconformances have been documented.
- Special sample preparation and analytical requirements have been met.
- The data generated have been reported with the appropriate number of significant figures as defined by the analytical method in the LIMS or otherwise specified by the client.

The initial verification of the data reduction (level 1 review) by the laboratory analyst is documented on a data review checklist, which is signed and dated by the laboratory analyst. The data review checklists identify which records must be checked as part of the data review.

19.13.4.2 Following the completion of the initial verification by the laboratory analyst performing the data reduction, a systematic check of the data that has been fully reduced and checked through level 1 review is performed by an experienced peer, group leader, or designee. This check (level 2 review) is performed to ensure that level 1 review has been completed correctly and thoroughly. This review includes an evaluation of all items required in the raw data package. Any exceptions noted by the laboratory analyst must be reviewed. Included in this review is an assessment of the acceptability of the data with respect to:

- Adherence of the procedure used to the requested analytical method SOP.
- Correct interpretation of chromatograms, mass spectra, etc.
- Correctness of numerical input when computer programs are used (checked randomly).
- Correct identification and quantitation of constituents with appropriate qualifiers.
- Numerical correctness of calculations and formulas (checked randomly).
- Acceptability of QC data.
- Documentation that instruments were operating according to method specifications (calibrations, performance checks, etc.).
- Documentation of dilution factors, standard concentrations, etc.
- Sample holding time assessment.

The level 2 review also serves as verification that the process the laboratory analyst

has followed is correct in regard to the following:

- The analytical procedure follows the methods and specific instructions given on the project QAS or equivalent summary form.
- Nonconforming events have been addressed by corrective action as defined on a nonconformance memo.
- Valid interpretations have been made during the examination of the data and the review comments of the initial reviewer are correct.
- Manual Integrations are valid and properly documented.
- The package contains all of the necessary documentation for data review and report production and results are reported in a manner consistent with the method used for preparation of data reports.

The specific items covered in the level 2 review may vary according to the analytical method, but this review of the data must be documented by signing the data review checklist.

19.13.4.3 A third-level review is performed by the PM. This review is required before results are submitted to clients. This review serves to verify the completeness of the data report and to ensure that project requirements are met for the analyses performed. The items to be reviewed are:

- Analysis results are present for every sample in the analytical batch, reporting group, or sample delivery group (SDG).
- Every parameter or target compound requested is reported with either a value or reporting limit.
- The correct units and correct number of significant figures are utilized.
- All nonconformances and receipt variances with the resolution, including holding time violations and data evaluation statements that impact the data quality, are accompanied by clearly expressed comments from the laboratory.
- The final report is legible, contains all the supporting documentation required by the project, and is in either the standard TestAmerica Knoxville format or in the client-required format.

A narrative to accompany the final report is finalized by the PM. This narrative will include relevant comments collected during the earlier reviews.

19.13.4.4 Additional reviews are performed by the QA department. These reviews are typically performed after the data has been reported to the client. These reviews are a routine part of the Quality System and are discussed in further detail in Section 15.1. For example, the QA department reviews 10% of all DoD and DOE data packages for technical completeness and accuracy.

19.13.5 Manual Integrations

Computerized data systems provide the laboratory analyst with the ability to re-integrate raw instrument data in order to optimize the interpretation of the data. Though manual integration of data is an invaluable tool for resolving variations in instrument performance and some sample matrix problems, when used improperly, this technique would make unacceptable data appear to meet quality control acceptance limits. Improper re-integrations lead to legally indefensible data, a poor reputation, or possible laboratory decertification. Because guidelines for re-integration of data are not provided in the methods and most methods were written prior to widespread implementation of computerized data systems, the laboratory trains all analytical staff on proper manual integration techniques using TestAmerica's Corporate SOP CA-Q-S-002 and SOP KNOX-QA-0022 as the guidelines**.**

19.13.5.1 The laboratory analyst must adjust the baseline or the area of a peak in some situations, for example when two compounds are not adequately resolved or when a peak shoulder needs to be separated from the peak of interest. The laboratory analyst must use professional judgment and common sense to determine when manual integrating is required. Laboratory Analysts are encouraged to ask for assistance from a senior laboratory analyst or manager when in doubt.

19.13.5.2 Laboratory Analysts must not increase or decrease peak areas for the sole purpose of achieving acceptable QC recoveries that would have otherwise been unacceptable. The intentional recording or reporting of incorrect information (or the intentional omission of correct information) is against company principles and policy and is grounds for immediate termination.

19.13.5.3 Client samples, performance evaluation samples, and quality control samples are all treated equally when determining whether or not a peak area or baseline is manually adjusted.

19.13.5.4 All manual integrations receive a second level review. Manual integrations must be indicated on an expanded scale "after" chromatograms such that the integration performed can be easily evaluated during data review. Expanded scale "before" chromatograms are also required for all manual integrations on QC parameters (initial calibrations, calibration verifications, laboratory control samples, internal standards, surrogates, etc.) unless the laboratory has another documented corporate approved procedure in place that can demonstrate an active process for detection and deterrence of improper integration practices.

Figure 19-1.
Example - Demonstration of Capability Documentation

Analyst Demonstration of Capability
TestAmerica Knoxville

Analyst Name

MM/DD/YYYY

Preparation Method(s):
Analytical Method(s):
Matrix:
Method Description:

Preparation SOP No:

Analytical SOP No:

We, the undersigned, CERTIFY that:

1. The analyst identified above, using the cited test method with the specifications in the cited SOP, which is in use at this facility for the analysis of samples under the laboratory's Quality Assurance Plan, has completed the Demonstration of Capability (DOC).
2. The test method(s) was performed by the analyst identified on this certificate.
3. A copy of test method(s) and laboratory SOPs are available for all personnel on-site.
   These documents have been reviewed by the analyst as part of this DOC.
4. The data associated with the demonstration of capability are true, accurate, complete and self-explanatory.
5. All raw data necessary to reconstruct and validate these analyses have been retained at the facility. The associated information is organized and available for review.

Analyst	**Signature**	**Date**

Technical Director	**Signature**	**Date**

Quality Assurance Officer	**Signature**	**Date**

Table 19-1 Analytical Methods and Matrices

Analytical Parameters	Fields of Testing[1]				
	Drinking Water (SDWA)	**Non-Potable Water (CWA/RCRA)**	**Solid and Chemical Materials (RCRA-SW846)**	**Air and Emissions (CAA)**	**Biological Tissue**
Anions (Br^-, Cl^-, F^-, NO_2, NO_3, o-PO_4, SO_4	**EPA 300.0**	**EPA 300.0 (CWA) EPA 9056 (RCRA)**	**EPA 9056**	Mod Method 26A/0050 (9057 Mod)	---
Ash	---	---	**ASTM D482**	---	---
Density	---	---	ASTM D1963, D854	---	---
Halogens	---	---	EPA 5050/9056 (KNOX-WC-0016)	---	---
Heat of Combustion (Btu)	---	---	**ASTM D5865, D240**	---	---
Hexavalent Chromium	---	---	---	Method 0061/7199	---
pH	---	EPA 9040C (RCRA) SM4500 H+B (CWA)	EPA 9040C EPA 9045D	---	---
Hardness	---	**SM 2340B (CWA)**	---	---	---
Particulates	---	---	---	PM-10, **0050/5, 5B, 5J**, 201A, **202**, **TCEQ-23**, OTM-27, OTM-28	---
Mercury	---	**EPA 7470A (RCRA)**	**EPA 7471A&B**	**EPA 29/0060/7470A** ASTM D6784-02/7470A EPA IO-3.1/7470A	**EPA3051/3052/ 7470A**
Metals	---	**EPA 200.7 (CWA) EPA 3005A/ 6010B&C EPA 3010A/ 6010B&C (RCRA)**	**EPA 3050B/ 6010B&C EPA 3051/3052/6010B&C**	**EPA 29/ 0060/6010B&C EPA IO-3.1/6010B&C 40CFR60-12 (Pb)**	**EPA 3051/3052/ 6010B&C**
Sulfur	---	---	ASTM D3177, ASTM D129	---	---
Viscosity	---	---	**ASTM D445**	---	---

Table 19-1 (continued) Analytical Methods and Matrices

Analytical Parameters	Fields of Testing[1]				
	Drinking Water (SDWA)	**Non-Potable Water (CWA/RCRA)**	**Solid and Chemical Materials (RCRA-SW846)**	**Air and Emissions (CAA)**	**Biological Tissue**
Volatiles by GC/MS	---	**EPA 5030B EPA 8260B (RCRA)**	**EPA 5035 EPA 8260B**	**TO-14A, TO-15 EPA 0031/5041A (VOST)**	---
Volatiles by GC	---	---	---	EPA 0040 Condensates **ASTM D1946**	---
Semivolatiles by GC/MS	---	**EPA 3520C EPA 8270C&D (RCRA)**	**EPA3550B&C EPA 3640A EPA 8270C&D**	**EPA 3542/8270C&D TO-13A**	---
Semivolatiles by GC	---	**EPA 3520C PCBs EPA 8082A (RCRA)**	**EPA 3550B&C EPA 3640A EPA 8082A**	**EPA 3542**/8082A **EPA 3542**/8081A **TO-4A, TO-10A** TCO/Grav	**EPA 3550B&C EPA 3640A** PCBs EPA 8082A
Dioxins/Furans by HRGC/HRMS	**EPA 1613B**	**EPA 1613B (CWA) EPA 8290 EPA 8290A (RCRA)**	**EPA 3640A EPA 8290 EPA 8290A**	**TO-9A**, **Method 23/8290/8290A EPA 0023A/8290/8290A**	**EPA 3640A EPA 8290 EPA 8290A EPA 1613B**
Lipids	---	---	---	---	EPA 8290, Micro-Lipids (KNOX-OP-0019)
PCBs by HRGC/HRMS	---	**EPA 1668A&B&C CWA**	**EPA3640A EPA 1668A&B&C**	**EPA 1668A&B&C**	**EPA 3640A EPA 1668A&B&C**
Polycyclic Aromatic Hydrocarbons (PAH)	---	**EPA 3520C EPA 8270C&D** ID0016	**EPA 3550B&C/3640A/ 8270C&D EPA 3540C/3640A/ ID0016**	**EPA 3542/8270C&D EPA 3542/ID0016**	**EPA 3550B&C/ 3640A/** 8270C&D EPA **3540C/3640A/ ID0016**

(1) NELAC accredited analytical methods and accepted prep methods are highlighted in bold fon

SECTION 20

EQUIPMENT and CALIBRATIONS

20.1 OVERVIEW

The laboratory purchases the most technically advanced analytical instrumentation for sample analyses. Instrumentation is purchased on the basis of accuracy, dependability, efficiency and sensitivity. Each laboratory is furnished with all items of sampling, preparation, analytical testing and measurement equipment necessary to correctly perform the tests for which the laboratory has capabilities. Each piece of equipment is capable of achieving the required accuracy and complies with specifications relevant to the method being performed. Before being placed into use, the equipment (including sampling equipment) is calibrated and checked to establish that it meets its intended specification. The calibration routines for analytical instruments establish the range of quantitation. Calibration procedures are specified in laboratory SOPs for the analytical methods. A list of laboratory equipment and instrumentation is presented in Table 20-1.

Equipment is only operated by authorized and trained personnel. Manufacturer's instructions for equipment use are readily accessible to all appropriate laboratory personnel.

20.2 PREVENTIVE MAINTENANCE

20.2.1 The laboratory follows a well-defined maintenance program to ensure proper equipment operation and to prevent the failure of laboratory equipment or instrumentation during use. This program of preventive maintenance helps to avoid delays due to instrument failure.

20.2.2 Routine preventive maintenance procedures and frequency, such as cleaning, and replacements, are performed according to the procedures outlined in the manufacturer's manual. Qualified personnel must also perform maintenance when there is evidence of degradation of peak resolution, a shift in the calibration curve, loss of sensitivity, or failure to continually meet one of the quality control criteria.

20.2.3 Table 20-2 summarizes the schedules for routine maintenance. It is the responsibility of each Group Leader to ensure that instrument maintenance logs are kept for all equipment in his/her department. Preventative maintenance procedures may also be outlined in analytical SOPs or instrument manuals. (Note: for some equipment, the log used to document maintenance is also used to monitor performance.)

20.2.4 Instrument maintenance logs are controlled and are used to document instrument problems, instrument repair and maintenance activities. Maintenance logs are kept for all major pieces of equipment. Instrument maintenance logs may also be used to specify instrument operating parameters.

20.2.4.1 Documentation must include all major maintenance activities such as contracted preventive maintenance and service and in-house activities such as the replacement of electrical components, lamps, tubing, valves, columns, detectors, cleaning and adjustments.

20.2.4.2 Each entry in the instrument log includes the Laboratory Analyst's initials, the date, a detailed description of the problem (or maintenance needed/scheduled), a detailed explanation of the solution or maintenance performed, and a verification that the equipment is functioning properly (state what was used to determine a return to control, e.g., continuing instrument calibration verification (CCV) run on *'date'* was acceptable, or instrument recalibrated on 'date' with acceptable verification, etc.). An entry in the associated analytical runlog documenting successful calibration may also be used to document instrument return to control following maintenance.

20.2.4.3 When maintenance or repair is performed by an outside agency, service receipts detailing the service performed are affixed into the maintenance logbook. The analyst signs across the entered item and the logbook page so that it is clear that the insert is missing if only half a signature is found in the logbook.

20.2.4.4 In addition, the maintenance records contain:

- The identification of the instrument/equipment **(**instrument's Serial Number and Model Number).
- The date the instrument/equipment was put into use.
- If available, the condition when the instrument was received (e.g., new, used, reconditioned).

20.2.5 If an instrument requires repair (subjected to overloading or mishandling, gives suspect results, or otherwise has shown to be defective or outside of specified limits), it is taken out of operation and tagged as out of service or otherwise isolated until such a time as the repairs have been made and the instrument can be demonstrated as operational by calibration and/or verification or other test to demonstrate acceptable performance. The laboratory examines the effect of this defect on previous analyses (refer to Sections 12 and 13).

20.2.6 In the event of equipment malfunction that cannot be resolved, service is obtained from the instrument vendor manufacturer, or qualified service technician, if such a service can be tendered. If on-site service is unavailable, arrangements are made to have the instrument shipped back to the manufacturer for repair. Back up instruments, which have been approved for the analysis perform the analysis normally carried out by the malfunctioning instrument. If the back up is not available and the analysis cannot be carried out within the needed timeframe, the samples are subcontracted.

20.2.7 At a minimum, if an instrument is sent out for service or transferred to another facility, it must be recalibrated and the laboratory MDL verified (using an MDLV) prior to return to lab operations.

20.2.8 An inventory of critical spare parts is maintained to minimize delays in the completion of analyses. For most test methods, back-up instrumentation is also maintained to minimize delays.

20.3 SUPPORT EQUIPMENT

This section applies to all devices that may not be the actual test instrument, but are necessary to support laboratory operations. These include but are not limited to: balances, ovens,

refrigerators, freezers, incubators, water baths, temperature measuring devices, and volumetric dispensing devices if quantitative results are dependent on their accuracy, as in standard preparation and dispensing or dilution into a specified volume. All raw data records associated with the support equipment are retained to document instrument performance. Refer to Table 20-3.

20.3.1 Weights and Balances

The accuracy of the balances used in the laboratory is checked every working day, before use. All balances are placed on stable counter tops. Balances must have their calibration checked each day of use with two weights bracketing the working range; refer to Table 20-3.

Each balance is checked prior to initial serviceable use with at least two certified ASTM type 1 weights spanning its range of use (weights that have been calibrated to ASTM type 1 weights may also be used for daily verification). ASTM type 1 weights used only for calibration of other weights (and no other purpose) are inspected for corrosion, damage or nicks at least annually and if no damage is observed, they are calibrated at least every 5 years by an outside calibration laboratory. Any weights (including ASTM Type 1) used for daily balance checks or other purposes are recalibrated/recertified annually to NIST standards (this may be done internally if the laboratory maintains “calibration only” ASTM type 1 weights).

All balances are serviced annually by a qualified service representative who supplies the laboratory with a certificate that identifies traceability of the calibration to the NIST standards.

All of this information is recorded in logs, and the recalibration/recertification certificates are kept on file. Further details on balance calibration may be found in SOP KNOX-QA-0005, Balance Calibration and Weight Verification.

20.3.2 pH and Conductivity Meters

The pH meters used in the laboratory are accurate to $\pm$ 0.1 pH units, and have a scale readability of at least 0.05 pH units. The meters automatically compensate for the temperature, and are calibrated with at least two working range buffer solutions before each use.

Conductivity meters are also calibrated before each use with a known standard to demonstrate the meters do not exceed an error of 1% or one umhos/cm.

All of this information is documented in logbooks.

Consult the pH and Routine Monitoring of Deionized Water SOPs for further information.

20.3.3 Thermometers

All thermometers are calibrated on an annual basis with a NIST-traceable thermometer. IR thermometers and digital thermometers are calibrated quarterly.

• If the temperature measuring device is used over a range of 10°C or less, then a single point verification within the range of use is acceptable;

• If the temperature measuring device is used over a range of greater than 10°C, then the verification must bracket the range of use.

The NIST mercury reference thermometer(s) are recalibrated every five years (unless thermometer has been exposed to temperature extremes or apparent separation of internal liquid) by an approved outside service and the provided certificate of traceability is kept on file. NIST digital reference thermometers are recalibrated every two years. The NIST thermometer(s) have increments of 1ºC, and have a range applicable to all method and certification requirements. The NIST traceable thermometer is used for no other purpose than to calibrate other thermometers.

Thermometer calibrations are documented as described in SOP KNOX-QA-0010, Temperature Monitoring and Thermometer Calibration.

20.3.4 Refrigerators/Freezer Units, Waterbaths, Ovens and Incubators

The temperatures of all refrigerator units and freezers used for sample and standard storage are monitored each working day. Monitoring is performed 7 days per week to ensure that samples remain within an acceptable range.

Ovens, waterbaths and incubators are monitored on days of use.

All of this equipment has a unique identification number, and is assigned a unique thermometer for monitoring.

Sample storage refrigerator temperatures are kept between > 0ºC and ≤ 6 ºC.

Specific temperature settings/ranges for other refrigerators, ovens waterbaths, and incubators can be found in method specific SOPs.

The temperatures are documented in temperature logbooks or in the method-specific logbooks/benchsheets.

20.3.5 Autopipettors, Dilutors, and Syringes

Mechanical volumetric dispensing devices including burettes (except Class A Glassware and Glass microliter syringes) are given unique identification numbers and the delivery volumes are verified gravimetrically, at a minimum, on a quarterly basis.
Any device not regularly verified cannot be used for any quantitative measurements.

Refer to SOP KNOX-QA-0012, Pipetter and Volumetric Labware Calibration Verification.

Micro-syringes are purchased from Hamilton Company. Each syringe is traceable to NIST. The laboratory keeps on file an “Accuracy and Precision Statement of Conformance” from Hamilton attesting established accuracy.

20.4 INSTRUMENT CALIBRATIONS

Calibration of analytical instrumentation is essential to the production of quality data. Strict calibration procedures are followed for each method. These procedures are designed to determine and document the method detection limits, the working range of the analytical instrumentation and any fluctuations that may occur from day to day.

Sufficient raw data records are retained to allow an outside party to reconstruct all facets of the initial calibration. Records contain, but are not limited to, the following: calibration date, method, instrument, laboratory analyst(s) initials or signatures, analysis date, analytes, concentration, response, type of calibration (Avg RF, curve, or other calculations that are used to reduce instrument responses to concentration).

Sample results must be quantitated from the initial calibration and must not be quantitated from any continuing instrument calibration verification unless otherwise required by regulation, method or program.

If the initial calibration results are outside of the acceptance criteria, corrective action is performed and any affected samples are reanalyzed if possible. If the reanalysis is not possible, any data associated with an unacceptable initial calibration is reported with appropriate data qualifiers (refer to Section 13).

Note: Instruments are calibrated initially and as needed after that and at least annually. The annual initial calibration requirement does not apply to isotope dilution methods**.**

20.4.1 CALIBRATION STANDARDS

20.4.1.1 Calibration standards are prepared using the procedures indicated in the Reagents and Standards section of the determinative method SOP. If a reference method does not specify the number of calibration standards, a minimum of 3 calibration points (exception being ICP and ICP/MS methods) shall be used.

20.4.1.2 Standards for instrument calibration are obtained from a variety of sources. All standards are traceable to national or international standards of measurement, or to national or international standard reference materials.

20.4.1.3 The lowest concentration calibration standard that is analyzed during an initial calibration must be at or below the stated reporting limit for the method based on the final volume of extract (or sample).

20.4.1.4 The other concentrations define the working range of the instrument/method or correspond to the expected range of concentrations found in actual samples that are also within the working range of the instrument/method. Results of samples not bracketed by initial instrument calibration standards (within calibration range to at least the same number of significant figures as that used to report the sample data) must be reported as having less certainty, e.g., defined qualifiers or flags (additional information may be included in the case narrative). The exception to these rules is ICP methods which define the working range with periodic linear dynamic range studies, rather than through the range of concentrations of daily calibration standards.

20.4.1.5 All initial calibrations are verified with a standard obtained from a second source and traceable to a national standard, when available (or vendor certified different lot if a second source is not available). For unique situations, such as air analysis where no other source or lot is available, a standard made by a different laboratory analyst is used for verification. This verification occurs immediately after the calibration curve has been analyzed, and before the analysis of any samples.

20.4.2 Continuing Calibration Verification (CCV)

The calibration relationship established during the initial calibration must be verified at least daily as specified in the laboratory method SOPs in accordance with the referenced analytical methods and in the 2009 TNI Standard. The process of calibration verification applies to both external standard and internal standard calibration techniques, as well as to linear and non-linear calibration models.

Note: The process of calibration verification referred to is fundamentally different from the approach called "calibration" in some methods. As described in those methods, the calibration factors or response factors calculated during calibration are used to update the calibration factors or response factors used for sample quantitation. This approach, while employed in other EPA programs, amounts to a daily single-point calibration.

All target analytes and surrogates, including those reported as non-detects, must be included in periodic calibration verifications for purposes of retention time confirmation and to demonstrate that calibration verification criteria are being met.

Note: For Ohio EPA VAP projects the calibration solution used for calibration verification must be from the same source as that used for the calibration curve unless the method states otherwise.

All samples must be bracketed by periodic analyses of standards that meet the QC acceptance criteria (e.g., calibration and retention time). The required frequency is found in the analytical method SOPs.

Note: If an internal standard calibration is being used (basically GCMS and some GC methods) then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

Generally, the initial calibrations must be verified at the beginning of each 12-hour analytical shift during which samples are analyzed. (Some methods may specify more or less frequent verifications). The 12-hour analytical shift begins with the injection of the continuing calibration verification standard (or the MS tuning standard in MS methods). The shift ends after the completion of the analysis of the last sample, QC, or standard that can be injected within 12 hours of the beginning of the shift.

A continuing calibration verification (CCV) must be repeated at the beginning and, for methods that have quantitation by external calibration models, at the end of each analytical batch. Some

methods have more frequent CCV requirements see specific SOPs. Most Inorganic methods require the CCV to be analyzed after ever 10 samples or injections, including matrix or batch QC samples.

Note: If an internal standard calibration is being used (basically GCMS) then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

If the results of a CCV are outside the established acceptance criteria and analysis of a second consecutive (and immediate) CCV fails to produce results within acceptance criteria, corrective action shall be performed. Once corrective actions have been completed & documented, the laboratory shall demonstrate acceptable instrument / method performance by analyzing two consecutive CCVs, or a new initial instrument calibration shall be performed. (Note: For Ohio EPA VAP projects, if the instrument conditions have been changed, the laboratory must analyze a new calibration curve.)

Sample analyses and reporting of data may not occur or continue until the analytical system is calibrated or calibration verified. However, data associated with an unacceptable continuing calibration verification may be fully useable under the following special conditions listed in Section 20.4.2.1, below, and reported based upon discussion and approval of the client.

20.4.2.1 Verification of Linear or Non-Linear Calibrations

Continuing calibration verification for calibrations involves the calculation of the percent drift or the percent difference of the instrument response between the initial calibration and each subsequent analysis of the continuing calibration verification standard. (These calculations are available in the laboratory method SOPs.) Continuing calibration verification standards are evaluated based on the % Difference from the average CF or RF of the initial calibration or based on % Drift or % Recovery if a linear or quadratic curve is used.

Regardless of whether a linear or non-linear calibration model is used, if initial continuing calibration verification criterion is not met, then no sample analyses may take place until the calibration has been verified or a new initial calibration is performed that meets the specifications listed in the method SOPs. If the calibration cannot be verified after the analysis of a single verification standard, then adjust the instrument operating conditions and/or perform instrument maintenance, and analyze another aliquot of the verification standard. If the calibration cannot be verified with the second standard, then a new initial calibration is performed.

- When the acceptance criteria for the continuing calibration verification are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported. Otherwise, the samples affected by the unacceptable continuing calibration verification shall be reanalyzed after a new initial calibration curve has been established, evaluated and accepted.

- When the acceptance criteria for the continuing calibration verification are exceeded low, i.e., low bias, those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise, the samples affected by the unacceptable verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted. Alternatively, a reporting limit standard may be analyzed to demonstrate that the laboratory can still support non-detects at their reporting limit. (Note: This is not permitted for Ohio EPA VAP projects.)

20.5 TENTATIVELY IDENTIFIED COMPOUNDS (TICS) – GC/MS ANALYSIS

For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by the purpose of the analyses being conducted. Data system library search routines must not use normalization routines that would misrepresent the library or unknown spectra when compared to each other.

Note: If the TIC compound is not part of the client target analyte list but is calibrated by the laboratory and is both qualitatively and/or quantitatively identifiable, it should not be reported as a TIC. If the compound is reported on the same form as true TICs, it must be qualified and/or narrated that the reported compound is qualitatively and quantitatively (if verification in control) reported compared to a known standard that is in control (where applicable). TestAmerica Knoxville will provide this service upon client request.

For example, the RCRA permit or waste delisting requirements may require the reporting of non-target analytes. Only after visual comparison of sample spectra with the nearest library searches may the analyst assign a tentative identification. See SOP KNOX-MS-0014, Tentatively Identified Compounds, for guidelines for making tentative identifications.

Note: For Ohio EPA VAP projects the laboratory may not attest under affidavit that TICs are “certified data.”

20.6 GC/MS TUNING

Prior to any GCMS analytical sequence, including calibration, the instrument parameters for the tune and subsequent sample analyses within that sequence must be set.

Prior to tuning/auto-tuning the mass spec, the parameters may be adjusted within the specifications set by the manufacturer or the analytical method. These generally don't need any adjustment but it may be required based on the current instrument performance. If the tune verification does not pass it may be necessary to clean the source or perform additional maintenance. Any maintenance is documented in the maintenance log or run log.

Table 20-1. Laboratory Instrument List

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Knoxville Instrument List

Instrument Type	Manufacturer	Model Number	Serial Number	Name	LIMS ID	Year Put into Service	Condition When Received
ICP-AES	Thermo Jarrell Ash	61E Trace	248490	ST1	ST1	1994	NEW
ICP-AES	Thermo Scientific	6500 Duo	20101714	Duo	Duo	2010	NEW
Mercury Analyzer (CVAAS)	Leeman Labs, Inc.	Hydra AA	6021	HG	HG	2006	NEW
GC/MS Semivolatiles	Hewlett-Packard	5973/6890	US00035127 (GC) US10450996 (MS)	MY	MY	2000	NEW
GC/MS Semivolatiles	Agilent Technologies	5975/6890	CN10816002 (GC) US81839504 (MS)	MP	MP	2008	NEW
GC/MS Semivolatiles	Hewlett-Packard	5973/6890	US00026427 (GC) US82321805 (MS)	MA	MA	1999	NEW
GC/MS Semivolatiles	Agilent Technologies	5973/6890	US10146146 (GC) US10451834 (MS)	MD	MD	2001	NEW
GC/MS Volatiles	Agilent Technologies	5973/6890	US10129076 (GC) US94260093 (MS)	ME	ME	2001	NEW
GC/MS Volatiles	Agilent Technologies	5975C	CN10031137 (GC) US10053001 (MS)	MR	MR	2010	NEW
GC/MS Volatiles	Agilent Technologies	5973/6890	US10506023 (GC) US44621247 (MS)	MG	MG	2005	NEW
GC/MS Volatiles	Agilent Technologies	5973/6890N	US10345111 (GC) US33220174 (MS)	MK	MK	2003	NEW
GC/MS Volatiles	Hewlett-Packard	5973/6890	DE00020254 (GC) US80310976 (MS)	MZ	MZ	1998	NEW
GC/MS Volatiles	Hewlett-Packard	5973/6890	US00021530 (GC) US80210991 (MS)	MX	MX	1998	NEW
GC/MS Volatiles	Hewlett-Packard	5973/6890	US00028390 (GC) US91911868 (MS)	MJ	MJ	2000	NEW
HRGC/HRMS	Finnigan	MAT-95/6890	2631	M1	M1D M1A	1991	NEW
HRGC/HRMS	Finnigan	MAT-95S/6890	2725	M2	M2A	1998	NEW
HRGC/HRMS	Thermo Scientific	DFS	03097	DFS	D11A	2009	NEW
HRGC/HRMS	Thermo Scientific	DFS	03190	DFS	D2A	2012	USED
Ion Chromatograph	Dionex	DX-320	00070167	Lil Mike	320	2000	NEW
Ion Chromatograph	Dionex	DX-600	02070458	Aragon	600	2002	NEW
Ion Chromatograph	Dionex	ICS-1500	03100244	1500	1500	2003	NEW
Calorimeter	Parr	Bomb Calorimeter 1266	A1126DDEA	NA	NA	2003	NEW
Furnace (Ash)	Barnstead Thermolyne Furnace	30400	1262041236063	NA	NA	2003	NEW
GPC	J2 Scientific	GPC Accuprep	05L-1179-4.0	GPC1	NA	2003	NEW
GPC	J2 Scientific	GPC Accuprep	1122-1.0	GPC2	NA	2008	USED
pH Meter	Accumet	Ab15	AB92318635	pH Meter	NA	2004	NEW
Spectrophotometer	Thermo Electron	Spectronic 20D+	3DUK270002	SPEC20	SPEC20	2007	NEW
GC-FID	Varian	3600 FID	0295	DW	DW	1998	NEW
GC-FID	Varian	3300 FID	3890	CO	CO	1987	NEW
GC-TCD	Varian	3400 TCD	3961	GR	GR	1989	NEW
GC-FID	Varian	3400 FID	4644	GTO	GTO	1987	NEW
GC-FID	Hewlett-Packard	5890 Series II	3126A36555	GX	GX	2006	USED
GC-ECD	Hewlett-Packard	6890 ECD	US00021272	GST	GST	1997	NEW
GC-ECD	Agilent Technologies	6890 ECD	US00041050	GH	GH	2001	NEW
GC-ECD	Hewlett-Packard	5890 ECD	3235A46090	GMN	MN	1986	NEW
GC-ECD	Agilent Technologies	6890 ECD	US10346012	CD	CD	2003	NEW

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Table 20-2 – Preventive Maintenance Procedures for Laboratory Equipment

Instrument/ Equipment Type	Activity	Frequency
Gas chromatograph	Check for sufficient supply of carrier and detector gases. Check for correct column flow and/or inlet pressures.	Daily – documented in runlog
	Fill solvent reservoirs	Daily – documented in runlog
	Check temperature program/instrument method.	Daily – documented in runlog
	Air analyses: Check liquid nitrogen and carrier gas levels.	Daily – documented in runlog
	Break off front portion of capillary columns. Replace column if this fails to restore column performance or when column performance (e.g. peak tailing, poor resolution, high backgrounds, etc.) indicates it is required.	As needed - documented in the instrument maintenance log
	Replace injection port liner when front portion of capillary column is removed or when breakdown exceeds limits.	As needed - documented in the instrument maintenance log
	Replace or repair flow controller if constant gas flow cannot be maintained.	As needed - documented in the instrument maintenance log
	Replace fuse.	As needed - documented in the instrument maintenance log
	Reactivate external carrier gas dryers.	As needed - documented in the instrument maintenance log
	Detectors: clean when baseline indicates contamination or when response is low. FID: clean/replace jet, replace igniter. ECD: follow manufacturers suggested maintenance schedule	As needed - documented in the instrument maintenance log
	Check inlets, septa. Replace septum.	As needed - documented in the instrument maintenance log
	Clean injector port.	As needed - documented in the instrument maintenance log
	Clip column leader.	As needed - documented in the instrument maintenance log
	Reactivate flow controller filter dryers when presence of moisture is suspected.	As needed - documented in the instrument maintenance log
	ECD: perform wipe test.	Semiannually – document in the instrument maintenance log
Ion Chromatograph	Check all lines for crimping, leaks and discoloration.	Daily – documented in runlog
	Check pump and gas pressure.	Daily – documented in runlog

Table 20-2 – Preventive Maintenance Procedures for Laboratory Equipment

Instrument/ Equipment Type	Activity	Frequency
	Clean conductivity cell.	As needed - documented in the instrument maintenance log
	Change column and guard column.	As needed - documented in the instrument maintenance log
	Change column and/or guard column bed support	As needed - documented in the instrument maintenance log
	De-gas pump head when flow is erratic.	As needed - documented in the instrument maintenance log
	Check/replace eluant end line filter.	As needed - documented in the instrument maintenance log
GC (Fixed Gases)	Check for correct column flow and/or inlet pressure	Daily – documented with successful calibration
	Check for correct carrier gas (He or Ar)	Daily – documented with successful calibration
	Check temperatures of injector, detector.	Daily – documented with successful calibration
	Verify temperature programs.	Daily – documented with successful calibration
	Check baseline level (offset)	Daily – documented with successful calibration
	Replace column.	As Needed
GC/MS (LRMS)	Check for correct column flow and/or inlet pressure.	Daily – documented with successful tune and calibration
	Check temperatures of injector, detector. Verify temperature programs.	Daily – documented with successful tune and calibration
	Check inlets, septa	Daily – documented with successful tune and calibration
	Check baseline level.	Daily – documented with successful tune and calibration
	Check relative abundance and mass assignments of the tuning compounds	Daily – documented with successful tune and calibration
	Ensure communication is established between the mass spec and the GC system.	Daily – documented with successful tune and calibration
	Check mass calibration (PFTBA or FC-43)	As needed - documented in the instrument maintenance log
	Change injection port liner.	As needed - documented in the instrument run/maintenance log
	Clip column	As needed - documented in the instrument run/maintenance log
	Replace electron multiplier when the tuning voltage approaches the maximum and/or when sensitivity falls below required level	As needed - documented in the instrument maintenance log

Table 20-2 – Preventive Maintenance Procedures for Laboratory Equipment

Instrument/ Equipment Type	Activity	Frequency
	Clean source, including lenses – the source cleaning is indicated by a variety of symptoms including inability of the analyst to tune the instrument to specifications, poor response, and high background contamination	As needed - documented in the instrument maintenance log
	Replace filaments when both filaments burn out or performance indicates need for replacement	As needed - documented in the instrument maintenance log
	Check ion source and analyzer (clean, replace parts as needed)	As needed - documented in the instrument maintenance log
	Clean air filters on GC/MS system.	As needed - documented in the instrument maintenance log
	Replace traps on Entech and Tekmar	As needed - documented in the instrument maintenance log
	Replace side plate o-ring.	As needed - documented in the instrument maintenance log
	Change inlet liners, seals and septa as needed, usually indicated by a loss of response in analytes that are sensitive to active sites or dirty parts	As needed - documented in the instrument run/maintenance log
	Check calibration vial.(PFTBA or FC-43)	As needed - documented in the instrument maintenance log
	Replace the exhaust filters on the mechanical rough pump every 1-2 years	As needed - documented in the instrument maintenance log
	Replace the diffusion pump fluid.	As needed - documented in the instrument maintenance log
	Replace the split vent trap between injection port and EPC	As needed - documented in the instrument maintenance log
	Change oil in the mechanical rough pump	Semi-annually: documented in the instrument maintenance log
ICP	Check that argon manifold gas pressure is 80 psi.	Daily – documented on chart cover page
	Check that nebulizer is not clogged.	Daily – documented on chart cover page
	Check that capillary tubing is clean and in good condition.	Daily – documented on chart cover page
	Check that peristaltic pump windings are secure.	Daily – documented on chart cover page
	Check that high voltage switch is on.	Daily – documented on chart cover page
	Check that exhaust fans are working.	Daily – documented on chart cover page
	Clean plasma torch assembly to remove accumulated deposits.	Daily – documented on chart cover page

Table 20-2 – Preventive Maintenance Procedures for Laboratory Equipment

Instrument/ Equipment Type	Activity	Frequency
	Check spray chamber O-rings	Daily – documented on chart cover page
	Clean nebulizer and drain chamber.	As needed
	Clean filters on back of power unit to remove dust.	As needed
	Replace when needed: peristaltic pump tubing sample capillary tubing autosampler sipper probe.	As needed
	Clean and lubricate autosampler arm.	As needed
	Check that cooling water supply system is full and drain bottle is not full.	As needed
	Clean air filter on water cooling system.	As needed
	Manufacturer service engineer for scheduled preventive maintenance service.	Annually
	Change vacuum pump oil on ST1	Annually
Cold Vapor Atomic Absorption (Leeman Mercury Analyzer)	Check tubing.	Daily
	Check maintenance schedule flags.	Daily
	Adjust/change Hg lamp.	As needed
	Clean or replace optical cell.	As needed
	Lubricate pump and autosampler arm.	As needed
	Change the drying tube.	As needed
GCMS HRGC/HRMS Isotope Dilution	Replace septum	As needed
	Replace injection port liner	As needed
	Perform column maintenance	As needed
	Replace carrier gas filter	As needed
	Check carrier gas pressure (record)	Weekly
	Install column (type and ID No.)	As needed
	Evaluate air spectrum, masses 28,32	Weekly
	Check tray chiller and water level.	Monthly
	Replace inlet seal.	As needed
	Clean injection port body.	As needed
	Replace interface ferrule on xfer line.	As needed
	Clean ion source	As needed
	Install clean ion volume	As needed
	Install new filament	As needed
	Replace reference gas reservoir septum (HRMS)	As needed

Table 20-2 – Preventive Maintenance Procedures for Laboratory Equipment

Instrument/ Equipment Type	Activity	Frequency
	Change mechanical pump oil	Annually
	Check coolant level and temp	As needed
	Check cooling fans	Weekly
	Check PCB seating and alignment	Biannually
	Check power supply voltages	As needed
	Check 5 volt card cage power supply (MAT 95, 95S, and 90S)	Monthly
Gel Permeation Chromatography (GPC)	Check solvent reservoir and waste container	Daily
	Check system for air bubbles	Daily
	Check all lines, valves and fittings for leaks	Daily
	Check column for dry patches, voids or channeling	Daily
	Check column pressure	Daily
	Prime sample pump several times before first injection	Daily
	Always watch first injection of ensure entire sample is loaded and there are no leaks at the injection port	Daily
	Perform flow rate check of the system	Weekly
	Verify tray calibration	Monthly
	Replace the solvent pump inlet check valve and outlet check valve	Yearly
	Replace the solvent pump seal	Yearly
	Replace the injection port seal on direct inject systems	Yearly
	Repack column with new beads when calibration does not meet QC criteria	As needed
	Do a Methanol cleaning run when column becomes extremely colored	As needed
	If separation is noticed in the column bed and plunger, push column bed back together and perform a calibration check to ensure the dump/collect windows have not changes	As needed
	Replace solvent line filters	As needed
	Replace the detector lamp	As needed
	Verify tray snap points each time trays are removed from the auto-sampler base	As needed
	Replace the syringe pump assembly	As needed
Sonicator	Tune sonicator assembly	Daily

Table 20-2 – Preventive Maintenance Procedures for Laboratory Equipment

Instrument/ Equipment Type	Activity	Frequency
	Disassemble and clean sonicator probe tips.	As Needed
	Replace probe tip.	As Needed
Calorimeter	Check O_2 tank level and change tank if low.	Daily – documented with successful calibration
	Verify temperature with external thermometer if method performance criteria cannot be consistently met.	As Needed
	Replace defective or worn parts and stems on bombs.	As Needed
	Polish bomb interior.	As Needed
Gas Chromatograph (ACS group)	Check for correct column flow and/or inlet pressure	Daily
	Check temperatures of injector, detector.	Daily
	Verify temperature programs.	Daily
	Check baseline level (offset)	Daily
	Replace sparger septum in PAT used for Method 0040	Weekly
	Replace the trap on the purge-and trap.	As Needed
	For Method 0040: Replace the carrier gas and purge gas filters.	As Needed
	Clip column ends and reinstall column	As Needed
	Replace column.	As Needed
	Clean sparger for Method 0040.	As Needed
	Re-ignite FID	As Needed
Muffle Furnace (ACS group)	Verify temperatures with platinum resistance thermometer per SOP.	Annually

Table 20-3. Periodic Calibration

Instrument/ Device	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
Analytical Balance	Accuracy determined using NIST traceable weights. Minimum of 2 standards bracketing the weight of interest.	Each day of use	Varies by balance and weight. See Balance SOP.	Clean, check level, recheck. If fails, call QA.
Top Loading Balance	Accuracy determined using NIST traceable weights. Minimum of 2 standards bracketing the weight of interest.	Each day of use	Varies by balance. See Balance SOP.	Clean, check level, recheck. If fails, call QA.
NIST Traceable Working Weights	Accuracy verified against NIST Reference Weights	Annually	See Balance and Weights SOP	Replace
NIST Reference Weights	Accuracy determined by A2LA or NVLAP accredited weights and measurement laboratory.	5 years	As per certificate.	Replace.
NIST-Traceable Reference Thermometer	Accuracy determined by approved calibration laboratory.	5 years for mercury (2 years for digital)	As per certificate.	Replace (or service digital).
Liquid in Glass Working Thermometer	Against NIST-traceable thermometer	When received and annually at appropriate temperature range for intended use	+/-0.5°C	Replace
Digital Working Thermometers	Against NIST-traceable thermometer	Quarterly	+/-0.5°C	Replace
Refrigerator	Temperature checked using NIST-traceable thermometer.	Daily.	> 0ºC and ≤ 6 ºC	Check temperature, reread, issue nonconformance, tag out, and move samples to working unit as described in SOP KNOX-QA-0010 Temperature Monitoring and Thermometer Calibration.

Instrument/ Device	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
Freezer	Temperature checked using NIST-traceable thermometer	Daily.	<-10°C <-20°C for Sediment and Tissue Samples	Check temperature, reread, issue nonconformance, tag out, and move samples to working unit as described in SOP KNOX-QA-0010 Temperature Monitoring and Thermometer Calibration.
Oven	Temperature checked using NIST-traceable thermometer.	When in use.	104 ± 1°C (% moisture) or as defined in analytical SOP	Adjust. Repair or Replace.
Volumetric Dispensing Devices (Eppendorf ® pipette, automatic volumetric or dispensing devices)	One delivery by weight. Using DI water, dispense into tared vessel. Record weight with device ID number. Volumetric dispensing devices used in support of DoD QSM require 10 replicate weighings. See SOP KNOX-QA-0012 for further details.	Quarterly	± 3% (+/-2% D for 10 replicate average)	Adjust. Repair or Replace.
Volumetric Labware (e.g. Class B volumetric glassware)	For non Class A Volumetric labware: 10 replicate weighings prior to first use. See SOP KNOX-QA-0012 for further details.	Before first use.	+/-2% D for 10 replicate average	Replace.
Non-Volumetric Labware (Non-Class A) used for measuring initial sample volume or final extract or digestate volume.	Verified by weight of DI water. Volumetric labware used in support of DoD QSM require 10 replicate weighings. See SOP KNOX-QA-0012 for further details	Once Per New Lot of Volumetric Labware	± 3%	Replace.

SECTION 21

MEASUREMENT TRACEABILITY

21.1 OVERVIEW

Traceability of measurements are assured using a system of documentation, calibration, and analysis of reference standards. Laboratory equipment that are peripheral to analysis and whose calibration is not necessarily documented in a test method analysis or by analysis of a reference standard are subject to ongoing certifications of accuracy. At a minimum, these must include procedures for checking specifications of ancillary equipment: balances, thermometers, temperature, Deionized (DI) and Reverse Osmosis (RO) water systems, automatic pipettes and other volumetric measuring devices. (Refer to Section 20.3) With the exception of Class A Glassware and Glass microliter syringes, quarterly accuracy checks are performed for all mechanical volumetric devices. Wherever possible, subsidiary or peripheral equipment is checked against standard equipment or standards that are traceable to national or international standards. Class A Glassware and Glass microliter syringes are routinely inspected for chips, acid etching or deformity (e.g., bent needle). If the Class A glassware or syringe is suspect, the accuracy of the glassware will be assessed prior to use.

21.2 NIST-TRACEABLE WEIGHTS AND THERMOMETERS

Reference standards of measurement are used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

For NIST-traceable weights and thermometers, the laboratory requires that all calibrations be conducted by a calibration laboratory accredited by A2LA, NVLAP (National Voluntary Laboratory Accreditation Program), APLAC (Asia-Pacific Laboratory Accreditation Cooperation), or EA (European Cooperation for Accreditation). A certificate and scope of accreditation is kept on file at the laboratory.

An external certified service engineer services laboratory balances on an annual basis. This service is documented on each balance with a signed and dated certification sticker. Balance calibrations are checked each day of use. All mercury thermometers are calibrated annually against a traceable reference thermometer. Temperature readings of ovens, refrigerators, and freezers are checked on each day of use.

21.3 REFERENCE STANDARDS / MATERIALS

Reference standards/materials, where commercially available, are traceable to certified reference materials. Commercially prepared reference standards, to the extent available, are purchased from vendors that are accredited to ISO Guide 34 and ISO/IEC Guide 17025. All reference standards from commercial vendors shall be accompanied with a certificate that includes at least the following information:

- Manufacturer
- Analytes or parameters calibrated
- Identification or lot number
- Calibration method

- Concentration with associated uncertainties
- Purity

If a standard cannot be purchased from a vendor that supplies a Certificate of Analysis, the purity of the standard is documented by analysis. The receipt of all reference standards must be documented. Reference standards are labeled with a unique Standard Identification Number and expiration date. All documentation received with the reference standard is retained as a QC record and references the Standard Identification Number.

All reference, primary and working standards/materials, whether commercially purchased or laboratory prepared, must be checked regularly to ensure that the variability of the standard or material from the 'true' value does not exceed method requirements. The accuracy of calibration standards is checked by comparison with a standard from a second source. In cases where a second standard manufacturer is not available, a vendor certified different lot is acceptable for use as a second source. For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst is acceptable for this comparison. The appropriate Quality Control (QC) criteria for specific standards are defined in laboratory SOPs. In most cases, the analysis of an Initial Calibration Verification (ICV) or LCS (where there is no sample preparation) is used as the second source confirmation. These checks are generally performed as an integral part of the analysis method (e.g., calibration checks, laboratory control samples).

All standards and materials must be stored and handled according to method or manufacturer's requirements in order to prevent contamination or deterioration. Refer to the Corporate Environmental Health and Safety Manual or laboratory SOPs. For safety requirements, please refer to method SOPs and the laboratory Environmental Health and Safety Manual.

Standards and reference materials shall not be used after their expiration dates unless their reliability is verified by the laboratory and their use is approved by the Quality Assurance Manager. The laboratory must have documented contingency procedures for re-verifying expired standards.

21.4 DOCUMENTATION AND LABELING OF STANDARDS, REAGENTS, AND REFERENCE MATERIALS

Reagents must be at a minimum the purity required in the test method. The date of reagent receipt and the expiration date are documented. The lots for most of the common solvents and acids are tested for acceptability prior to company wide purchase. Refer to TestAmerica's Corporate SOP No. CA-Q-S-001, Solvent and Acid Lot Testing.

All manufacturer or vendor supplied Certificates of Analysis or Purity must be retained, stored appropriately, and readily available for use and inspection. These records are maintained in the analytical laboratory. Records must be kept of the date of receipt and date of expiration of standards, reagents and reference materials. In addition, records of preparation of laboratory standards, reagents, and reference materials must be retained, stored appropriately, and be readily available for use and inspection. For detailed information on documentation and labeling, please refer to SOP KNOX-QA-0001, Standard/Reagent Labeling and Documentation.

Commercial materials purchased for preparation of calibration solutions, spike solutions, etc.., are usually accompanied with an assay certificate or the purity is noted on the label. If the assay purity is 96% or better, the weight provided by the vendor may be used without correction. If the assay purity is less than 96%, a correction is made to concentrations applied to solutions prepared from the stock commercial material. (For 1613B dioxin/furan analyses the purity must be 98% or corrections must be made.) Blended gas standard cylinders use a nominal concentration if the certified value is within +/-15%, otherwise the certified values is used for the canister concentration.

21.4.1 All standards, reagents, and reference materials must be labeled in an unambiguous manner. Standards are logged into the laboratory's LIMS system, and are assigned a unique identification number. The following information is typically recorded in the electronic database within the LIMS.

- Standard ID
- Description of Standard
- Department
- Preparer's name
- Final volume and number of vials prepared
- Solvent type and lot number
- Preparation Date
- Expiration Date
- Standard source type (stock or daughter)
- Standard type (spike, surrogate, other)
- Parent standard ID (if applicable)
- Parent Standard Analyte Concentration (if applicable)
- Parent Standard Amount used (if applicable)
- Component Analytes
- Final concentration of each analyte
- Comment box (text field)

Note: All solvents and acids are stored at ambient temperature unless otherwise specified in the SOPs.

Records are maintained electronically for standard and reference material preparation. These records show the traceability to purchased stocks or neat compounds. These records also include method of preparation, date of preparation, expiration date and preparer's name or initials. Preparation procedures are provided in the Method SOPs and as described below.

21.4.2 All standards, reagents, and reference materials must be clearly labeled with a minimum of the following information:

- Expiration Date (include prep date for reagents)
- Standard ID
- Special Health/Safety warnings if applicable (Refer to the Health and Safety Manual)

Note: Refer to SOP KNOX-QA-0001 for more details.

All containers of prepared reagents must include an expiration date and an ID number to trace back to preparation.

Procedures for preparation of reagents can be found in the Method SOPs.

Standard ID numbers must be traceable through associated logbooks, worksheets and preparation/analytical batch records.

All reagents and standards must be stored in accordance to the following priority: 1) with the manufacturer's recommendations; 2) with requirements in the specific analytical methods and 3) according to the analytical SOPs.

SECTION 22

SAMPLING

22.1 OVERVIEW

TestAmerica Knoxville does not provide sampling services. The laboratory's responsibility in the sample collection process lies in supplying the sampler with the necessary coolers, reagent water, sample containers, preservatives, sample labels, custody seals, COC forms, ice, and packing materials required to properly preserve, pack, and ship samples to the laboratory. TestAmerica Knoxville also provides pre-cleaned sampling media for sample collection (e.g. source emission testing air sampling media).

22.2 SAMPLING CONTAINERS

The laboratory offers clean sampling containers for use by clients. The laboratory purchases clean containers from ESS and I-Chem (ESS QC class and I-Chem 300 Series containers). Certificates of cleanliness for bottles and preservatives are provided by the supplier and maintained at the laboratory. Alternatively, the certificates may be maintained by the supplier and available to the laboratory on-line.

22.2.1 Preservatives

Upon request, preservatives are provided to the client in pre-cleaned sampling containers. In some cases containers are purchased pre-preserved from the container supplier. Whether prepared by the laboratory or bought pre-preserved, the grades of the preservatives are at a minimum:

- Hydrochloric Acid – Reagent ACS (Certified VOA Free) or equivalent
- Methanol – Purge and Trap grade (for Volatiles with TerraCore)
- Nitric Acid – Instra-Analyzed or equivalent
- Sodium Bisulfate – ACS Grade or equivalent (for Volatiles with TerraCore)
- Sodium Hydroxide – Instra-Analyzed or equivalent
- Sulfuric Acid – Instra-Analyzed or equivalent

22.3 DEFINITION OF HOLDING TIME

The date and time of sampling documented on the COC form establishes the day and time zero. As a general rule, when the maximum allowable holding time is expressed in "days" (e.g., 14 days, 28 days), the holding time is based on calendar day measured. Holding times expressed in "hours" (e.g., 6 hours, 24 hours, etc.) are measured from date and time zero. The first day of holding time ends twenty-four hours after sampling. Holding times for analysis include any necessary reanalysis.

22.3.1 Semi-Volatile - Holding times for sample preparation for semi-volatile organics are measured from the sampling date until the day solvent contacts the sample. Holding times for analysis are measured from the date of initiation of extraction to the date of injection into the gas chromatograph.

22.3.2 Volatiles - Holding times for volatile organics are measured from the date (and time where applicable) of sampling to the date of injection into the gas chromatograph. Holding times for Encore preservation of volatiles samples is measured from the date and time of sampling to the date and time of sample preservation.

22.3.3 Inorganics - For inorganic and metals analysis, the preparation/digestion/distillation must be started within the maximum holding time as measured from the sampling date (and time where applicable). TestAmerica Knoxville measures the holding time for inorganics from sampling date (and time where applicable) to analysis date (and time where applicable).

22.4 SAMPLING CONTAINERS, PRESERVATION REQUIREMENTS, HOLDING TIMES

The preservation and holding time criteria specified in the following tables are derived from the source documents for the methods. If method required holding times (refer to Tables 22-1 to 22-6) -or preservation requirements are not met, the reports are qualified using a flag, footnote or case narrative. As soon as possible or "ASAP" is an EPA designation for tests for which rapid analysis is advised, but for which neither EPA nor the laboratory have a basis for a holding time.

22.5 SAMPLE ALIQUOTS / SUBSAMPLING

Taking a representative sub-sample from a container is necessary to ensure that the analytical results are representative of the sample collected in the field. The size of the sample container, the quantity of sample fitted within the container, and the homogeneity of the sample need consideration when sub-sampling for sample preparation. It is the laboratory's responsibility to take a representative subsample or aliquot of the sample provided for analysis.

Analysts must handle each sample as if it is potentially dangerous. At a minimum, safety glasses, gloves, and lab coats must be worn when preparing aliquots for analysis.

Refer to SOP KNOX-QA-0006, Subsampling, for details on the procedures to obtain representative subsamples for analysis from the samples submitted by the client.

Tables 22-1 to 22-6 detail holding times, preservation and container requirements, and sample volumes for SDWA and NPDES methods. The sample volumes are intended to be a minimal amount to perform the method, the containers that are used may be of larger size. ***Please Note:*** *the holding times are program specific and different programs may have different holding times for equivalent methods (e.g., there are differences in Holding times for many Organic analytes between SDWA and NPDES. RCRA methods may also be different).*

Table 22-1.
Holding Times, Preservation and Container Requirements: Drinking Water (SDWA)

PARAMETER	CONTAINER	PRESERVATION[1,2] Temp.[6]	Chemical	HOLDING TIME[3]	SAMPLE VOLUME
Nitrate	Plastic/Glass	4ºC	None	48 hours[4]	250 mL
Dioxin	Glass[5]	4ºC	$Na_2S_2O_3$	1 year	1 L

Key to Table

1. Sample preservation should be performed immediately upon sample collection. For composite chemical samples, each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.
2. When any sample is to be shipped by common carrier or sent through the United States mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring compliance. For the preservation requirements of Table 6-8, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid, (HCl) in water, solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).
3. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Holding Times are determined from time of collection to time of analysis.
4. If the sample is chlorinated, the holding time for an un-acidified sample kept at 4°C is extended to 14 days.
5. With Teflon lined septum.
6. For samples with a temperature requirement of 4°C, a sample temperature of just above the water freezing temperature to < 6°C is acceptable.

Table 22-2
Holding Times, Preservation and Container Requirements: NPDES - Inorganic

PARAMETER	CONTAINER [1]	PRESERVATION[2,3] Temp[10].	Chemical	HOLDING TIME[4]	SAMPLE VOLUME
Boron	Plastic[5]	None	HNO_3 to pH<2	6 months	200 mL
Bromide	Plastic/Glass	None	None	28 days	100 mL
Chloride	Plastic/Glass	None	None	28 days	50 mL
Fluoride	Plastic	None	None	28 days	300 mL
Hardness	Plastic/Glass	None	HNO_3 to pH<2[7]	6 months	100 mL
Hydrogen Ion (pH)	Plastic/Glass	None	None	15 min.[6]	200 mL
Mercury	Plastic/Glass	None	HNO_3 to pH<2	28 days	200 mL
Metals[8,9]	Plastic/Glass	None	HNO_3 to pH<2[11]	6 months	200 mL
Nitrate	Plastic/Glass	≤ 6ºC	None	48 hours	100 mL
Nitrate-Nitrite	Plastic/Glass	≤ 6ºC	H_2SO_4 to pH <2	28 days	100 mL
Nitrite	Plastic/Glass	≤ 6ºC	None	48 hours	100 mL
Orthophosphate	Plastic/Glass	≤ 6ºC	Filter within 15 min.	48 hours	250 mL
Sulfate	Plastic/Glass	≤ 6ºC	None	28 days	250 mL

Key to Table

1. Plastic should be Polyethylene.
2. Sample preservation should be performed immediately upon sample collection. For composite chemical samples, each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at ≤ 6ºC until compositing and sample splitting is completed.
3. When any sample is to be shipped by common carrier or sent through the United States mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring compliance. For the preservation requirements of Table 6-8, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid, (HCl) in water, solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).
4. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Holding Times are determined from time of collection to time of analysis.
5. May also be collected in quartz or PFTE Plastic.
6. For compliance testing, the analysis must be performed in the field at the time of analysis. If transported to the laboratory for analysis, the analysis will be performed as soon as practical and reported qualified.
7. H_2SO_4 to a pH <2 is also acceptable.
8. Except Mercury and Hexavalent Chromium.
9. For dissolved metals, samples must be filtered on site before adding HNO_3 preservative (or before

Key to Table

shipping to laboratory).

10. Aqueous samples must be preserved at ≤6 °C unless otherwise indicated, and should not be frozen unless data demonstrating that sample freezing does not adversely impact sample integrity is maintained on file and accepted as valid by the regulatory authority. Also, for purposes of NPDES monitoring, the specification of ‘‘≤ °C’’ is used in place of the ‘‘4 °C’’ and ‘‘<4 °C’’ sample temperature requirements listed in some methods.

11 Acid preservation may be omitted for shipping and laboratory will acidify at least 24 hours prior to analysis.

Table 22-3
Holding Times, Preservation and Container Requirements: NPDES - Organic

PARAMETER	CONTAINER	PRESERVATION[1,2] Temp.[7]	PRESERVATION[1,2] Chemical	HOLDING TIME[3]	SAMPLE VOLUME
CDD/CDFs[6] – Aqueous: Field/Lab Preservation	Glass	≤ 6ºC	pH <9, 0.008 % $Na_2S_2O_3$[5]	1 year	1 L
CDD/CDFs[6] – Solids/Mixed Phase/ - Field Preservation	Glass	≤ 6ºC	None	7 days[8]	10 grams/1 L
CDD/CDFs[6] – Tissue – Field Preservation	Glass	≤ 6ºC	None	24 hours[8]	10 grams
CDD/CDFs[6] – Solids/Mixed Phase/Tissue - Lab Preservation	Glass	< -10ºC	None	1 year	10 grams/1 L
Polychlorinated Biphenyls (PCB Congeners): Aqueous: Field/Lab Preservation[9]	Glass	≤ 6ºC	0.008 % $Na_2S_2O_3$[5]	1 year	1 L
Polychlorinated Biphenyls (PCB Congeners): Solid/Mixed Phase– Field Preservation[9]	Glass	≤ 6ºC	None	1 year	10 grams/1 L
Polychlorinated Biphenyls (PCB Congeners): Tissue- Field Preservation[9]	Glass	≤ 6ºC	None	24 hours[8]	10 grams
Polychlorinated Biphenyls (PCB Congeners): Solid/Mixed Phase/Tissue – Lab Preservation[9]	Glass	< -10ºC	None	1 year	10 grams/1 L

Key to Table

1. Sample preservation should be performed immediately upon sample collection. For composite chemical samples, each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at ≤ 6°C until compositing and sample splitting is completed.
2. When any sample is to be shipped by common carrier or sent through the United States mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring compliance. For the preservation requirements of Table 6-8, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid, (HCl) in water, solutions at concentrations of 0.04% by

Key to Table

weight or less (pH about 1.96 or greater); Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

3. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Holding Times are determined from time of collection to time of analysis (See also Footnote 8).
4. With Teflon lined septum.
5. Should only be used in the presence of residual chlorine. Ascorbic may be used instead.
6. When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity. When the analytes of concern fall within two or more categories, the sample may be preserved by cooling to $\leq 6^{o}C$ reducing residual chlorine with 0.0008 % sodium thiosulfate, storing in the dark, and adjusting the pH to 6-9. Samples preserved in this manner may be held for 7 days before extraction and for 40 days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (re the requirement for thiosulfate reduction of residual chlorine) and footnotes 10 and 11(re the analysis of Benzidine).
7. Aqueous samples must be preserved at ≤6 °C unless otherwise indicated, and should not be frozen unless data demonstrating that sample freezing does not adversely impact sample integrity is maintained on file and accepted as valid by the regulatory authority. Also, for purposes of NPDES monitoring, the specification of ''≤ °C'' is used in place of the ''4 °C'' and ''<4 °C'' sample temperature requirements listed in some methods.

8 Holding time from sampling field preservation at <6ºC to time of preservation at <-10ºC.

9 Polychlorinated biphenyls (PCB congeners) are in the proposed 40CFR Part 136 Rule September 23, 2010.

Table 22-4.
Holding Times, Preservation and Container Requirements: RCRA - Aqueous

PARAMETER	CONTAINER [1]	PRESERVATION[2,3] Temp.[9]	Chemical	HOLDING TIME[4]	SAMPLE VOLUME
Chloride	Plastic/Glass	4ºC	None	28 days	100 mL
Hydrogen Ion (pH)	Plastic/Glass	4ºC	None	24 hours[8]	100 mL
Nitrate	Plastic/Glass	4ºC	None	48 hours	28 days
Sulfate	Plastic/Glass	4ºC	None	28 days	400 mL
Mercury	Plastic/Glass	None	HNO_3 to pH<2	28 days	250 mL
Other Metals	Plastic/Glass	None	HNO_3 to pH<2	6 months	250 mL
Acrolein and Acrylonitrile	Glass[7]	4ºC	0.0008 % Na2S2O3[5] Adjust pH to 4-5[10]	14 days	1 L
Benzidines	Glass[7]	4ºC	0.0008 % $Na_2S_2O_3$[5]	7 days[6]	1 L
Chlorinated Hydrocarbons	Glass[7]	4ºC	0.0008 % $Na_2S_2O_3$[5]	7 days[6]	1 L
Dioxins and Furans	Glass[7]	4ºC	0.0008 % $Na_2S_2O_3$[5]	30 days[6]	1 L
Haloethers	Glass[7]	4ºC	0.0008 % $Na_2S_2O_3$[5]	7 days[6]	1 L
Nitroaromatics and cyclic ketones	Glass[7]	4ºC	0.0008 % $Na_2S_2O_3$[5], store in dark	7 days[6]	1 L
Nitrosamines	Glass[7]	4ºC	0.0008 % $Na_2S_2O_3$[5], store in dark	7 days[6]	1 L
PCBs	Glass[7]	4ºC	None	1 year[6]	1 L
Phenols	Glass[7]	4ºC	0.0008 % $Na_2S_2O_3$[5]	7 days[6]	1 L
Phthalate Esters	Glass[7]	4ºC	None	7 days[6]	1 L
Polynuclear Aromatic Hydrocarbons	Glass[7]	4ºC	0.0008 % $Na_2S_2O_3$[5], store in dark	7 days[6]	1 L
Purgeable Hydrocarbons	Glass[7]	4ºC	0.0008 % $Na_2S_2O_3$[5] Adjust pH <2[2]	14 days	40 mL
Purgeable Halocarbons	Glass[7]	4ºC	0.0008 % $Na_2S_2O_3$[5]	14 days	40 mL

Key to Table

1. Plastic should be Polyethylene.
2. Sample preservation should be performed immediately upon sample collection. For composite chemical samples, each aliquot should be preserved at the time of collection. When use of an automated sampler

Key to Table

makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.

3. When any sample is to be shipped by common carrier or sent through the United States mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring compliance. For the preservation requirements of Table 6-8, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid, (HCl) in water, solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).
4. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Holding Times are determined from time of collection to time of preparation (or to time of analysis if there is no separate preparation step).
5. Free Chlorine must be removed by the appropriate addition of $Na_2S_2O_3$.
6. 7 days to extraction. 40 days from extraction to analysis. For Dioxins/Furans: 30 days to extraction 45 days from extraction to analysis. For PCBs, no holding time is specified in SW-846 Chapter 4.
7. With Teflon lined septum.
8. Holding Time is listed as “As Soon as Possible” in SW 846. Per EPA MICE, the recommended maximum holding time for pH in water is 24 hours and pH in soil is 7 days. There are no mandated regulatory requirements.
9. For samples with a temperature requirement of 4°C, a sample temperature of just above the water freezing temperature to $\leq$ 6°C is acceptable.
10 Based on guidance from EPA MICE, if samples are received without pH adjustment, the holding time is 7 days.

Table 22-5.
Holding Times, Preservation and Container Requirements: RCRA – Non-Aqueous

PARAMETER	CONTAINER [1]	PRESERVATION Temp.[7]	PRESERVATION Chemical	HOLDING TIME[2]	SAMPLE WEIGHT
Chloride	Glass	4ºC	None	28 days	50 g
Hydrogen Ion (pH)	Glass	4ºC	None	7 days[6]	50 g
Nitrate	Glass	4ºC	None	N/A	50 g
Mercury	Plastic/Glass	4ºC	None	28 days	50 g
Other Metals	Plastic/Glass	None	None	6 months	50 g
Acrolein and Acrylonitrile	Glass[4]	4ºC	None	14 days	50 g
Benzidines	Glass[4]	4ºC	None	14 days[3]	50 g
Chlorinated Hydrocarbons	Glass[4]	4ºC	None	14 days[3]	50 g
Dioxins and Furans	Glass[4]	4ºC	None	30 days[3]	50 g
Haloethers	Glass[4]	4ºC	None	14 days[3]	50 g
Nitroaromatics and cyclic ketones	Glass[4]	4ºC	None	14 days[3]	50 g
Nitrosamines	Glass[4]	4ºC	None	14 days[3]	50 g
PCBs	Glass[4]	4ºC	None	1 year[3]	50 g
Phenols	Glass[4]	4ºC	None	14 days[3]	50 g
Phthalate Esters	Glass[4]	4ºC	None	14 days[3]	50 g
Polynuclear Aromatic Hydrocarbons	Glass[4]	4ºC	None	14 days[3]	50 g
Purgeable Hydrocarbons	Glass[4]	4ºC	None	14 days[5]	50 g
Purgeable Halocarbons	Glass[4]	4ºC	None	14 days[5]	50 g

Key to Table

1. Plastic should be Polyethylene.
2. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid.
3. 14 days to extraction. 40 days from extraction to analysis. For Dioxins/Furans (Method 8290) in Matrices other than tissue: 30 days to extraction 45 days from extraction to analysis. For Dioxins/Furans (Method 8290) in Tissue: 30 days to extraction 45 days from collection to analysis. Holding Times are determined from time of collection to time of preparation (or to time of analysis if there is no separate preparation

step). For PCBs, no holding time is specified in SW-846 Chapter 4.

4. With Teflon Lined Septum
5. See Volatile SOP for more detailed preservation requirements.
6. Holding Time is listed as “As Soon as Possible” in SW 846. Per EPA MICE, the recommended maximum holding time for pH in water is 24 hours and pH in soil is 7 days. There are no mandated regulatory requirements.
7. For samples with a temperature requirement of $4^{o}C$, a sample temperature of just above the water freezing temperature to $\leq 6^{o}C$ is acceptable.

Table 22-6.
Holding Times, Preservation and Container Requirements: Air Samples[1]

PARAMETER	CONTAINER	PRESERVATION Temp.	PRESERVATION Chemical	HOLDING TIME[2]	SAMPLE WEIGHT
Volatile Organics (TO-15, TO-14A)	Summa Canister	None	None	30 days	6L or 1L
Volatile Organics (TO-15, TO-14A)	Tedlar Bag	None	None	72 hrs[3,4]	1 L
Polynuclear Aromatic Hydrocarbons (TO-13A)	PUF/XAD	4ºC[5]	None	7 days[6]	N/A
Organochlorine Pesticides/PCBs (TO-4A)	PUF/XAD	4ºC[5]	None	7 days[6]	N/A
Dioxins/Furans (TO-9A)	PUF/XAD	4ºC[5]	None	7 days[6]	N/A

Key to Table

1. For details on Source Air Emission Holding Times, Containers, and Preservation please contact the laboratory for method specific information.
2. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Holding Times are determined from time of collection to time of preparation (or to time of analysis if there is no separate preparation step).
3. Holding Time is based on SW 846 Method 0040 "SAMPLING OF PRINCIPAL ORGANIC HAZARDOUS CONSTITUENTS FROM COMBUSTION SOURCES USING TEDLAR® BAGS". Some states specifically enforce this holding time (e.g. Florida, New Jersey) and others have not specified this information in their regulatory requirements.
4. The holding time is 72 hours unless the laboratory has a documented validation study that indicates a longer HT is acceptable for the analytes of interest. Alternatively, the sample may be transferred into a Summa Canister within 72 hours.

5 For samples with a temperature requirement of 4°C, a sample temperature of just above the water freezing temperature to $\leq$ 6°C is acceptable.

6 7 days from collection to extraction, 40 days from extraction to analysis.

SECTION 23

HANDLING OF SAMPLES

Sample management procedures at the laboratory ensure that sample integrity and custody are maintained and documented from sampling/receipt through disposal.

23.1 CHAIN OF CUSTODY (COC)

The COC form is the written documented history of any sample and is initiated at the time of sampling. This form is completed by the sampling personnel and accompanies the samples to the laboratory where it is received and stored under the laboratory's custody. The purpose of the COC form is to provide a legal written record of the handling of samples from the time of collection until they are received at the laboratory. It also serves as the primary written request for analyses from the client to the laboratory. The COC form acts as a purchase order for analytical services when no other contractual agreement is in effect. An example of a COC form is found in Figure 23-1.

23.1.1 Field Documentation

The information the sampler needs to provide at the time of sampling on the container label is:

- Sample identification
- Date and time
- Preservative

During the sampling process, the COC form is completed and must be legible (see Figure 23-1). This form includes information such as:

- Client name, address, phone number and fax number (if available)
- Project name and/or number
- The sample identification
- Date, time and location of sampling
- Sample collectors name
- The matrix description
- The container description
- The total number of each type of container
- Preservatives used
- Analysis requested
- Requested turnaround time (TAT)
- Any special instructions
- Purchase Order number or billing information (e.g. quote number) if available
- The date and time that each person received or relinquished the sample(s), including their signed name.

When the sampling personnel deliver the samples directly to TestAmerica personnel, the samples are stored in a cooler with ice, as applicable, and remain solely in the possession of the client's field technician until the samples are delivered to the laboratory. The sample collector must assure that each container is in his/her physical possession or in his/her view at all times, or stored in such a place and manner to preclude tampering. The field technician relinquishes the samples in writing on the COC form to the sample receiving personnel at the laboratory or to a TestAmerica courier. When sampling personnel deliver the samples through a common carrier (Fed-Ex, UPS), the COC relinquished date/time is completed by the field personnel and samples are released to the carrier. Samples are only considered to be received by lab when personnel at the fixed laboratory facility have physical contact with the samples.

Note: Independent couriers are not required to sign the COC form.

23.1.2 Legal / Evidentiary Chain-of-Custody

TestAmerica Knoxville provides internal sample chain-of-custody tracking. However, it does not provide chain-of-custody evidence for samples identified for legal/evidentiary purposes as defined by the 2003 NELAC Standard Section 5.4.12.

23.2 SAMPLE RECEIPT

Per State and/or Federal Regulation, the client is responsible to ensure that samples are shipped in accordance with DOT/IATA requirements, and that radioactive materials may only be delivered to licensed facilities. Any samples containing (or suspected to contain) Source, Byproduct, or Special Nuclear Material as defined by 10 CFR should be delivered directly to facilities licensed to handle such radioactive material. Natural material or ores containing naturally occurring radionuclides may be delivered to any TestAmerica facility or courier as long as the activity concentration of the material does not exceed 270 pCi/g alpha or 2700 pCi/g beta (49 CFR Part 173).

Samples are received at the laboratory by designated sample receiving personnel and a unique laboratory project identification number is assigned. Each sample container is assigned a unique sample identification number that is cross-referenced to the client identification number such that traceability of test samples is unambiguous and documented. Each sample container is affixed with a durable sample identification label. Sample acceptance, receipt, tracking and storage procedures are summarized in the following sections.

23.2.1 Laboratory Receipt

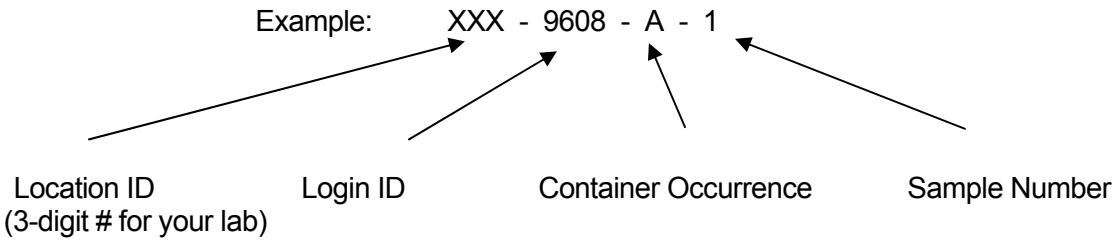
When samples arrive at the laboratory, sample receiving personnel inspect the coolers and samples. The integrity of each sample must be determined by comparing sample labels or tags with the COC and by visual checks of the container for possible damage. Any non-conformance, irregularity, or compromised sample receipt must be documented on a Condition Upon Receipt Variance Form (See Example form in Figure 23-3). Details on the receipt of samples are found in SOP KNOX-SC-0003, Sample Receipt and Log-in.

Note: North Carolina requires that they be notified when samples are processed that do not meet sample acceptance criteria.

23.2.1.1 Unique Sample Identification

All samples that are processed through the laboratory receive a unique sample identification to ensure that there can be no confusion regarding the identity of such samples at anytime. This system includes identification for all samples, subsamples and subsequent extracts and/or digestates.

The laboratory assigns a unique identification (e.g., Sample ID\) code to each sample container received at the laboratory. This Primary ID is made up of the following information (consisting of 4 components):



The above example states that TestAmerica <location> Laboratory (Location XXX). Login ID is 9608 (unique to a particular client/job occurrence). The container code indicates it is the first container ("A") of Sample #1.

If the primary container goes through a prep step that creates a "new" container, then the new container is considered secondary and gets another ID. An example of this being a client sample in a 1-Liter amber bottle is sent through a Liquid/Liquid Extraction and an extraction vial is created from this step. The vial would be a SECONDARY container. The secondary ID has 5 components.

Example: XXX - 9608 - A - 1 - **A** ← **Secondary Container Occurrence**

Example: 140-9608-A-1-A, would indicate the PRIMARY container listed above that went through a step that created the 1st occurrence of a Secondary container.

With this system, a client sample can literally be tracked throughout the laboratory in every step from receipt to disposal

23.3 SAMPLE ACCEPTANCE POLICY

The laboratory has a written sample acceptance policy (Figure 23-2) that clearly outlines the circumstances under which samples are accepted or rejected. These include:

1 a COC filled out completely;
2 samples must be properly labeled;
3 proper sample containers with adequate volume for the analysis and necessary QC;
4 samples must be preserved according to the requirements of the requested analytical method;

5 sample holding times must be adhered to;

6 the client is notified if any sample is received in damaged condition.

Data from samples which do not meet these criteria are flagged and the nature of the variation from policy is defined.

23.4 SAMPLE STORAGE

In order to avoid deterioration, contamination or damage to a sample during storage and handling, from the time of receipt until all analyses are complete, samples are stored in refrigerators, freezers or protected locations suitable for the sample matrix. Samples for methods that do not require refrigeration (e.g., aqueous samples for ICP metals analysis) are stored on shelves at ambient temperature. In addition, samples to be analyzed for volatile organic parameters are stored in separate refrigerators designated for volatile organic parameters only. Samples are never to be stored with reagents, standards or materials that may create contamination.

To ensure the integrity of the samples during storage, refrigerator blanks are maintained in the volatile sample refrigerators and analyzed every two weeks.

Laboratory Analysts retrieve the sample container(s) allocated to their analysis from the designated storage location, analyze the sample, and return the remaining sample to the storage location from which it originally came. Residual samples are maintained in the designated storage location until disposal at least thirty days after the report is issued. (Exception: TO-14A or TO-15 canister samples are subject to disposal two days after the report is issued.) Special arrangements are made to store samples for longer periods of time.

Access to the laboratory is controlled such that sample storage need not be locked at all times unless a project specifically demands it. Samples are accessible to laboratory personnel only. Visitors to the laboratory are prohibited from entering the refrigerator and laboratory areas unless accompanied by an employee of TestAmerica.

23.5 HAZARDOUS SAMPLES AND FOREIGN SOILS

All samples are assumed to be hazardous. All samples are either returned to the client or disposed of appropriately through a hazardous waste disposal firm. All soil samples are sent out for incineration by a USDA-approved waste disposal facility.

23.6 SAMPLE SHIPPING

In the event that the laboratory needs to ship samples, the samples are placed in a cooler with enough ice to ensure the samples remain just above freezing and at or below 6.0°C during transit. The samples are carefully surrounded by packing material to avoid breakage (yet maintain appropriate temperature). A trip blank is enclosed for those samples requiring water/solid volatile organic analyses. The chain-of-custody form is signed by the sample control technician and attached to the shipping paperwork. Samples are generally shipped overnight express or hand-delivered by a TestAmerica courier to maintain sample integrity. All personnel involved with shipping and receiving samples must be trained to maintain the proper chain-of-

custody documentation and to keep the samples intact and on ice. The Environmental, Health and Safety Manual contains additional shipping requirements.

Note: If a client does not request trip blank analysis on the COC or other paperwork, the laboratory will not analyze the trip blanks that were supplied. However, in the interest of good client service, the laboratory will advise the client at the time of sample receipt that it was noted that they did not request analysis of the trip blank; and that the laboratory is providing the notification to verify that they are not inadvertently omitting a key part of regulatory compliance testing.

23.7 SAMPLE DISPOSAL

Samples should be retained for a minimum of 30 days after the project report is sent, however, provisions may be made for earlier disposal of samples once the holding time is exceeded. Some samples are required to be held for longer periods based on regulatory or client requirements (e.g., 60 days after project report is sent). The laboratory must follow the longer sample retention requirements where required by regulation or client agreement. Several possibilities for sample disposal exist: the sample may be consumed completely during analysis, the sample may be returned to the customer or location of sampling for disposal, or the sample may be disposed of in accordance with the laboratory's waste disposal procedures (SOP: KNOX-SC-0005, Sample Disposal Return and Archive). All procedures in the laboratory Environmental, Health and Safety Manual are followed during disposal. Samples are normally maintained in the laboratory no longer than two months from receipt unless otherwise requested. Unused portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work. Waste disposal complies with all federal and state laws and regulations.

Figure 23-1. Example: Chain of Custody (COC)

TestAmerica Knoxville
5815 Middlebrook Pike
Knoxville, TN 37921
phone 865-291-3000

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager:**	**Site Contact:**	**Date:**	COC No:
Company Name	**Tel/Fax:**	**Lab Contact:**	**Carrier:**	_____ of _____ COCs
Address	**Analysis Turnaround Time**			Job No.
City/State/Zip	Calendar (C) or Work Days (W) _____			
Phone	TAT if different from Below _____			
Project Name:	☐ 2 weeks			SDG No.
Site:	☐ 1 week			
P O #	☐ 2 days			
Sampler Name:	☐ 1 day			

Sample Identification	**Sample Date**	**Sample Time**	**Sample Type**	**Matrix**	**# of Cont.**	**Filtered Sample**	Sample Specific Notes:

Preservation Used: 1= Ice, 2= HCl; 3= H_2SO_4; 4=HNO_3; 5=NaOH; 6= Other _____

Possible Hazard Identification

☐ *Non-Hazard* ☐ *Flammable* ☐ *Skin Irritant* ☐ *Poison B* ☐ *Unknown*

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ *Return To Client* ☐ *Disposal By Lab* ☐ *Archive For _____ Months*

Special Instructions/QC Requirements & Comments:

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:

Figure 23-2. Example: Sample Acceptance Policy

NELAC specifies requirements under which any NELAC accredited laboratory will accept or reject samples. TestAmerica Knoxville will review your sample shipment against those requirements listed below, and will communicate any discrepancies to you. Your project manager will assist you in the appropriate resolution of any issues related to sample receipt. Please contact your project manager with any questions.

When completing the chain of custody form, please do not forget to sign your name in the "relinquished by" box.

NELAC requirements are as follows:

- Proper, full and complete documentation, which includes sample identification, the location, date and time of collection, the collector's name, the preservation type, the sample matrix type, the requested testing method, and any special remarks concerning the samples shall be provided. (Chain of Custody filled out properly)

- Each sample shall be labeled with unique, durable and indelible identification, (See note below regarding SUMMA canisters and VOST tubes).

- The samples shall be collected in the appropriate sample containers.

- The samples shall arrive at the laboratory within the specified holding time for the analyses requested.

- Sufficient sample volume must be available to perform the requested analyses and associated quality control.

- All samples submitted for water/solid Volatile Organic analyses must have a Trip Blank submitted at the same time

- The laboratory will notify the client upon sample receipt if the samples exhibit obvious signs of damage, contamination or inadequate preservation. Also, if there is a breach in the chain-of-custody associated with the sample(s), the client will be notified to determine the disposition of the samples.

- Samples shall be rejected if they are received in broken containers or if they exceed the laboratory radiological license limits. The client will be notified to determine the disposition of the samples.

NOTE: Never affix a label directly on a SUMMA canister. A special tag is attached to each canister for this purpose. Never place a label on a VOST tube; use the external container for labeling.

NOTE: Canisters and flow controllers must be returned even if they were not used. Sampling equipment that is lost or not returned will be invoiced to the client at the replacement costs.

Figure 23-3. Example: Condition Upon Receipt Form

Return to Forms Navigator

TESTAMERICA KNOXVILLE SAMPLE RECEIPT/CONDITION UPON RECEIPT ANOMALY CHECKLIST **Log In Number:**

Review Items	Yes	No	NA	If No, what was the problem?	Comments/Actions Taken
1. Are the shipping containers intact?				☐ **Containers, Broken**	
2. Were ambient air containers received intact?				☐ Checked in lab	
3. The coolers/containers custody seal if present, is it intact?				☐ Yes ☐ NA	
4. Is the cooler temperature within limits? (> freezing temp. of water to 6 °C, VOST: 10°C) Thermometer ID :_____ Correction factor: _____				☐ **Cooler Out of Temp, Client Contacted, Proceed/Cancel** ☐ **Cooler Out of Temp, Same Day Receipt**	
5. Were all of the sample containers received intact?				☐ **Containers, Broken**	
6. Were samples received in appropriate containers?				☐ **Containers, Improper; Client Contacted; Proceed/Cancel**	
7. Do sample container labels match COC? (IDs, Dates, Times)				☐ **COC & Samples Do Not Match** ☐ **COC Incorrect/Incomplete** ☐ **COC Not Received**	
8. Were all of the samples listed on the COC received?				☐ **Sample Received, Not on COC** ☐ **Sample on COC, Not Received**	
9. Is the date/time of sample collection noted?				☐ **COC; No Date/Time; Client Contacted**	
10. Was the sampler identified on the COC?				☐ **Sampler Not Listed on COC**	**Labeling Verified by:** **Date:**
11. Is the client and project name/# identified?				☐ **COC Incorrect/Incomplete**	
12. Are tests/parameters listed for each sample?				☐ **COC No tests on COC**	**pH test strip lot number:**
13. Is the matrix of the samples noted?				☐ **COC Incorrect/Incomplete**	
14. Was COC relinquished? (Signed/Dated/Timed)				☐ **COC Incorrect/Incomplete**	
15. Were samples received within holding time?				☐ **Holding Time - Receipt**	
16. Were samples received with correct chemical preservative (excluding Encore)?				☐ **pH Adjusted, pH Included (See box 16A)** ☐ **Incorrect Preservative**	
17. Were VOA samples received without headspace?				☐ **Headspace (VOA only)**	
18. Did you check for residual chlorine, if necessary? (e.g. 1613B, 1668) Chlorine test strip lot number:_____				☐ **Residual Chlorine**	
19. For 1613B water samples is pH<9?				☐ If no, lab will adjust	
20. For rad samples was sample activity info. Provided?				☐ Project missing info	

Box 16A: pH Preservation	Box 18A: Residual Chlorine
Preservative:	
Lot Number:	
Exp Date:	
Analyst:	
Date:	
Time:	

Project #: _____ PM Instructions: _____

Sample Receiving Associate: _____ Date: _____ QA026R30.doc, 080916

Section 24

ASSURING THE QUALITY OF TEST RESULTS

24.1 OVERVIEW

In order to assure our clients of the validity of their data, the laboratory continuously evaluates the quality of the analytical process. The analytical process is controlled not only by instrument calibration as discussed in Section 20, but also by routine process quality control measurements (e.g. Method Blanks, Laboratory Control Samples (LCS), Matrix Spikes (MS), duplicates (DUP), surrogates, Internal Standards (IS)). These quality control checks are performed as required by the method or regulations to assess precision and accuracy. In addition to the routine process quality control samples, Proficiency Testing (PT) Samples (concentrations unknown to laboratory) are analyzed to help ensure laboratory performance.

24.2 CONTROLS

Sample preparation or pre-treatment is commonly required before analysis. Typical preparation steps include homogenization, solvent extraction, sonication, acid digestion, distillation, evaporation, drying and ashing. During these pre-treatment steps, samples are arranged into discrete manageable groups referred to as preparation (prep) batches. Prep batches provide a means to control variability in sample treatment. Control samples are added to each prep batch to monitor method performance and are processed through the entire analytical procedure with investigative/field samples. Refer to the analytical SOPs for further information regarding the type, frequency and acceptance criteria for the control samples.

24.3 NEGATIVE CONTROLS

Table 24-1. Example – Negative Controls

Control Type	Details
Method Blank (MB)	Are used to assess preparation and analysis for possible contamination during the preparation and processing steps.
	The specific frequency of use for method blanks during the analytical sequence is defined in the specific standard operating procedure for each analysis. Generally it is 1 for each batch of samples; not to exceed 20 environmental samples.
	The method blank is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (e.g., Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The method blank goes through all of the steps of the process (including as necessary: filtration, clean-ups, etc.).
	Reanalyze or qualify associated sample results when the concentration of a targeted analyte in the method blank is at or above the reporting limit as established by the method or by regulation, AND is greater than 1/10 of the amount measured in the sample. (Ohio VAP method blanks must be <RL)
Calibration Blanks	Are prepared and analyzed along with calibration standards where applicable or injected at specified frequencies throughout an analytical sequence.. They are prepared using the same reagents that are used to prepare the standards. In some analyses the calibration blank is included in the calibration curve. These blanks are termed Initial Calibration Blanks (ICB) or Continuing Calibration Blanks (CCB)

Table 24-1. Example – Negative Controls

Control Type	Details
Instrument Blanks	Are reagents or reagent water that are processed during an analytical sequence in order to assess contamination in the analytical system. In general, instrument blanks are used to differentiate between contamination caused by the analytical system and that caused by the sample handling or sample prep process. Instrument blanks may also be inserted throughout the analytical sequence to minimize the effect of carryover from samples with high analyte content.
Trip Blanks [1]	Are required to be submitted by the client with each shipment of samples requiring aqueous and solid volatiles analyses (or as specified in the client's project plan). Additionally, trip blanks are prepared and analyzed for volatile analysis of air samples, when required by the client. A trip blank is purchased (certified clean) or is prepared by the laboratory by filling a clean container with pure deionized water that has been purged to remove any volatile compounds. Appropriate preservatives are also added to the container. The trip blank is sent with the bottle order and is intended to reflect the environment that the containers are subjected to throughout shipping and handling and help identify possible sources if contamination is found. The field sampler returns the trip blank in the cooler with the field samples.
Field Blanks [1]	Are sometimes used for specific projects by the field samplers. A field blank prepared in the field by filling a clean container with pure reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken. (EPA OSWER)
Equipment Blanks [1]	Are also sometimes created in the field for specific projects. An equipment blank is a sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (TNI)
Holding Blanks	Also referred to as refrigerator or freezer blanks, are used to monitor the sample storage units for volatile organic compounds during the storage of VOA samples in the laboratory

[1] When known, these field QC samples are not selected for matrix QC as it does not provide information on the behavior of the target compounds in the field samples. Usually, the client sample ID will provide information to identify the field blanks with labels such as "FB", "EB", or "TB."

Evaluation criteria and corrective action for these controls are defined in the specific standard operating procedure for each analysis.

24.4 POSITIVE CONTROLS

Control samples (e.g., QC indicators) are analyzed with each batch of samples to evaluate data based upon (1) Method Performance (Laboratory Control Sample (LCS) or Blank Spike (BS)), which entails both the preparation and measurement steps; and (2) Matrix Effects (Matrix Spike (MS) (Matrix spikes are not applicable to air) or Sample Duplicate (MD, DUP), which evaluates field sampling accuracy, precision, representativeness, interferences, and the effect of the matrix on the method performed. Each regulatory program and each method within those programs specify the control samples that are prepared and/or analyzed with a specific batch.

Note that frequency of control samples vary with specific regulatory, methodology and project specific criteria. Complete details on method control samples are listed in each analytical SOP.

24.4.1 Method Performance Control - Laboratory Control Sample (LCS)

24.4.1.1 The LCS measures the accuracy of the method in a matrix and assesses method performance independent of potential field sample matrix affects in a laboratory batch.

24.4.1.2 The LCS is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (for example: Reagent water, Ottawa sand, glass

beads, etc.) and is processed along with and under the same conditions as the associated samples. The LCS is spiked with verified known amounts of analytes or is made of a material containing known and verified amounts of analytes, and taken through all preparation and analysis steps along with the field samples. Where there is no preparation for an analysis (such as in aqueous volatiles), or when all samples and standards undergo the same preparation and analysis process (such as Phosphorus), a continuing calibration verification standard is reported as the LCS. In some instances (e.g., ICP metals in soil), aqueous LCS's are processed for solid matrices; final results are calculated as mg/kg or ug/kg, assuming 100% solids.

24.4.1.3 The specific frequency of use for LCS during the analytical sequence is defined in the specific standard operating procedure for each analysis. It is generally 1 for each batch of samples; not to exceed 20 environmental samples.

24.4.1.4 If the mandated or requested test method, or project requirements, do not specify the spiking components, the laboratory spikes all reportable components to be reported in the Laboratory Control Sample (and Matrix Spike) where applicable (e.g., no spike of pH). However, in cases where the components interfere with accurate assessment (such as simultaneously spiking chlordane, toxaphene and PCBs in Method 608), the test method has an extremely long list of components or components are incompatible, at a minimum, a representative number of the listed components (see below) are used to control the test method. The selected components of each spiking mix represent all chemistries, elution patterns and masses, permit specified analytes and other client requested components. However, the laboratory ensures that all reported components are used in the spike mixture within a two-year time period. Note: this section is not applicable to Ohio EPA VAP projects.

24.4.1.4.1 For methods that have 1-10 target analytes, spike all components.

24.4.1.4.2 For methods that include 11-20 target analytes, spike at least 10 or 80%, whichever is greater.

24.4.1.4.3 For methods with more than 20 target analytes, spike at least 16 components.

24.4.1.4.4 Exception: Due to analyte incompatibility in pesticides, Toxaphene and Chlordane are only spiked at client request based on specific project needs.

24.4.1.4.5 Exception: Due to analyte incompatibility between the various PCB Aroclors, Aroclors 1016 and 1260 are used for spiking as they cover the range of all of the Aroclors. Specific Aroclors may be used by request on a project specific basis.

24.5 SAMPLE MATRIX CONTROLS

Table 24-3. Sample Matrix Control

Control Type	Details	
Matrix Spikes (MS)	Use	Used to assess the effect sample matrix of the spiked sample has on the precision and accuracy of the results generated by the method used;
	Typical Frequency [1]	At a minimum, with each matrix-specific batch of samples processed, an MS is carried through the complete analytical procedure. Unless specified by the client, samples used for spiking are randomly selected and rotated between different client projects. If the mandated or requested test method does not specify the spiking components, the laboratory spikes all reportable components to be reported in the Laboratory Control Sample and Matrix Spike. Refer to the method SOP for complete details
	Description	essentially a sample fortified with a known amount of the test analyte(s).
Surrogate	Use	Measures method performance to sample matrix (organics only).
	Typical Frequency [1]	Are added to all samples, standards, and method blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. The recovery of the surrogates is compared to the acceptance limits for the specific method. Poor surrogate recovery may indicate a problem with sample composition and is reported, with data qualifiers, to the client whose sample produced poor recovery.
	Description	Are similar to matrix spikes except the analytes are compounds with properties that mimic the analyte of interest and are unlikely to be found in environment samples.
Duplicates[2]	Use	For a measure of analytical precision, with each matrix-specific batch of samples processed, a matrix duplicate (MD or DUP) sample, matrix spike duplicate (MSD), or LCS duplicate (LCSD) is carried through the complete analytical procedure.
	Typical Frequency [1]	Duplicate samples are usually analyzed with methods that do not require matrix spike analysis.
	Description	Performed by analyzing two aliquots of the same field sample independently or an additional LCS.
Internal Standards	Use	Are spiked into all environmental and quality control samples (including the initial calibration standards) to monitor the qualitative aspect of organic and some inorganic analytical measurements.
	Typical Frequency [1]	All organic and ICP methods as required by the analytical method.
	Description	Used to correct for matrix effects and to help troubleshoot variability in analytical response and are assessed after data acquisition. Possible sources of poor internal standard response are sample matrix, poor analytical technique or instrument performance.

[1] See the specific analytical SOP for type and frequency of sample matrix control samples.

[2] LCSD's are normally not performed except when regulatory agencies or client specifications require them. The recoveries for the spiked duplicate samples must meet the same laboratory established recovery limits as the accuracy QC samples. If an LCSD is analyzed both the LCS and LCSD must meet the same recovery criteria and be included in the final report. The precision measurement is reported as "Relative Percent Difference" (RPD). Poor precision between duplicates (except LCS/LCSD) may indicate non-homogeneous matrix or sampling.

24.6 ACCEPTANCE CRITERIA (CONTROL LIMITS)

24.6.1 As mandated by the test method, each individual analyte in the LCS, MS, or Surrogate Spike are evaluated against the control limits as published in the test method. Where there are no established acceptance criteria, the laboratory calculates control limits with the use of control charts or, in some cases, utilizes client project specific control limits. When this occurs, the regulatory or project limits will supersede the laboratory's in-house limits.

Note: For methods, analytes and matrices with very limited data (e.g., unusual matrices not analyzed often), interim limits are established using available data or by analogy to similar methods or matrices.

24.6.2 Once control limits have been established, they are verified, reviewed, and updated if necessary on an annual basis unless the method requires more frequent updating. Control limits are established per method (as opposed to per instrument) regardless of the number of instruments utilized.

24.6.3 Laboratory generated % Recovery acceptance (control) limits are generally established by taking $\pm$ 3 Standard Deviations (99% confidence level) from the average recovery of a minimum of 20-30 data points (more points are preferred).

24.6.3.1 Regardless of the calculated limit, the limit should be no tighter than the Continuing Calibration Verification (CCV) limits (unless the analytical method specifies a tighter limit).

24.6.3.2 In-house limits cannot be any wider than those mandated in a regulated analytical method (e.g., SDWA Dioxin Method 1613B 2,3,7,8-TCDD on-going precision and recovery limits of 73% to 146% recovery). Client or contract required control limits are evaluated against the laboratory's statistically derived control limits to determine if the data quality objectives (DQOs) can be achieved. If laboratory control limits are not consistent with DQOs, then alternatives must be considered, such as method improvements or use of an alternate analytical method.

24.6.4 The lab must be able to generate a current listing of their control limits and track when the updates are performed. In addition, the laboratory must be able to recreate historical control limits.

24.6.4.1 Refer to SOP KNOX-QA-0004, Control Limits and Control Charting for details on the generation of control limits and the use of control charts at TestAmerica Knoxville.

24.6.5 A LCS that is within the acceptance criteria establishes that the analytical system is in control and is used to validate the process. Samples that are analyzed with an LCS with recoveries outside of the acceptance limits may be determined as out of control and should be reanalyzed if possible. If reanalysis is not possible, then the results for all affected analytes for samples within the same batch must be qualified when reported. The internal corrective action process (see Section 12) is also initiated if an LCS exceeds the acceptance limits. Sample results may be qualified and reported without reanalysis if:

24.6.5.1 The analyte results are below the reporting limit and the LCS is above the upper control limit.

24.6.5.2 If the analytical results are above the relevant regulatory limit and the LCS is below the lower control limit. (Note: This is not applicable to Ohio EPA VAP projects.)

24.6.5.3 For Department of Defense (DOD) and Department of Energy (DOE) work, there are an allowable number of Marginal Exceedances (ME). The use of allowable marginal exceedances may also be used for evaluation of LCS recoveries for TNI accredited

methods. Note: For Ohio EPA VAP, if an analyte is identified as a contaminant of interest, then the analyte must meet the LCS criteria and marginal exceedance limits are not applicable.

<11 analytes	0 marginal exceedances are allowed.
11 – 30 Analytes	1 marginal exceedance is allowed
31-50 Analytes	2 marginal exceedances are allowed
51-70 Analytes	3 marginal exceedances are allowed
71-90 Analytes	4 marginal exceedances are allowed
> 90 Analytes	5 marginal exceedances are allowed

24.6.5.3.1 Marginal exceedances are recovery exceedances between 3 SD and 4 SD from the mean recovery limit (TNI). (Note: The DOD/DOE QSM has defined limits for marginal exceedances. Refer to the DOD QSM SOP KNOX-QA-0021, DOD/DOE QSM Program Requirements.)

24.6.5.3.2 Marginal exceedances must be random. If the same analyte exceeds the LCS control limit repeatedly, it is an indication of a systematic problem. The source of the error must be located and corrective action taken. The laboratory has a system to monitor marginal exceedances to ensure that they are random. Refer to the DOD/DOE QSM SOP KNOX-QA-0021, DOD/DOE QSM Program Requirements for details on how the laboratory ensures that the marginal exceedences are random.

24.6.5.3.3 Though marginal exceedences may be allowed, the data must still be qualified to indicate it is outside of the normal limits.

24.6.6 If the MS/MSDs do not meet acceptance limits, the MS/MSD and the associated spiked sample is reported with a qualifier for those analytes that do not meet limits. If obvious preparation errors are suspected, or if requested by the client, unacceptable MS/MSDs are reprocessed and reanalyzed to prove matrix interference. A more detailed discussion of acceptance criteria and corrective action can be found in the analytical SOPs and in Section 12.

24.6.7 If a surrogate standard falls outside the acceptance limits, if there is not obvious chromatographic matrix interference, reanalyze the sample to confirm a possible matrix effect. If the recoveries confirm or there was obvious chromatographic interference, results are reported from the original analysis and a qualifier is added. If the reanalysis meets surrogate recovery criteria, the second run is reported (or both are reported if requested by the client).

24.7 ADDITIONAL PROCEDURES TO ASSURE QUALITY CONTROL

24.7.1 The laboratory has written and approved method SOPs to assure the accuracy of the test method including calibration (see Section 20), use of certified reference materials (see Section 21) and use of PT samples (see Section 15).

24.7.2 A discussion regarding MDLs, Limit of Detection (LOD) and Limit of Quantitation (LOQ) can be found in Section 19.

24.7.3 Use of formulae to reduce data is discussed in the method SOPs and in Section 20.

24.7.4 Selection of appropriate reagents and standards is included in Section 9 and 21.

24.7.5 A discussion on selectivity of the test is included in Section 5.

24.7.6 Constant and consistent test conditions are discussed in Section 18.

24.7.7 The laboratories sample acceptance policy is included in Section 23.

SECTION 25

REPORTING RESULTS

25.1 OVERVIEW

The results of each test are reported accurately, clearly, unambiguously, and objectively in accordance with State and Federal regulations as well as client requirements. Analytical results are issued in a format that is intended to satisfy customer and laboratory accreditation requirements as well as provide the end user with the information needed to properly evaluate the results. Where there is a conflict between the client requests and laboratory ethics or regulatory requirements, the laboratory's ethical and legal requirements are paramount, and the laboratory works with the client during project set up to develop and acceptable solution. Refer to Section 7.

A variety of report formats are available to meet specific needs.

In cases where a client asks for simplified reports, there must be a written request from the client. There still must be enough information that would show any analyses that were out of conformance (QC out of limits) and there should be a reference to a full report that is made available to the client.

Review of reported data is included in Section 19.

25.2 TEST REPORTS

Analytical results are reported in a format that is satisfactory to the client and meets all requirements of applicable accrediting authorities and agencies. A variety of report formats are available to meet specific needs. The report is printed on laboratory letterhead, reviewed, and signed by the appropriate project manager. At a minimum, the standard laboratory report contains the following information:

25.2.1 A report title (e.g., Analytical Report) on the cover page with a "Result" column header on the sample results page.

25.2.2 Each report cover page printed on company letterhead, which includes the laboratory name, address and telephone number.

25.2.3 A unique identification of the report (e.g., Lot Number) and on each page an identification in order to ensure the page is recognized as part of the report and a clear identification of the end.

Note: Page numbers of reports are represented on the upper right hand corner of each page. A table of contents precedes the cover page on each report which includes the page number of each section as well as the total number of pages.

25.2.4 A copy of the chain of custody (COC).

- Any COCs involved with Subcontracting are included.

25.2.5 The name and address of client and a project name/number, if applicable.

25.2.6 Client project manager or other contact.

25.2.7 Description and unambiguous identification of the tested sample(s) including the client identification code.

25.2.8 Date of receipt of sample, date and time of collection, and date(s) of test preparation and performance, and time of preparation or analysis if the required holding time for either activity is less than or equal to 72 hours. Both date and time of preparation and analysis are required to be included in the data report for work done in support of the DoD QSM; see SOP KNOX-QA-0021, "Department of Defense Quality Systems Manual Program Requirements."

25.2.9 Date reported or date of revision, if applicable.

25.2.10 Method of analysis including method code (EPA, Standard Methods, etc).

25.2.11 Reporting limit or Minimum Level.

25.2.12 Method detection limits or Estimated Detection Limits (if requested).

25.2.13 Definition of Data qualifiers and reporting acronyms (e.g. ND).

25.2.14 Sample results.

25.2.15 QC data consisting of method blank, surrogate, LCS, and MS/MSD (if applicable) recoveries and control limits.

25.2.16 Condition of samples at receipt including temperature. This may be accomplished in a narrative or by attaching sample login sheets. This is discussed in the narrative and a copy of the condition upon receipt form is included with the chain of custody.

25.2.17 A statement to the effect that the results relate only to the items tested and the sample as received by the laboratory.

25.2.18 A statement that the report shall not be reproduced except in full, without the written approval of the laboratory.

25.2.19 A signature and title of the person(s) accepting responsibility for the content of the report and date of issue. Authorized signatories are qualified Project Managers appointed by the Manager of Project Managers

25.2.20 When TNI accreditation is required, the lab certifies that the test results meet all requirements of TNI or provides reasons and/or justifications if they do not.

25.2.21 Where applicable, a narrative to the report that explains the issue(s) and corrective action(s) taken in the event that a specific accreditation or certification requirement was not met.

25.2.22 When soil samples are analyzed, a specific identification as to whether soils are reported on a "wet weight" or "dry weight" basis.

25.2.23 Appropriate laboratory certification number for the state of origin of the sample, if applicable.

25.2.24 If only part of the report is provided to the client (client requests some results before all of it is complete), it must be clearly indicated on the report (e.g., preliminary report), and that a complete report will follow once all of the work has been completed. A complete report must be sent once all of the work has been completed.

25.2.25 Any non-TestAmerica subcontracted analysis results are provided as a separate report on the official letterhead of the subcontractor. All TestAmerica subcontracting is clearly identified on the report as to which laboratory performed a specific analysis.

25.2.26 For Ohio EPA VAP work, a VAP affidavit must be completed and included with the report. Refer to the current Ohio Rules OAC 3745-300-04 and 3745-300-13(N) for additional details regarding Ohio EPA VAP affidavits.

25.2.27 A clear statement notifying the client that non-accredited tests were performed and directing the client to the laboratory's accreditation certificates of approval shall be provided when non-accredited tests are included in the report.

25.3 REPORTING LEVEL OR REPORT TYPE

TestAmerica Knoxville offers four standard types of data report format.

- A Standard Report is a report containing the items in Section 25.2 above.
- A CLP Forms Only Report is a standard report using CLP (or CLP like) report forms.
- An Expanded Deliverable Report is a Standard Report which includes the supporting raw data.
- A CLP Expanded Deliverable Report is an Expanded Deliverable report using CLP (or CLP-like) report forms.

Further details, including other specific reporting options, are defined in SOP KNOX-AD-0004, Data Reporting.

25.3.1 Electronic Data Deliverables (EDDs)

EDDs are routinely offered as part of TestAmerica's services in addition to the test report as described in section 25.2. When NELAP accreditation is required and both a test report and EDD are provided to the client, the official version of the test report will be the combined information of the report and the EDD. TestAmerica Knoxville offers a variety of EDD formats including industry standard and client specific electronic deliverables.

EDDs are subject to a review to ensure their accuracy and completeness. If EDD generation is automated, review may be reduced to periodic screening if the laboratory can demonstrate that it can routinely generate that EDD without errors. Any revisions to the EDD format must be reviewed until it is demonstrated that it can routinely be generated without errors. If the EDD can be reproduced accurately and if all subsequent EDDs can be produced error-free, each EDD does not necessarily require a review.

25.4 SUPPLEMENTAL INFORMATION FOR TEST

The lab identifies any unacceptable QC analyses or any other unusual circumstances or observations such as environmental conditions and any non-standard conditions that may have affected the quality of a result. This is typically in the form of a footnote or a qualifier and/or a narrative explaining the discrepancy in the front of the report. See Appendix 4 for example data qualifiers.

25.4.1 Numeric results with values outside of the calibration range, either high or low are qualified as 'estimated'.

25.4.2 Where quality system requirements are not met, a statement of compliance/non-compliance with requirements and/or specifications is required, including identification of test results derived from any sample that did not meet TNI sample acceptance requirements such as improper container, holding time, or temperature.

25.4.3 Where applicable, a statement on the estimated uncertainty of measurements is provided; information on uncertainty is needed when a client's instructions so require.

25.4.4 Opinions and Interpretations - The test report contains objective information, and generally does not contain subjective information such as opinions and interpretations. If such information is required by the client, the Laboratory Director will determine if a response can be prepared. If so, the Laboratory Director will designate the appropriate member of the management team to prepare a response. The response is fully documented, and reviewed by the Laboratory Director, before release to the client. There may be additional fees charged to the client at this time, as this is a non-routine function of the laboratory.

When opinions or interpretations are included in the report, the laboratory provides an explanation as to the basis upon which the opinions and interpretations have been made. Opinions and interpretations are clearly noted as such and where applicable, a comment should be added suggesting that the client verify the opinion or interpretation with their regulator.

25.5 ENVIRONMENTAL TESTING OBTAINED FROM SUBCONTRACTORS

If the laboratory is not able to provide the client the requested analysis, the samples would be subcontracted following the procedures outlined in the Corporate SOP on Subcontracting Procedures (SOP# CA-L-S-002).

Data reported from analyses performed by a subcontractor laboratory are clearly identified as such on the analytical report provided to the client. Results from a subcontract laboratory outside of TestAmerica are reported to the client as provided from the subcontract laboratory.

Note: For Ohio EPA VAP projects TestAmerica's affidavit must not attest that the data from the subcontract laboratory are certified. The subcontractor's affidavit must be included and the report must clearly state the test were subcontracted.

25.6 CLIENT CONFIDENTIALITY

In situations involving the transmission of environmental test results by telephone, facsimile or other electronic means, client confidentiality must be maintained.

TestAmerica will not intentionally divulge to any person (other than the Client or any other person designated by the Client in writing) any information regarding the services provided by TestAmerica or any information disclosed to TestAmerica by the Client. Furthermore, information known to be potentially endangering to national security or an entity's proprietary rights will not be released.

Note: This does not apply to the extent that the information is required to be disclosed by TestAmerica under the compulsion of legal process. TestAmerica will, to the extent feasible, provide reasonable notice to the client before disclosing the information.

Note: Authorized representatives of an accrediting authority are permitted to make copies of any analyses or records relevant to the accreditation process, and copies may be removed from the laboratory for purposes of assessment.

25.6.1 Report deliverable formats are discussed with each new client. If a client requests that reports be faxed or e-mailed, the reports are faxed with a cover sheet or e-mailed with the following note that includes a confidentiality statement similar to the following:

Confidentiality Notice: The information contained in this message is intended only for the use of the addressee, and may be confidential and/or privileged. If the reader of this message is not the intended recipient, or the employee or agent responsible to deliver it to the intended recipient, you are hereby notified that any dissemination, distribution or copying of this communication is strictly prohibited. If you have received this communication in error, please notify the sender immediately.

25.7 FORMAT OF REPORTS

The format of reports is designed to accommodate each type of environmental test carried out and to minimize the possibility of misunderstanding or misuse.

25.8 AMENDMENTS TO TEST REPORTS

Corrections, additions, or deletions to reports are only made when justification arises through supplemental documentation. Justification is documented using the laboratory's corrective action system (refer to Section 12).

The revised report is retained on the archive data server, as is the original report. The revised report is stored in the archive data server under the lot number followed by "rev". The revised report will have the word "revised" on the cover page.

When the report is re-issued, a notation of "Reissued Report" is placed on the cover/signature page of the report or at the top of the narrative page with a brief explanation of reason for the re-issue.

25.9 POLICIES ON CLIENT REQUESTS FOR AMENDMENTS

25.9.1 Policy on Data Omissions or Reporting Limit Increases

Fundamentally, our policy is simply to not omit previously reported results (including data qualifiers) or to not raise reporting limits and report sample results as ND. This policy has few exceptions. Exceptions are:

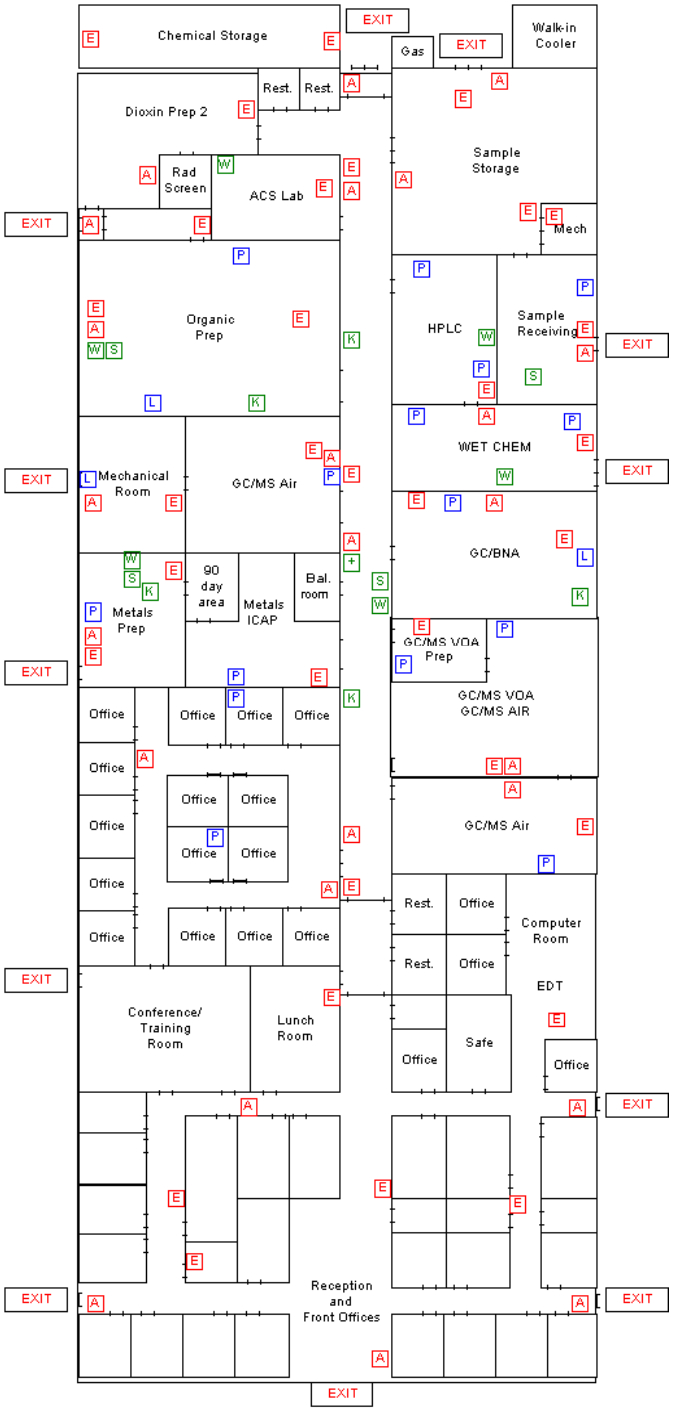
- Laboratory error.
- Sample identification is indeterminate (confusion between COC and sample labels).
- An incorrect analysis (not analyte) was requested (e.g., COC lists 8315 but client wanted 8310). A written request for the change is required.
- Incorrect limits reported based on regulatory requirements.
- The requested change has absolutely *no possible* impact on the interpretation of the analytical results and there is *no possibility* of the change being interpreted as misrepresentation by anyone inside or outside of our company.

25.9.2 Multiple Reports

TestAmerica does not issue multiple reports for the same work order where there is different information on each report (this does not refer to copies of the same report) unless required to meet regulatory needs and approved by QA.

Appendix 1. Laboratory Floor Plan

TestAmerica Knoxville Laboratory
Main Building - Figure 1

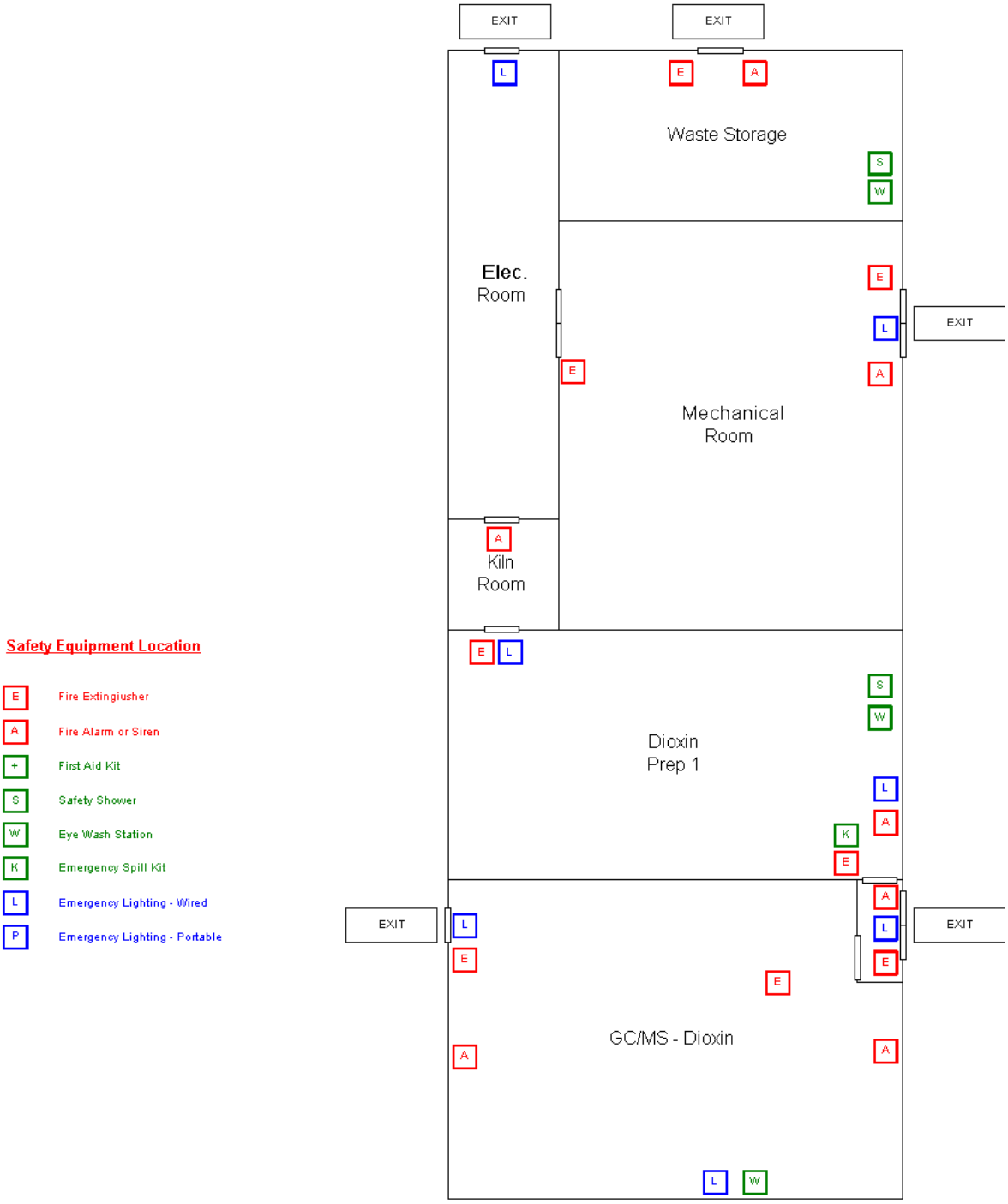


Safety Equipment Location

- E Fire Extingiusher
- A Fire Alarm or Siren
- + First Aid Kit
- S Safety Shower
- W Eye Wash Station
- K Emergency Spill Kit
- L Emergency Lighting - Wired
- P Emergency Lighting - Portable

Appendix 1. Laboratory Floor Plan (continued)

TestAmerica Knoxville Laboratory
Building 2 - Dioxin Lab - Figure 2



Appendix 2. Glossary/Acronyms

Glossary:

Acceptance Criteria:
Specified limits placed on characteristics of an item, process, or service defined in requirement documents. (ASQC)

Accreditation:
The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory.

Accuracy:
The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (QAMS)

Analyst: [aka: Laboratory Analyst]
The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.

Analytical Uncertainty:
A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis. (TNI)

Anomaly:
A condition or event, other than a deficiency, that may affect the quality of the data, whether in the laboratory's control or not.

Assessment:
The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of laboratory accreditation). (TNI)

Audit:
A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives. (TNI)

Batch:
Environmental samples which are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A preparation batch is composed of one to 20 environmental samples of the same matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24

hours. An analytical batch is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group An analytical batch can include prepared samples originating from various quality system matrices and can exceed twenty (20) samples. (TNI)

Bias:
The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value). (TNI)

Blank:
A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. (ASQC)

Calibration:

A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. (TNI)

1) In calibration of support equipment the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI).

2) In calibration according to methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications

Calibration Curve:
The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (TNI)

Calibration Standard:
A substance or reference material used to calibrate an instrument (QAMS)

Certified Reference Material (CRM):
A reference material, accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute. (TNI)

Chain of Custody (COC) Form:
Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; the collector; time of collection; preservation; and requested analyses. (TNI)

Compromised Samples:
Those samples which are improperly sampled, insufficiently documented (chain of custody and other sample records and/or labels), improperly preserved, collected in improper containers, or exceeding holding times when delivered to a laboratory. Under normal conditions, compromised samples are not analyzed. If emergency situation require analysis, the results must be appropriately qualified.

Confidential Business Information (CBI):
Information that an organization designates as having the potential of providing a competitor with inappropriate insight into its management, operation or products. TNI and its representatives agree to safeguarding identified CBI and to maintain all information identified as such in full confidentiality.

Confirmation:
Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited toSecond column confirmation,Alternate wavelength,Derivatization,Mass spectral interpretation,Alternative detectors,or Additional Cleanup proceduresTNI

Conformance:
An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements. (ANSI/ASQC E4-1994)

Corrective Action:
The action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO 8402)

Data Audit:
A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data re of acceptable quality (i.e., that they meet specified acceptance criteria).

Data Reduction:
The process of transforming the number of data items by arithmetic or statistical calculations, standard curves, and concentration factors, and collation into a more useable form. (TNI)

Deficiency:
An unauthorized deviation from acceptable procedures or practices, or a defect in an item. (ASQC), whether in the laboratory's control or not.

Demonstration of Capability:
A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision. (TNI)

Document Control:
The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly, and controlled to

ensure use of the correct version at the location where the prescribed activity if performed. (ASQC)

Duplicate Analyses:
The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. (EPA-QAD)

Equipment Blank:
Sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures.

External Standard Calibration:
Calibrations for methods that do not utilize internal standards to compensate for changes in instrument conditions.

Field Blank:
Blank prepared in the field by filing a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken (EPA OSWER)

Field of Accreditation:
Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.

Holding Blank:
A blank matrix stored with field samples of a similar matrix (volatiles only) that measures storage contribution to any source of contamination.

Holding Times:
The maximum times that samples may be held prior to analyses and still be considered valid or not compromised. (40 CFR Part 136)

Internal Standard:
A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical test method. (TNI)

Internal Standard Calibration:
Calibrations for methods that utilize internal standards to compensate for changes in instrument conditions.

Instrument Blank:
A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. (EPA-QAD)

Instrument Detection Limit (IDL):
The minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific instrument. The IDL is associated with the instrumental portion of a specific method only, and sample preparation

steps are not considered in its derivation. The IDL is a statistical estimation at a specified confidence interval of the concentration at which the relative uncertainty is ± 100%. The IDL represents a range where qualitative detection occurs on a specific instrument. Quantitative results are not produced in this range.

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample):
A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes, taken through all preparation and analysis steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

An LCS is prepared at a minimum of 1 per batch of 20 or less samples per matrix type per sample extraction or preparation method except for analytes for which spiking solutions are not available such as total suspended solids, total dissolved solids, total volatile solids, total solids, pH, color, odor, temperature, dissolved oxygen or turbidity. The results of these samples are used to determine batch acceptance.

Least Squares Regression (1st Order Curve):
The least squares regression is a mathematical calculation of a straight line over two axes. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The regression calculation will generate a correlation coefficient (r) that is a measure of the "goodness of fit" of the regression line to the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r must be greater than or equal to 0.99 for organics and 0.995 for inorganics.

Limit(s) of Detection (LOD): [a.k.a., Method Detection Limit (MDL)]:
A laboratory's estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect in their facility. (TNI)

LOD Verification [a.k.a., MDL Verification]:
A processed QC sample in the matrix of interest, spiked with the analyte at no more than 3X the LOD for single analyte tests and 4X the LOD for multiple analyte tests and processed through the entire analytical procedure.

Limit(s) of Quantitation (LOQ) [a.k.a., Reporting Limit]:
The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. (TNI)

(QS) Matrix:
The component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions are used:

> Aqueous: Any aqueous sample excluded from the definition of Drinking Water matrix or Saline/Estuarine source. Includes surface water, groundwater, effluents, and TCLP or other extracts.

Drinking Water: any aqueous sample that has been designated as a potable or potential potable water source.

Saline/Estuarine: any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.

Non-aqueous Liquid: any organic liquid with <15% settleable solids.

Biological Tissue: any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples are grouped according to origin.

Solids: includes soils, sediments, sludges, and other matrices with >15% settleable solids.

Chemical Waste: a product or by-product of an industrial process that results in a matrix not previously defined.

Air & Emissions: whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device. (TNI)

Matrix Spike (spiked sample or fortified sample):

A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Matrix Spike Duplicate (spiked sample or fortified sample duplicate):
A replicate matrix spike prepared and analyzed to obtain a measure of the precision of the recovery for each analyte.

Method Blank:
A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.

Method Detection Limit:
The minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40 CFR Part 136, Appendix B)

Negative Control:
Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results.

Non-conformance:
An indication, judgment, or state of not having met the requirements of the relevant specifications, contract, or regulation.

Observation:
A record of phenomena that (1) may assist in evaluation of the sample data; (2) may be of importance to the project manager and/or the client, and yet not at the time of the observation have any known effect on quality.

Performance Audit:
The routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory.

Positive Control:
Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects.

Precision:
The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. (TNI)

Preservation:
Any conditions under which a sample must be kept in order to maintain chemical and/or biological integrity prior to analysis. (TNI)

Proficiency Testing:
A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (TNI)

Proficiency Testing Program:
The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories. (TNI)

Proficiency Test Sample (PT):
A sample, the composition of which is unknown to the laboratory and is provided to test whether the laboratory can produce analytical results within specified acceptance criteria. (TNI)

Quality Assurance:
An integrated system of management activities involving planning, implementation, assessment, reporting and quality improvement to ensure that a process, item, or service is of the type of quality needed and expected by the client. (TNI)

Quality Assurance [Project] Plan (QAPP):

A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. (EAP-QAD)

Quality Control:
The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against “out of control” conditions and ensuring that the results are of acceptable quality. (TNI)

Quality Control Sample:
A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control. (TNI)

Quality Manual:
A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. (TNI)

Quality System:
A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC activities. (TNI)

Raw Data:
The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records. (TNI)

Record Retention:
The systematic collection, indexing and storing of documented information under secure conditions.

Reference Material:
Material or substance one or more properties of which are sufficiently homogenous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (TNI)

Reference Standard:
Standard used for the calibration of working measurement standards in a given organization or a given location. (TNI)

Sampling:
Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.

Second Order Polynomial Curve (Quadratic):
The 2nd order curves are a mathematical calculation of a slightly curved line over two axis. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The 2nd order regression will generate a coefficient of determination (COD or r^2) that is a measure of the "goodness of fit" of the quadratic curvature the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r^2 must be greater than or equal to 0.99.

Selectivity:
The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system. (TNI)

Sensitivity:
The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (TNI)

Spike:
A known mass of target analyte added to a blank, sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.

Standard:
The document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies. (TNI)

Standard Operating Procedures (SOPs):
A written document which details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks. (TNI)

Storage Blank:
A blank matrix stored with field samples of a similar matrix (volatiles only) that measures storage contribution to any source of contamination.

Surrogate:
A substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes.

Surrogate compounds must be added to all samples, standards, and method blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. Poor surrogate recovery may indicate a problem with sample composition and is reported to the client whose sample produced poor recovery. (QAMS)

Systems Audit (also Technical Systems Audit):

A thorough, systematic, qualitative on-site assessment of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system. (EPA-QAD)

Technical Manager:
A member of the staff of an environmental laboratory who exercises actual day-to-day supervision of laboratory operations for the appropriate fields of accreditation and reporting of results

Technology:
A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.

Traceability:
The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project. (TNI)

Trip Blank:
A blank matrix placed in a sealed container at the laboratory that is shipped, held unopened in the field, and returned to the laboratory in the shipping container with the field samples.

Uncertainty:
A parameter associated with the result of a measurement that characterizes the dispersion of the value that could reasonably be attributed to the measured value.

Acronyms:

ANSI- American National Standards Institute
ASQC- American Society for Quality Control
CAR – Corrective Action Report
CCV – Continuing Calibration Verification
CF – Calibration Factor
CFR – Code of Federal Regulations
COC – Chain of Custody
DOC – Demonstration of Capability
DQO – Data Quality Objectives
DUP - Duplicate
EDL – Estimated Detection Limit (for Isotope Dilution Methods)
EHS – Environment, Health and Safety
EPA – Environmental Protection Agency
EPA-QAD- Quality Assurance Division
GC - Gas Chromatography
GC/MS - Gas Chromatography/Mass Spectrometry
HPLC - High Performance Liquid Chromatography
ICP - Inductively Coupled Plasma Atomic Emission Spectroscopy
ICP/MS – ICP/Mass Spectrometry
ICV – Initial Calibration Verification
IDL – Instrument Detection Limit
IH – Industrial Hygiene
IS – Internal Standard
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
LIMS – Laboratory Information Management System
LOD – Limit of Detection
LOQ – Limit of Quantitation
MDL – Method Detection Limit
MDLV – MDL Verification Check Standard
MRL – Method Reporting Limit Check Standard
MS – Matrix Spike
MSD – Matrix Spike Duplicate
SDS - Safety Data Sheet
NELAP - National Environmental Laboratory Accreditation Program
PT – Performance Testing
QAM – Quality Assurance Manual
QAMS- QAMS 005/80, Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans (EPA 1980)
QA/QC – Quality Assurance / Quality Control
QAPP – Quality Assurance Project Plan
RF – Response Factor
RPD – Relative Percent Difference
RSD – Relative Standard Deviation
SD – Standard Deviation
SOP: Standard Operating Procedure

TAT – Turn-Around-Time
TNI – The NELAC Institute
VOA – Volatiles
VOC – Volatile Organic Compound

Appendix 3.

Laboratory Certifications, Accreditations, Validations

TestAmerica Knoxville maintains accreditations, certifications, and approvals with numerous state and national entities. Programs vary but may include on-site audits, reciprocal agreements with another entity, performance testing evaluations, review of the Quality Assurance Manual, Standard Operating Procedures, Method Detection Limits, training records, etc. At the time of this QAM revision, the laboratory has accreditation/certification/licensing with the following organizations:

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Certifications

Laboratory	Program	Authority	Identification	Expiration Date
TestAmerica Knoxville	DoD ELAP	L-A-B	L2311	02/13/2019
TestAmerica Knoxville	Federal	USDA	P330-13-00262	08/20/2019
TestAmerica Knoxville	NELAP	Florida	E87177	06/30/2017
TestAmerica Knoxville	NELAP	Kansas	E-10349	10/31/2017
TestAmerica Knoxville	NELAP	Louisiana	83979	06/30/2017
TestAmerica Knoxville	NELAP	Louisiana (DW)	LA160005	12/31/2016
TestAmerica Knoxville	NELAP	New Jersey	TN001	06/30/2017
TestAmerica Knoxville	NELAP	New York	10781	03/31/2017
TestAmerica Knoxville	NELAP	Pennsylvania	68-00576	12/31/2016
TestAmerica Knoxville	NELAP	Texas	T104704380-16-9	08/31/2017
TestAmerica Knoxville	NELAP	Utah	TN00009	07/31/2016 *
TestAmerica Knoxville	NELAP	Virginia	460176	09/14/2017
TestAmerica Knoxville	State Program	Arkansas DEQ	88-0688	06/16/2017
TestAmerica Knoxville	State Program	California	2423	06/30/2018
TestAmerica Knoxville	State Program	Colorado	TN00009	02/28/2017
TestAmerica Knoxville	State Program	Connecticut	PH-0223	09/30/2017
TestAmerica Knoxville	State Program	Georgia	906	04/13/2017
TestAmerica Knoxville	State Program	Hawaii	N/A	04/13/2017
TestAmerica Knoxville	State Program	Kentucky (DW)	90101	12/31/2016
TestAmerica Knoxville	State Program	Maryland	277	03/31/2017
TestAmerica Knoxville	State Program	Michigan	9933	04/13/2017
TestAmerica Knoxville	State Program	Nevada	TN00009	07/31/2017
TestAmerica Knoxville	State Program	North Carolina (DW)	21705	07/31/2017
TestAmerica Knoxville	State Program	North Carolina (WW/SW)	64	12/31/2016
TestAmerica Knoxville	State Program	Ohio VAP	CL0059	01/16/2017
TestAmerica Knoxville	State Program	Oklahoma	9415	08/31/2017
TestAmerica Knoxville	State Program	South Carolina	84001	06/30/2017
TestAmerica Knoxville	State Program	Tennessee	2014	04/13/2017
TestAmerica Knoxville	State Program	Washington	C593	01/19/2017
TestAmerica Knoxville	State Program	West Virginia (DW)	9955C	12/31/2016
TestAmerica Knoxville	State Program	West Virginia DEP	345	04/30/2017
TestAmerica Knoxville	State Program	Wisconsin	998044300	08/31/2017

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* Certification Valid - Laboratory is Pending Renewal with the Program Authority

For more information, or to contact a local TestAmerica representative nearest you, please visit our website at www.testamericainc.com

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The certificates and parameter lists for each organization may be found on the corporate web site, and on the local server in a protected QA share.

* The Agency assigned Laboratory ID number is listed where provided. Otherwise the number corresponds to the Agency Certificate ID where provided.

Appendix 4. Example Data Qualifiers (Standard Flagging Suite)[1]

Qualifier	Footnote
!	Laboratory is not accredited for this parameter.
*	RPD of the LCS and LCSD exceeds the control limits
*	LCS or LCSD is outside acceptance limits
>	The analyte exceeded the indicated concentration
^	Instrument related QC is outside acceptance limits
4	MS,MSD: The analyte present in the original sample is greater than 4 times the matrix spike concentration; therefore control limits are not applicable
AP	Altered Pattern
B	Compound was found in the blank and sample
B7	Target analyte detected in the method blank at or above method reporting limit. Concentration found in sample was at 10X the concentration found in the blank
c	Compound falls outside routine control limits, but is within acceptable client specific calibration criteria
cn	Refer to Case Narrative for further detail
D	Sample results are obtained from a dilution; the surrogate or matrix spike recoveries reported are calculated from diluted samples
D	Surrogate or matrix spike recoveries were not obtained because the extract was diluted for analysis; also compounds analyzed at a dilution may be flagged with a D
D	Sample results are obtained from a dilution; the surrogate or matrix spike recoveries reported are calculated from diluted samples.
DW	Result has been dry weight corrected
E	Result exceeded calibration range.
F1	MS and/or MSD Recovery is outside acceptance limits.
F2	MS/MSD RPD exceeds control limits
F3	Duplicate RPD exceeds the control limit
F4	MS/MSD RPD exceeds control limits due to sample size difference.
F5	Duplicate RPD exceeds limit, and one or both sample results are less than 5 times RL. The data are considered valid because the absolute difference is less than the RL.
H	Sample was prepped or analyzed beyond the specified holding time
h	Alternate peak selection upon analytical review.
I	Indicates the presence of an interference, recovery is not calculated.
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
NC	Not Confirmed
p	The %RPD between the primary and confirmation column/detector is >40%. The lower value has been reported.
P	The %RPD between the primary and confirmation column/detector is >40%. The higher value has been reported
Q	Result was qualitatively confirmed, but not quantitated.
q	The reported result is the estimated maximum possible concentration of this analyte, quantitated using the theoretical ion ratio. The measured ion ratio does not meet qualitative identification criteria and indicates a possible interference.

S	Ion suppression
U	Indicates the analyte was analyzed for but not detected.
V	Serial Dilution exceeds the control limits
W	PS: Post-digestion spike was outside control limits
X	Surrogate is outside control limits

1 – This is a standard list of qualifiers commonly used. Other qualifiers are available in LIMS.

Quality Assurance Manual

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Quality Assurance Manual
Approval Signatures



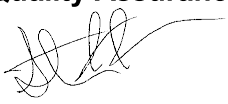
6/27/2017

Laboratory Director - Deborah L. Lowe — Date



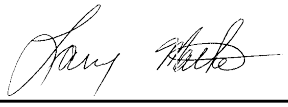
5/29/2017

Quality Assurance Manager – Virginia Zusman — Date



6/6/2017

Health and Safety Coordinator - Steve Jackson — Date



6/15/2017

Technical Director - Larry Matko — Date



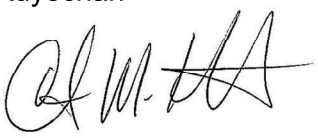
6/1/2017

Department/Technical Manager (Organics) - Sharon Bacha — Date



6/14/2017

Department/Technical Manager (Inorganics) - Roseann Ruyechan — Date



6/27/2017

Department Manager (Sample Management) - Chris Kovitch — Date

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REFERENCED CORPORATE SOPS AND POLICIES

SOP / Policy Reference	Title
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CA-I-P-002	Electronic Reporting and Signature Policy
CA-L-P-002	Contract Compliance Policy
CA-L-S-004	Subcontracting
CA-Q-M-002	Corporate Quality Management Plan
CA-Q-P-003	Calibration Curves and Selection of Calibration Points
CA-Q-S-001	Acid & Solvent Lot Testing and Approval
CA-Q-S-002	Acceptable Manual Integration Practices
CA-Q-S-006	Detection Limits
CA-Q-S-009	Root Cause Analysis
CA-T-P-001	Qualified Products List
CW-E-M-001	Corporate Environmental Health & Safety Manual
CW-F-P-002	Company-Wide Authorization Matrix
CW-F-P-004	Procurement and Contracts Policy
CW-F-S-007	Fixed Asset Acquisition, Retention and Safeguarding
CW-L-P-001	Records Retention Policy
CW-L-P-004	Ethics Policy
CW-L-S-002	Internal Investigation
CW-Q-S-001	Corporate Document Control and Archiving
CW-Q-S-002	Writing a Standard Operating Procedure (SOPs)
CW-Q-S-003	Internal Auditing
CW-Q-S-004	Management Systems Review
CW-Q-S-005	Data Recall Process

REFERENCED LABORATORY DOCUMENTS

SOP Reference	Title
PT-QA-001	Employee Orientation and Training (DOCs)
PT-QA-002	Internal Auditing
PT-QA-005	Measurement Uncertainty
PT-QA-006	Procurement of Standards and Materials; Labeling and Traceability
PT-QA-007	Detection Limits
PT-QA-008	Thermometer and Barometer Verification and Temperature Monitoring
PT-QA-010	Document and Spreadsheet Development & Control
PT-QA-012	Selection and Calibration of Balances and Weights
PT-QA-013	Independent QA Data Review
PT-QA-016	Nonconformance and Corrective Action System
PT-QA-017	Aqueous Pipette / Dispenser Calibration – Gravimetric Method
PT-QA-018	Technical Data Review Requirements
PT-QA-019	Records Management, Retention and Archive
PT-QA-021	Laboratory Quality Control Program
PT-QA-022	Equipment Maintenance
PT-QA-024	Subsampling
PT-QA-WI-002	Master Document List

SECTION 3
INTRODUCTION, SCOPE AND APPLICABILITY

3.1 INTRODUCTION AND COMPLIANCE REFERENCES

TestAmerica Pittsburgh's Quality Assurance Manual (QAM) is a document prepared to define the overall policies, organization objectives and functional responsibilities for achieving TestAmerica's data quality goals. The laboratory maintains a local perspective in its scope of services and client relations and maintains a national perspective in terms of quality.

The QAM has been prepared to assure compliance with The NELAC Institute (TNI) Standard, dated 2009, Volume 1 Modules 2 and 4, and ISO/IEC Guide 17025:2005(E) (TNI). In addition, the policies and procedures outlined in this manual are compliant with TestAmerica's Corporate Quality Management Plan (CQMP) CA-Q-M-002, and the various accreditation and certification programs listed in Appendix 3. The CQMP provides a summary of TestAmerica's quality and data integrity system. It contains requirements and general guidelines under which all TestAmerica facilities shall conduct their operations.

This QAM has been prepared to be consistent with requirements of the following documents:

- EPA *Requirements for Quality Management Programs* (QA/R-2), EPA/240/B-01/002, May 31, 2006
- EPA 600/4-88/039, *Methods for the Determination of Organic Compounds in Drinking Water,* EPA, Revised July 1991
- EPA 600/R-95/131, *Methods for the Determination of Organic Compounds in Drinking Water,* Supplement III, EPA, August 1995
- EPA 600/4-79-019, *Handbook for Analytical Quality Control in Water and Wastewater Laboratories,* EPA, March 1979
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008, Final Update V, August 2015*
- *Federal Register, 40 CFR Parts 136, 141, 172, 173, 178, 179 and 261*
- *Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration*
- APHA, *Standard Methods for the Examination of Water and Wastewater,* 18th Edition, 19th, 20th, 21st, 22nd and on-line Editions
- *U.S. Department of Energy* Order 414.1D, *Quality Assurance*, April 25, 2011
- Nuclear Regulatory Commission (NRC) quality assurance requirements
- Marine Protection, Research, and Sanctuaries Act (MPRSA)
- Toxic Substances Control Act (TSCA)

3.2 TERMS AND DEFINITIONS

A Quality Assurance Program is a company-wide system designed to ensure that data produced by the laboratory conforms to the standards set by state and/or federal regulations. The program functions at the management level through company goals and management policies, and at the analytical level through Standard Operating Procedures (SOPs) and quality control. The TestAmerica program is designed to minimize systematic error, encourage constructive, documented problem solving, and provide a framework for continuous improvement within the organization.

Refer to Appendix 2 for the Glossary/Acronyms.

3.3 SCOPE / FIELDS OF TESTING

The laboratory analyzes a broad range of environmental and industrial samples every month. Sample matrices vary among effluent water, surface water, groundwater, hazardous waste, sludge, soils, sediments, and tissue. The Quality Assurance Program contains specific procedures and methods to test samples of differing matrices for chemical, physical and biological parameters. The Program also contains guidelines on maintaining documentation of analytical processes, reviewing results, servicing clients and tracking samples through the laboratory. The technical and service requirements of all analytical requests are thoroughly evaluated before commitments are made to accept the work. Measurements are made using published reference methods or methods developed and validated by the laboratory.

The methods covered by this manual include the most frequently requested methodologies needed to provide analytical services in the United States and its territories. The specific list of test methods used by the laboratory can be found in the Statement of Qualifications (SOQ). The current list of accredited methods is maintained in Total Access. The approach of this manual is to define the minimum level of quality assurance and quality control necessary to meet these requirements. All methods performed by the laboratory shall meet these criteria as appropriate. In some instances, quality assurance project plans (QAPPs), project specific data quality objectives (DQOs) or local regulations may require criteria other than those contained in this manual. In these cases, the laboratory will abide by the requested criteria following review and acceptance of the requirements by the Laboratory Director and the Quality Assurance (QA) Manager. In some cases, QAPPs and DQOs may specify less stringent requirements. The Laboratory Director and the QA Manager must determine if it is in the lab's best interest to follow the less stringent requirements.

3.3.1 Specialty Analyses

3.3.1.1 Dredged Material Evaluations

TestAmerica Pittsburgh offers trace level testing of waters (site-waters and elutriates), sediments, and tissues in support of Dredged Material Evaluations for in-water (ocean and inland waters) and upland (Confined Disposal Facilities (CDFs), beneficial use, etc.) disposal options. In-house capabilities for commonly requested sediment program parameters include:

- Organochlorine Pesticides
- Organophosphorus Pesticides
- PCBs (as Aroclors and Congeners)
- Volatile Organics
- Semivolatile Organics
- Metals
- Cyanide
- Total Sulfides
- Acid Volatile Sulfide (AVS) and Simultaneously Extracted Metals (SEM)
- Nitrogen, Ammonia
- Nitrogen, Nitrate + Nitrite
- Biochemical Oxygen Demand (BOD)
- Chemical Oxygen Demand (COD)
- Total Organic Carbon (combustion procedure for sediments)

- Total Solids/Moisture Content
- Total Volatile Solids
- Lipids
  - With teaming arrangements with other TestAmerica facilities, additional sediment program capabilities include:
    - Polychlorinated Dibenzo-Dioxins and Furans (PCDDs/PCDFs)
    - Butyl Tins (mono – tetra)
    - Total Kjeldahl Nitrogen
    - Total Phosphorus
    - Grain Size
    - Specific Gravity
    - Atterberg Limits

TestAmerica Pittsburgh also generates elutriate samples following appropriate U.S. Army Corps of Engineers procedures. These include:

- Standard Elutriate Test (SET) for in-water disposal evaluations, and
- Modified Elutriate Test (MET) or Effluent Elutriate Test (EET) for CDF disposal evaluations.
- Illinois Resuspension Tests (Supernatant and Elutriate Tests).
- Dredge Elutriate Test (DRET)

TestAmerica Pittsburgh currently supports dredge material evaluation projects following several state specific programs, as well as, under the following guidance documents:

- Ocean Testing Manual or OTM (USACE, 1991).
- New Jersey's Tidal Waters Technical Manual (NJDEP, 1997).
- Inland Testing Manual or ITM (USACE, 1998).
- Upland Testing Manual or UTM (USACE, 2003).

3.3.1.2 Tissue Analyses

TestAmerica Pittsburgh has extensive experience in supporting projects requiring tissue analyses. These include analyses of laboratory cultured reference species from bioaccumulation tests associated with dredged material evaluations to a variety of field collected species (aquatic and terrestrial). TestAmerica Pittsburgh has developed modifications to the standard solid methodologies (where possible) to allow for the use of smaller sample weights and achieve lower quantitation limits. In-house capabilities for commonly requested tissue parameters include:

- Organochlorine Pesticides
- PCBs (as Aroclors and Congeners)
- Semivolatile Organics
- Metals
- Lipids
- Moisture Content

- With teaming arrangements with other TestAmerica facilities, additional tissue capabilities include:
  - Polychlorinated Dibenzo-Dioxins and Furans (PCDDs/PCDFs)
  - Butyl Tins (mono – tetra)

3.4 MANAGEMENT OF THE MANUAL

3.4.1 Review Process

The template on which this manual is based is reviewed annually by Corporate Quality Management Personnel to assure that it remains in compliance with Section 3.1. This manual itself is reviewed every two years by senior laboratory management to assure that it reflects current practices and meets the requirements of the laboratory's clients and regulators as well as the CQMP. Occasionally, the manual may need changes in order to meet new or changing regulations and operations. The QA Manager will review the changes in the normal course of business and incorporate changes into revised sections of the document. All updates will be reviewed by the senior laboratory management staff. The laboratory updates and approves such changes according to Pittsburgh laboratory SOP No. PT-QA-010, *Document Development and Control*.

SECTION 4

MANAGEMENT REQUIREMENTS

4.1 Overview

TestAmerica Pittsburgh is a local operating unit of TestAmerica Laboratories, Inc.. The organizational structure, responsibilities and authorities of the Corporate staff of TestAmerica Laboratories, Inc. are presented in the CQMP. The laboratory has day-to-day independent operational authority overseen by Corporate officers (e.g., President and Chief Executive Officer (CEO), Chief Operating Officer (COO), Executive Vice President (VP) Operations, Corporate Quality etc.). The laboratory operational and support staff work under the direction of the Laboratory Director. The organizational structure for both Corporate & TestAmerica Pittsburgh is presented in Figure 4-1.

4.2 Roles And Responsibilities

In order for the Quality Assurance Program to function properly, all members of the staff must clearly understand and meet their individual responsibilities as they relate to the quality program. The following descriptions briefly define each role in its relationship to the Quality Assurance Program.

4.2.1 Additional Requirements for Laboratories

The responsibility for quality resides with every employee of the laboratory. All employees have access to the QAM, are trained to this manual, and are responsible for upholding the standards therein. Each person carries out his/her daily tasks in a manner consistent with the goals and in accordance with the procedures in this manual and the laboratory's SOPs. Role descriptions for Corporate personnel are defined in the CQMP. This manual is specific to the operations of TestAmerica's Pittsburgh laboratory.

4.2.2 President and Chief Executive Officer (CEO)

The President and CEO is a member of the Board of Directors and is ultimately responsible for the quality and performance of all TestAmerica facilities. The President and CEO establishes the overall quality standard and data integrity program for the Analytical Business, providing the necessary leadership and resources to assure that the standard and integrity program are met.

~~4.2.3~~ Chief Operation Officer (COO)

The COO reports directly to the President and CEO of TestAmerica. The COO~~VPO~~ oversees the operations of all TestAmerica laboratories and the EMLab P&K business unit. The VP's of Operations report directly to COO

4.2.4 Vice President of Operations

Each VP of Operations reports directly to the Executive VP of Operations and is a part of the Executive Committee. Each VP of Operations is responsible for the overall administrative and operational management of their respective laboratories. The VP's responsibilities include allocation of personnel and resources, long-term planning, goal setting, and achieving the financial, business, and quality objectives of TestAmerica. The VP's ensure timely compliance with Corporate Management directives, policies, and management systems reviews. The VP's are also responsible for restricting any laboratory from performing analyses that cannot be consistently and successfully performed to meet the standards set forth in this manual.

4.2.5 Vice President of Quality and Environmental Health and Safety (VP-QA/EHS)

The Vice President (VP) of QA/EHS reports directly to the President and CEO. With the aid of the Executive Committee, Laboratory Directors, Quality Directors, Safety Manager, EH&S Coordinators and QA Managers, the VP-QA/EHS has the responsibility for the establishment, general overview and Corporate maintenance of the Quality Assurance and EH&S Programs within TestAmerica. Additional responsibilities include:

- Review of QA/QC and EHS aspects of Corporate SOPs & Policies, national projects and expansions or changes in services.
- Work with various organizations outside of TestAmerica to further the development of quality standards and represent TestAmerica at various trade meetings.
- Preparation of a monthly report that includes quality metrics across the analytical laboratories and a summary of any quality related initiatives and issues.
- Preparation of a monthly report that includes EH&S metrics across the analytical laboratories and a summary of any EH&S related initiatives and issues.
- Work with various organizations outside of TestAmerica to further the development of quality standards and represent TestAmerica at various trade meetings.
- With the assistance of the Corporate Senior Management Teams and the EHS Director~~s~~, development and implementation of the TestAmerica Environmental, Health and Safety Program

4.2.6 Vice President of Client Service

The VP of Client Services leads the Client Service Organization (CSO) and is responsible for client satisfaction, driving operational excellence and improving client responsiveness. The VP provides direction to the Client Service Directors, Programs Managers and Project Managers.

4.2.7 Quality Assessment Director

The Quality Assessment Director reports to the VP-QA/EHS. The Quality Assessment Director has QA oversight of laboratories; responsible for the internal audit system, schedule and procedure; monitors laboratory internal audit findings; identifies common laboratory weaknesses; and monitors corrective action closures. Together with the Quality Compliance Director, the Quality Systems Director, and the VP-QA/EHS, the Quality Assessment Director has the responsibility for the establishment, general overview and maintenance of the Analytical Quality Assurance Program within TestAmerica.

4.2.8 Quality Compliance Director

The Quality Compliance Director reports to the VP-QA/EHS. The Quality Compliance Director has QA oversight of laboratories; monitors and communicates DoD / DoE requirements; develops Corporate tools for ensuring and improving compliance; develops Corporate assessment tools; identifies common laboratory weaknesses; and monitors corrective action closures. Together with the Quality Assessment Director, Quality Systems Director and the VP-QA/EHS, the Quality Compliance Director has the responsibility for the establishment, general overview and maintenance of the Analytical Quality Assurance Program within TestAmerica.

4.2.9 Quality Systems Director

The Quality Systems Director reports to the VP-QA/EHS. The Quality Systems Director has QA oversight of laboratories; develops quality policies, procedures and management tools; monitors and communicates regulatory and certification requirements; identifies common laboratory weaknesses; and monitors corrective action closures. Together with the Quality Assessment Director, Quality Compliance Director and the VP-QA/EHS, the Quality Systems Director has the responsibility for the establishment, general overview and maintenance of the Analytical Quality Assurance Program within TestAmerica.

4.2.10 Quality Information Manager

The Quality Information Manager is responsible for managing all company official documents (e.g., Policies, Procedures, Work Instructions), the company's accreditation database, intranet websites, external laboratory subcontracting, regulatory limits for clients on the company's TotalAccess website; internal and external client support for various company groups (e.g., Client Services, EH&S, Legal, IT, Sales) for both quality and operational functions. The Quality Information Manager reports to the VP-QA/EHS; and works alongside the Quality Assessment, Quality Compliance and Quality System Directors and EHS Managers to support both the Analytical Quality Assurance and EHS Programs within TestAmerica.

4.2.11 Technical Services Director

The Technical Services Director is responsible for establishing, implementing and communicating TestAmerica's Analytical Business's Technical Policies, SOPs, and Manuals. Other responsibilities include conducting technical assessments as required, acting as a technical resource in national contracts review, coordinating new technologies, establishing best practices, advising staff on technology advances, innovations, and applications.

4.2.12 Ethics and Compliance Officers (ECOs)

TestAmerica has designated two senior members of the Corporate staff to fulfill the role of Ethics and Compliance Officer (ECO) – Corporate Counsel & VP of Human Resources and the VP-QA/EHS. Each ECO acts as a back-up to the other ECO and both are involved when data investigations occur. Each ECO has a direct line of communication to the entire senior Corporate and lab management staff.

The ECOs ensure that the organization distributes the data integrity and ethical practices policies to all employees and ensures annual trainings and orientation of new hires to the ethics program and its policies. The ECO is responsible for establishing a mechanism to foster employee reporting of incidents of illegal, unethical, or improper practices in a safe and confidential environment.

The ECOs monitor and audit procedures to determine compliance with policies and to make recommendations for policy enhancements to the President and CEO, VPOs, Laboratory Director or other appropriate individuals within the laboratory. The ECO will assist the laboratory QA Manager in the coordination of internal auditing of ethical policy related activities and processes within the laboratory, in conjunction with the laboratories regular internal auditing function.

The ECOs will also participate in investigations of alleged violations of policies and work with the appropriate internal departments to investigate misconduct, remedy the situation, and prevent recurrence of any such activity.

4.2.13 Chief Information Officer (CIO)

The CIO is responsible for establishing, implementing and communicating TestAmerica's Information Technology (IT) Policies, SOPs and Manuals. Other responsibilities include coordinating new technologies, development of electronic communication tools such as TestAmerica's intranet and internet sites, ensuring data security and documentation of software, ensuring compliance with the NELAC standard, and assistance in establishing, updating, and maintaining Laboratory Information Management Systems (LIMS) at the various TestAmerica facilities.

4.2.14 Environmental Health and Safety Managers (Corporate)

The EHS Managers report directly to the VP-QA/EHS. The EHS Managers are responsible for the development and implementation of the TestAmerica Environmental, Health and Safety program. Responsibilities include:

- Consolidation and tracking all safety and health-related information and reports for the company, and managing compliance activities for TestAmerica locations
- Coordination/preparation of the Corporate Environmental, Health and Safety Manual Template that is used by each laboratory to prepare its own laboratory-specific Safety Manual/ CHP
- Preparation of information and training materials for laboratory EHS Coordinators
- Assistance in the internal and external coordination of employee exposure and medical monitoring programs to insure compliance with applicable safety and health regulations

- Serving as Department of Transportation (D.O.T.) focal point and providing technical assistance to location management
- Serving as Hazardous Waste Management main contact and providing technical assistance to location management

4.2.15 Laboratory Director

Pittsburgh's Laboratory Director is responsible for the overall quality, safety, financial, technical, human resource and service performance of the whole laboratory and reports to their respective GM. The Laboratory Director provides the resources necessary to implement and maintain an effective and comprehensive Quality Assurance and Data Integrity Program. The Laboratory Director can also serve as the Technical Manager.

Specific responsibilities include, but are not limited to:

- Providing one or more technical managers for the appropriate fields of testing. If the Technical Manager is absent for a period of time exceeding 15 consecutive calendar days, the Laboratory Director must designate another full time staff member meeting the qualifications of the Technical Manager to temporarily perform this function. If the absence exceeds 35 consecutive calendar days, the primary accrediting authority must be notified in writing.
- Ensuring that all analysts and supervisors have the appropriate education and training to properly carry out the duties assigned to them and ensures that this training has been documented.
- Ensuring that personnel are free from any commercial, financial and other undue pressures which might adversely affect the quality of their work.
- Ensuring TestAmerica's human resource policies are adhered to and maintained.
- Ensuring that sufficient numbers of qualified personnel are employed to supervise and perform the work of the laboratory.
- Ensuring that appropriate corrective actions are taken to address analyses identified as requiring such actions by internal and external performance or procedural audits. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs may be temporarily suspended by the Laboratory Director.
- Reviewing and approving all SOPs prior to their implementation and ensures all approved SOPs are implemented and adhered to.
- Pursuing and maintaining appropriate laboratory certification and contract approvals. Supports ISO 17025 requirements.
- Ensuring client specific reporting and quality control requirements are met.
- Captaining the management team, consisting of the QA Manager, the Technical Managers and the Department Managers.
- Monitoring the validity of the analyses performed and data generated in the laboratory.
- Providing training and development programs to applicable laboratory staff as new hires and, on a scheduled basis. Training includes instruction on calculations, instrumentation management to include troubleshooting and preventive maintenance.
- The Technical Manager meets the requirements specified in the Section 5.2.6.1 of the TNI standards.

4.2.16 Quality Assurance (QA) Manager or Designee

The QA Manager has responsibility and authority to ensure the continuous implementation of the quality system. The QA Manager reports directly to the Laboratory Director and their Corporate Quality Director. This position is able to evaluate data objectively and perform assessments without outside (e.g., managerial) influence. Corporate QA may be used as a resource in dealing with regulatory requirements, certifications and other quality assurance related items. The QA Manager directs the activities of the QA Specialists to accomplish specific responsibilities, which include, but are not limited to:

- Serving as the focal point for QA/QC in the laboratory.
- Having functions independent from laboratory operations for which he/she has quality assurance oversight.
- Maintaining and updating the QAM.
- Monitoring and evaluating laboratory certifications; scheduling proficiency testing samples.
- Monitoring and communicating regulatory changes that may affect the laboratory to management.
- Training and advising the laboratory staff on quality assurance/quality control procedures that are pertinent to their daily activities.
- Having documented training and/or experience in QA/QC procedures and the laboratory's Quality System.
- Having a general knowledge of the analytical test methods for which data audit/review is performed (and/or having the means of getting this information when needed).
- Arranging for or conducting internal audits on quality systems and the technical operation.
- Maintaining records of all ethics-related training, including the type and proof of attendance.
- Maintaining, improving, and evaluating the corrective action database and the corrective and preventive action systems.
- Notifying laboratory management of deficiencies in the quality system and ensuring corrective action is taken. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs shall be investigated following procedures outlined in Section 12 and if deemed necessary may be temporarily suspended during the investigation.
- Objectively monitoring standards of performance in quality control and quality assurance without outside (e.g., managerial) influence.
- Having the responsibility and final authority to accept or reject data and to stop work in progress in the event that procedures and practices compromise the validity and integrity of analytical data.
- Coordinating of document control of SOPs, MDLs, control limits, and miscellaneous forms and information. Controlling distribution of controlled documents.
- Reviewing a percentage of all final data reports for internal consistency, including Chain of Custody (COC), correspondence with the analytical request, batch QC status, completeness of any corrective action statements, 5% of calculations, format, holding time, sensibility and completeness of the project file contents.
- Reviewing of external audit reports and data validation requests.

- Following-up with audits to ensure client QAPP requirements are met.
- Establishing reporting schedule and preparation of various quality reports for the Laboratory Director, clients and/or Corporate QA.
- Approving quality control reference data in TALS.
- Developing suggestions and recommendations to improve quality systems.
- Researching current state and federal requirements and guidelines.
- Captaining the QA team to enable communication and to distribute duties and responsibilities.
- Ensuring Communication & monitoring standards of performance to ensure that systems are in place to produce the level of quality as defined in this document.
- Evaluating the thoroughness and effectiveness of training.
- Ensuring Compliance with ISO 17025, and other national and state programs

4.2.17 Technical Director

The Technical Director serves as a technical resource for TestAmerica's personnel and clients in their field of expertise. The Technical Director reports directly to the Laboratory Director. Specific responsibilities include, but are not limited to:

- Managing technical projects and evaluating technologies, reviewing technical data
- Solving technical problems in the laboratory including troubleshooting instruments and developing or modifying methods as needed to meet customer requirements.
- Maintaining and repairing analytical instruments to reduce downtime.
- Consulting with clients, regulators, and others regarding technical aspects of analyses.
- Suggesting and implementing process improvements to maximize productivity, save costs, and decrease turn-around time.
- Participating in TestAmerica's best practice process to spread best technical practices and developing TestAmerica Standard Operating Procedures (SOPs). Leads the implementation and follow-up of the best practices and SOPs in the laboratory.
- Evaluating and adapting new technologies and methodologies. Performs non-routine analysis as required to meet the needs of current long-term clients or as a means to capture new clients in support of business development efforts.
- Training analysts and technicians in area of expertise.
- Assisting with the development of health and safety protocols.
- Consulting with Project Managers and sales staff regarding analytical techniques and capabilities.
- Investigating issues raised by clients, QA, sales, and other departments to find root cause and implement corrective action and proper response.
- Contributing technical information and evaluation for deciding major new equipment purchases and capital expenditures.
- Ensuring compliance with ISO 17025, and other national and state programs

4.2.18 Quality Assurance Specialist

The QA Specialist is responsible for QA documentation and involvement in the following activities:

- Assisting the QA Manager in performing the annual internal laboratory audits, compiling the evaluation, and coordinating the development of an action plan to address any deficiency identified.
- Facilitating external audits, coordinating with the QA Manager and Laboratory Staff to address any deficiencies noted at the time of the audit and subsequently presented in the final audit report.
- Assisting the QA Manager in the preparation of new SOPs and in the maintenance of existing SOPs, coordinating annual reviews and updates.
- Managing the performance testing (PT) studies, coordinates follow up studies for failed analytes and works with QA Manager and Laboratory Staff to complete needed corrective action reports.
- Assisting with review and maintenance of training records.
- Assisting the Quality Manager and Project Management Group in the review of program plans for consistency with organizational and contractual requirements. Summarize and convey to appropriate personnel anomalies or inconsistencies observed in the review process.
- Assisting with management of and applications for certifications and accreditations.
- Monitoring for compliance the following QA Metrics: temperature monitoring of refrigeration units and incubators; thermometer calibrations; balance calibrations; Eppendorf/pipette calibrations; and proper standard/reagent storage.
- Performing Technical Data Audits and the Audit Miner data file review process for organic instrumentation. Maintain tracking of reviews.
- Assisting with technical review of data packages which require QA review.

4.2.19 Technical Manager / Department Manager

The Technical Manager reports directly to the Laboratory Director. The scope of responsibility ranges from the new-hire training and existing technology through the ongoing training and development programs for existing analysts and new instrumentation and for compliance with the ISO 17025 Standard. Specific responsibilities include, but are not limited to:

- Exercising day-to-day supervision of laboratory operations for the appropriate field of accreditation and reporting of results. Coordinating, writing, and reviewing preparation of all test methods, i. e., SOPs, with regard to quality, integrity, regulatory and optimum and efficient production techniques, and subsequent analyst training and interpretation of the SOPs for implementation and unusual project samples. He/she insures that the SOPs are properly managed and adhered to at the bench. He/she develops standard costing of SOPs to include supplies, labor, overhead, and capacity (design vs. demonstrated versus first-run yield) utilization.
- Reviewing and approving, with input from the QA Manager, proposals from marketing, in accordance with an established procedure for the review of requests and contracts. This procedure addresses the adequate definition of methods to be used for analysis and any limitations, the laboratory's capability and resources, the client's expectations. Differences are resolved before the contract is signed and work begins. A system documenting any significant changes is maintained, as well as pertinent discussions with the client regarding their requirements or the results of the analyses during the performance of the contract. All

work subcontracted by the laboratory must be approved by the client. Any deviations from the contract must be disclosed to the client. Once the work has begun, any amendments to the contract must be discussed with the client and so documented.

- Monitoring the validity of the analyses performed and data generated in the laboratory. This activity begins with reviewing and supporting all new business contracts, insuring data quality, analyzing internal and external non-conformances to identify root cause issues and implementing the resulting corrective and preventive actions, facilitating the data review process (training, development, and accountability at the bench), and providing technical and troubleshooting expertise on routine and unusual or complex problems.
- Providing training and development programs to applicable laboratory staff as new hires and, subsequently, on a scheduled basis. Training includes instruction on calculations, instrumentation management to include troubleshooting and preventive maintenance.
- Enhancing efficiency and improving quality through technical advances and improved LIMS utilization. Capital forecasting and instrument life cycle planning for second generation methods and instruments as well as asset inventory management.
- Coordinating sample management from “cradle to grave,” insuring that no time is lost in locating samples.
- Scheduling all QA/QC-related requirements for compliance, e.g., MDLs, etc..
- Captaining department personnel to communicate quality, technical, personnel, and instrumental issues for a consistent team approach.
- Coordinating audit responses with the QA Manager.
- Ensuring compliance with ISO 17025, and other national and state programs

4.2.20 Manger of Project Management

The Manager of Project Management reports directly to the Client Services Director with dotted line reporting to the Laboratory Director. There is an entire staff of Project Managers that makes up the Project Management team. With the overall goal of total client satisfaction. In addition to the responsibilities of the Project Manager, listed in section 4.2.10, the MPM’s responsibilities include, but are not limited to:

- Training project managers in technical procedures and promoting the growth of the Project Management Team
- Acting as liaison between laboratory management and the Project Management Team
- Managing human resources for the Project Management Team

4.2.21 Project Manager

The PM reports to the Manager of Project Management and serves as the interface between the laboratory’s technical departments and the laboratory’s clients. The responsibilities of this position include, but are not limited to:

- Ensuring that clients receive the proper sampling supplies
- Responding to client inquiries concerning sample status
- Assisting clients with the resolution of problems concerning COC

- Ensuring that client specifications, when known, are met by communicating project and quality assurance requirements to the laboratory
- Notifying the supervisors of incoming projects and sample delivery schedules
- Maintaining communication with clients on sample progress from daily status meeting with agreed-upon due dates
- Discussing with client any project-related problems, resolving service issues, and coordinating technical details with the laboratory staff
- Familiarizing laboratory staff with specific quotes, sample log-in review, and final report completeness
- Informing QA Manager of special client requests that are outside of standard operating procedure
- Monitoring the status of all data package projects in-house to ensure timely and accurate delivery of reports
- Informing clients of data package-related problems and resolve service issues
- Coordinating requests for sample containers and other services

4.2.22 Project Manager Assistant (PMA)

The PMA reports to the Manager of Project Management and serves as the interface between the laboratory's technical departments and the laboratory's clients. The responsibilities of this position include, but are not limited to:

- Collating data reports, expanded deliverables and CLP data packages for delivery to clients and reviews for accuracy
- Assisting the CSMs and PMs in the reporting process
- Printing reports as needed for Project Managers
- Monitoring report due dates for timely delivery
- Providing clerical support to the CSMs, PMs and other laboratory staff as needed
- Generating credit or debit invoices to ensure proper payment in compliance with client requirements as established and communicated
- Sending final data to clients via email or courier

4.2.23 Team Leader/Supervisor

The Team Leader/Supervisor reports directly to the Organics or Inorganics Manager and/or Laboratory Director or designee. The responsibilities of this position include, but are not limited to:

- Ensuring that analysts in their department adhere to applicable SOPs and the QA Manual. He/she performs frequent SOP review to determine if analysts are in compliance and if new, modified, and optimized measures are feasible and should be added to these documents.
- Overseeing training, development of performance objectives and standards of performance, appraisal (measurement of objectives), scheduling, counseling, discipline, and motivation of analysts and documents these activities in accordance with systems developed by the QA and Personnel Departments.
- Providing guidance to analysts in resolving problems encountered daily during sample prep/analysis in conjunction with the Technical Manager(s) and/or QA Manager. Each is

responsible ensuring 100% implementation of the data review and documentation, non-conformance and corrective action issues, the timely and accurate completion of performance evaluation samples and MDLs, for his/her department.

- Ensuring that all logbooks are maintained, current, and properly labeled or archived.
- Ensuring that all data is properly entered into the LIMS system and is reviewed and approved as required by laboratory documentation policy.
- Reporting all non-conformance conditions to the QA Manager and Department Manager.
- Ensuring that preventive maintenance is performed on instrumentation as detailed in the QA Manual or SOPs. He/she is responsible for developing and implementing a system for preventive maintenance, troubleshooting, and repairing or arranging for repair of instruments.
- Maintaining adequate and valid inventory of reagents, standards, spare parts, and other relevant resources required to perform daily analysis.
- Achieving optimum turnaround time on analyses and compliance with holding times.
- Assisting QA department with root cause investigations and corrective action proposals for responses to external and internal audit issues, system failures and client complaints.

4.2.24 Laboratory Analyst

Laboratory analysts are responsible for conducting analysis and performing all tasks assigned to them by the team leader or supervisor. The responsibilities of the analysts include, but are not limited to:

- Performing analyses by adhering to analytical and quality control protocols prescribed by current SOPs, this QA Manual, and project-specific plans honestly, accurately, timely, safely, and in the most cost-effective manner.
- Ensuring sample and data integrity by adhering to internal chain-of-custody procedures.
- Documenting standard and sample preparation, instrument calibration and maintenance, data calculations, sample matrix effects, and any observed non-conformance on bench sheets, lab notebooks, run logs, and/or the Non-Conformance Database.
- Reporting all non-conformance situations, instrument problems, matrix problems and QC failures, which might affect the reliability of the data, to their supervisor, Department Manager, and/or the QA Manager or member of QA staff.
- Performing 100% review of the data generated prior to entering and submitting for secondary level review. Performs data processing using available tools/software.
- Suggesting method improvements to their supervisor, the Technical Manager (s), and the QA Manager. These improvements, if approved, will be incorporated. Ideas for the optimum performance of their assigned area, for example, through the proper cleaning and maintenance of the assigned instruments and equipment, are encouraged.
- Working cohesively as a team in their department to achieve the goals of accurate results, optimum turnaround time, cost effectiveness, cleanliness, complete documentation, and personal knowledge of environmental analysis.
    - A “work cell” is considered to be all those individuals who see a sample through the complete process of preparation, extraction, and analysis. To ensure that the entire preparation, extraction, and analysis process is completed by a group of capable individuals, the laboratory shall ensure that each member of the work cell (including a new member entering an already existing work cell) demonstrates capability in his/her area of responsibility in the sequence. Even though the work cell operates as a “team,”

the demonstration of capability at each individual step in the sequence, as performed by each individual analyst/team member, remains of utmost importance. A work cell may NOT be defined as a group of analysts who perform the same step in the same process (for example, extractions for Method 8270), represented by one analyst who has demonstrated capability for that step.

4.2.25 Sample Management Manager

The Sample Receiving/Login Manager reports to the Laboratory Director and Client Services Manager. The responsibilities of this position include, but are not limited to:

- Ensuring implementation of proper sample receipt procedures, including maintenance of chain-of-custody.
- Reporting nonconformances associated with condition-upon-receipt of samples.
- Ensuring accurate login of samples into the LIMS.
- Ensuring that all samples are stored in the proper environment.
- Assisting Environmental Health and Safety staff with sample disposal.

4.2.26 Field Service Technician

The Field Service Technicians report to the Sample Management Department Manager. The responsibilities of the Field Service Technician include, but are not limited to:

- Performing sample collection and sample pick-up
- Ensuring sample containers are prepared for sampling
- Performing field tests and measurements and operating and maintaining equipment used for those purposes.

4.2.27 Environmental Health and Safety Coordinator

The Health and Safety Coordinator reports to the Laboratory Director and ensures that systems are maintained for the safe operation of the laboratory. The EH&S Coordinator :

- Conduct ongoing, necessary safety training and conduct new employee safety orientation.
- Assist in developing and maintaining the Chemical Hygiene/Safety Manual.
- Administer dispersal of all Safety Data Sheet (SDS) information.
- Perform regular chemical hygiene and housekeeping instruction.
- Give instruction on proper labeling and practice.
- Serve as chairman of the laboratory safety committee.
- Provide and train personnel on protective equipment.
- Oversee the inspection and maintenance of general safety equipment – fire extinguishers, safety showers, eyewash fountains, etc. and ensure prompt repairs as needed.
- Supervise and schedule fire drills and emergency evacuation drills.
- Determine what initial and subsequent exposure monitoring, if necessary to determine potential employee exposure to chemicals used in the laboratory.
- When determined necessary, conduct exposure monitoring assessments.
- Determine when a complaint of possible over-exposure is “reasonable” and should be referred for medical consultation.
- Assist in the internal and external coordination of the medical consultation/monitoring program conducted by TestAmerica’s medical consultants.

4.2.28 Hazardous Waste Coordinator

The Hazardous Waste Coordinator reports directly to the Laboratory Director. The duties include, but are not limited to:

- Staying current with the hazardous waste regulations
- Continuing training on hazardous waste issues
- Reviewing and updating annually the Hazardous Waste Contingency Plan in the Environmental Health & Safety Manual
- Auditing the staff with regard to compliance with the Hazardous Waste Contingency Plan
- Contacting the hazardous waste subcontractors for review of procedures and opportunities for minimization of waste

4.3 DEPUTIES

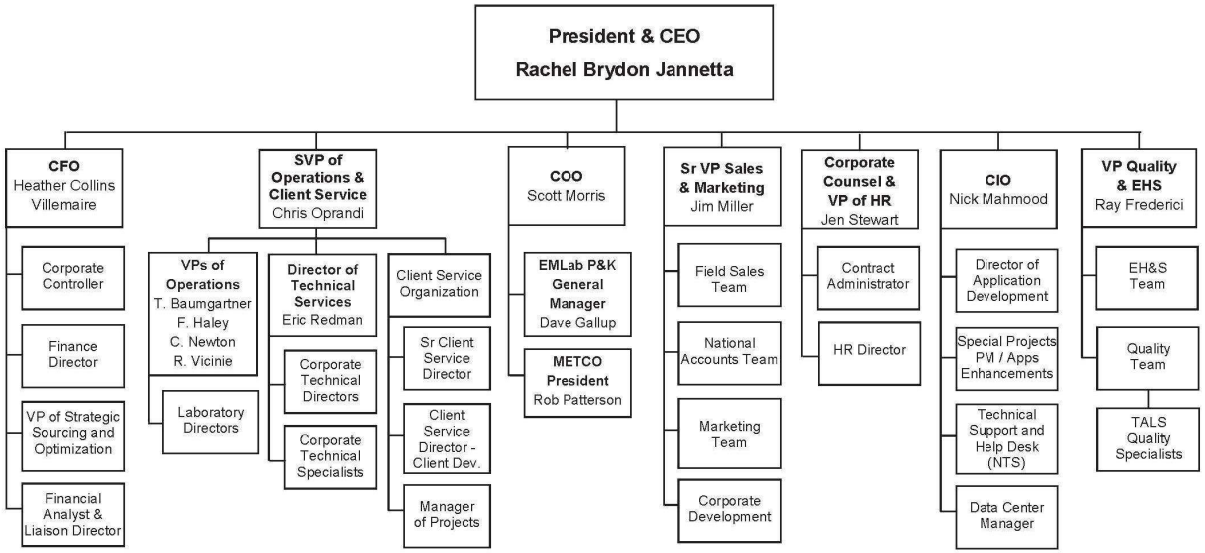
The following table defines who assumes the responsibilities of key personnel in their absence:

Key Personnel	Deputy	Comment
Laboratory Director: Deborah Lowe	Project Technical Manager – Dave Dunlap	NELAP Technical Manager (entire laboratory)
Quality Assurance Manager: Virginia Zusman	Quality Assurance Specialist: Pam Dudeck	
Technical Director: Larry Matko	Laboratory Director: Deborah Lowe	NELAP Technical Manager (Lipids & 8141)
Organics Department Manager: Sharon Bacha	Designated Senior GC and GCMS Analyst	NELAP Technical Manager (Organics)
Inorganics Department Manager: Roseann Ruyechan	Designated Metals and Wet Chemistry Supervisors / Senior Analyst	NELAP Technical Manager (Inorganics, Inorganics-Non-metals)
Organic Prep Team Leader: Sharon Bacha/Larry Matko	Designated Senior Organic Prep Analyst	
Sample Management Department Manager: Christina Kovitch	Lab Director or Designated person in the Sample Management group	

If the NELAP Technical Manager is absent for a period of time exceeding 15 consecutive calendar days, the Laboratory Director must designate another full time staff member meeting the qualifications of the Technical Manager to temporarily perform this function. If the absence exceeds 35 consecutive calendar days, the primary accrediting authority must be notified in writing.

Figure 4-1 - Corporate and Laboratory Organization Charts **Executive Committee**

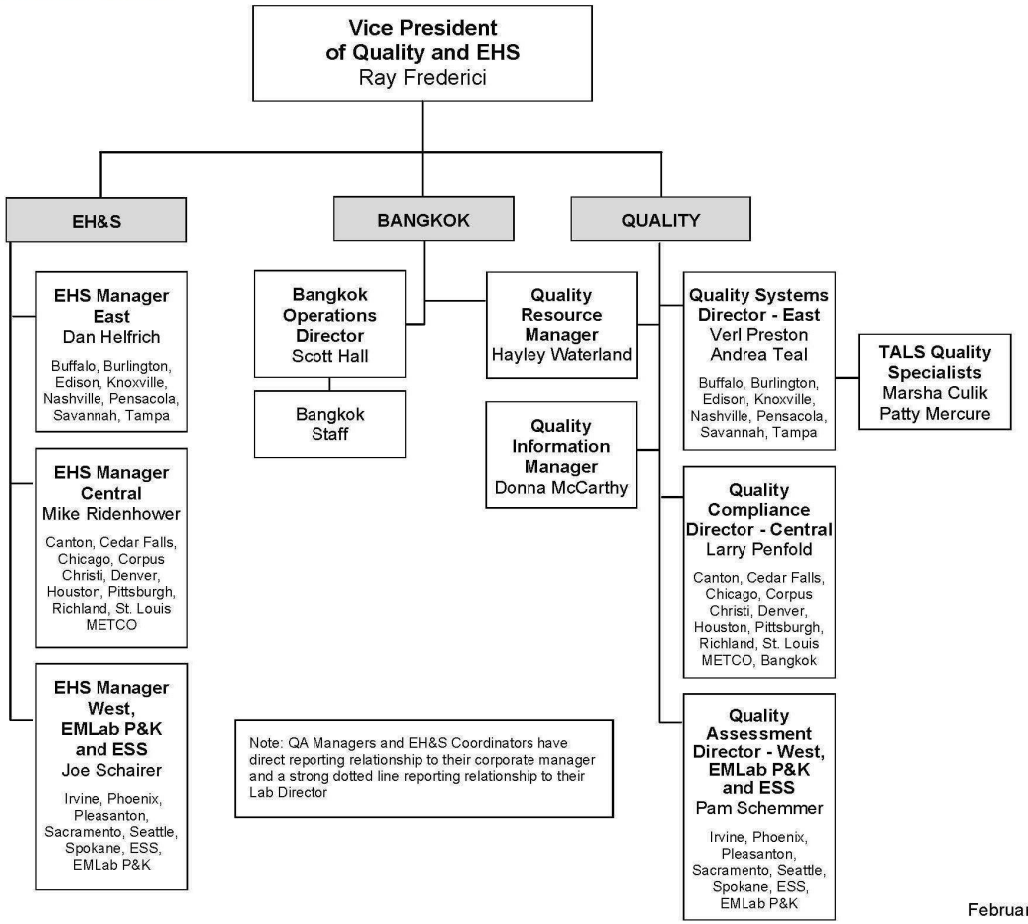
TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING



Note: Organization Charts are subject to change, contact the laboratory for the most recent version

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

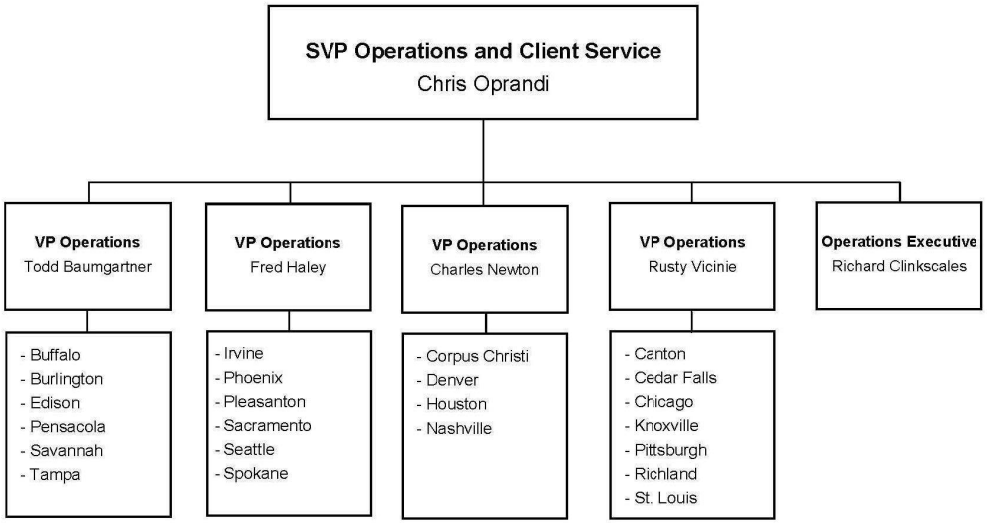
Quality, EHS, Bangkok



February 24 2017

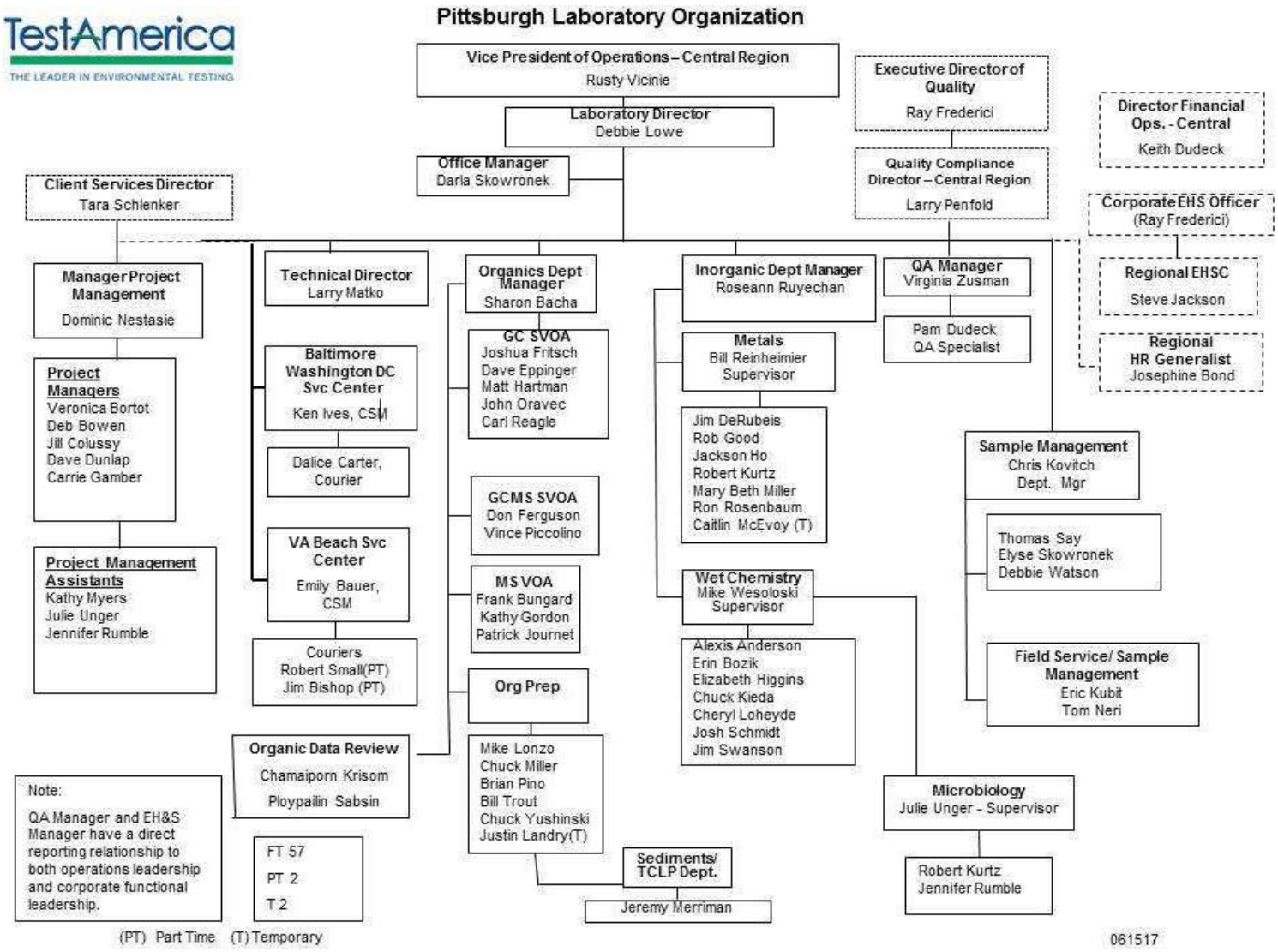
Note: Organization Charts are subject to change, contact the laboratory for the most recent version

TestAmerica Laboratories Operations



February 24, 2017

Note: Organization Charts are subject to change, contact the laboratory for the most recent version



Note: Organization Charts are subject to change, contact the laboratory for the most recent version

SECTION 5

QUALITY SYSTEM

5.1 Quality Policy Statement

It is TestAmerica's Policy to:

- Provide data of known quality to its clients by adhering to approved methodologies, regulatory requirements and the QA/QC protocols.
- Effectively manage all aspects of the laboratory and business operations by the highest ethical standards.
- Continually improve systems and provide support to quality improvement efforts in laboratory, administrative and managerial activities. TestAmerica recognizes that the implementation of a quality assurance program requires management's commitment and support as well as the involvement of the entire staff.
- Provide clients with the highest level of professionalism and the best service practices in the industry.
- To comply with the ISO/IEC 17025:2005(E) International Standard, the 2009 TNI Standard and to continually improve the effectiveness of the management system.

Every staff member at the laboratory plays an integral part in quality assurance and is held responsible and accountable for the quality of their work. It is, therefore, required that all laboratory personnel are trained and agree to comply with applicable procedures and requirements established by this document.

5.2 Ethics And Data Integrity

TestAmerica is committed to ensuring the integrity of its data and meeting the quality needs of its clients. The elements of TestAmerica's Ethics and Data Integrity Program include:

- Ethics Policy (Corporate Policy No. CW-L-P-004) and Employee Ethics Statements
- Ethics and Compliance Officers (ECOs)
- A Training Program
- Self-governance through disciplinary action for violations
- A Confidential mechanism for anonymously reporting alleged misconduct and a means for conducting internal investigations of all alleged misconduct. (Corporate SOP No. CW-L-S-002)
- Procedures and guidance for recalling data if necessary (Corporate SOP No. CW-Q-S-005)
- Effective external and internal monitoring system that includes procedures for internal audits (Section 15, laboratory SOP No. PT-QA-002, Internal Auditing)
- Produce results, which are accurate and include QA/QC information that meets client pre-defined Data Quality Objectives (DQOs)
- Present services in a confidential, honest and forthright manner
- Provide employees with guidelines and an understanding of the Ethical and Quality Standards of our Industry
- Operate our facilities in a manner that protects the environment and the health and safety of employees and the public

- Obey all pertinent federal, state and local laws and regulations and encourage other members of our industry to do the same
- Educate clients as to the extent and kinds of services available
- Assert competency only for work for which adequate personnel and equipment are available and for which adequate preparation has been made
- Promote the status of environmental laboratories, their employees, and the value of services rendered by them

5.3 Quality System Documentation

The laboratory's Quality System is communicated through a variety of documents.

- Quality Assurance Manual – Each laboratory has a lab specific quality assurance manual.
- Corporate SOPs and Policies - Corporate SOPs and Policies are developed for use by all relevant laboratories. They are incorporated into the laboratory's normal SOP distribution, training and tracking system. Corporate SOPs may be general or technical.
- Work Instructions - A subset of procedural steps, tasks or forms associated with an operation of a management system (e.g., checklists, preformatted bench sheets, forms).
- Laboratory SOPs – General and Technical
- Laboratory QA/QC Policy Memorandums

5.3.1 Order of Precedence

In the event of a conflict or discrepancy between policies, the order of precedence is as follows:

- Corporate Quality Management Plan (CQMP)
- Corporate SOPs and Policies
- Laboratory QA/QC Policy Memorandum
- Laboratory Quality Assurance Manual (QAM)
- Laboratory SOPs and Policies
- Other (Work Instructions (WI), memos, flow charts, etc.)

Note: The laboratory has the responsibility and authority to operate in compliance with regulatory requirements of the jurisdiction in which the work is performed. Where the CQMP conflicts with those regulatory requirements, the regulatory requirements of the jurisdiction shall hold primacy. The laboratory's QAM shall take precedence over the CQMP in those cases.

5.4 QA/QC Objectives For The Measurement Of Data

Quality Assurance (QA) and Quality Control (QC) are activities undertaken to achieve the goal of producing data that accurately characterize the sites or materials that have been sampled. Quality Assurance is generally understood to be more comprehensive than Quality Control. Quality Assurance can be defined as the integrated system of activities that ensures that a product or service meets defined standards.

Quality Control is generally understood to be limited to the analyses of samples and to be synonymous with the term *"analytical quality control"*. QC refers to the routine application of statistically based procedures to evaluate and control the accuracy of results from analytical measurements. The QC program includes procedures for estimating and controlling precision and bias and for determining reporting limits.

Request for Proposals (RFPs) and Quality Assurance Project Plans (QAPP) provide a mechanism for the client and the laboratory to discuss the data quality objectives in order to ensure that analytical services closely correspond to client needs. The client is responsible for developing the QAPP. In order to ensure the ability of the laboratory to meet the Data Quality Objectives (DQOs) specified in the QAPP, clients are advised to allow time for the laboratory to review the QAPP before being finalized. Additionally, the laboratory will provide support to the client for developing the sections of the QAPP that concern laboratory activities.

Historically, laboratories have described their QC objectives in terms of precision, accuracy, representativeness, comparability, completeness, selectivity and sensitivity.

5.4.1 Precision

The laboratory objective for precision is to meet the performance for precision demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Precision is defined as the degree of reproducibility of measurements under a given set of analytical conditions (exclusive of field sampling variability). Precision is documented on the basis of replicate analysis, usually duplicate or matrix spike (MS) duplicate samples.

5.4.2 Accuracy

The laboratory objective for accuracy is to meet the performance for accuracy demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Accuracy is defined as the degree of bias in a measurement system. Accuracy may be documented through the use of laboratory control samples (LCS) and/or MS. A statement of accuracy is expressed as an interval of acceptance recovery about the mean recovery.

5.4.3 Representativeness

The laboratory objective for representativeness is to provide data which is representative of the sampled medium. Representativeness is defined as the degree to which data represent a characteristic of a population or set of samples and is a measurement of both analytical and field sampling precision. The representativeness of the analytical data is a function of the procedures used in procuring and processing the samples. The representativeness can be documented by the relative percent difference between separately procured, but otherwise identical samples or sample aliquots.

The representativeness of the data from the sampling sites depends on both the sampling procedures and the analytical procedures. The laboratory may provide guidance to the client regarding proper sampling and handling methods in order to assure the integrity of the samples.

5.4.4 Comparability

The comparability objective is to provide analytical data for which the accuracy, precision, representativeness and reporting limit statistics are similar to these quality indicators generated by other laboratories for similar samples, and data generated by the laboratory over time.

The comparability objective is documented by inter-laboratory studies carried out by regulatory agencies or carried out for specific projects or contracts, by comparison of periodically generated statements of accuracy, precision and reporting limits with those of other laboratories.

5.4.5 Completeness

The completeness objective for data is 90% (or as specified by a particular project), expressed as the ratio of the valid data to the total data over the course of the project. Data will be considered valid if they are adequate for their intended use. Data usability will be defined in a QAPP, project scope or regulatory requirement. Data validation is the process for reviewing data to determine its usability and completeness. If the completeness objective is not met, actions will be taken internally and with the data user to improve performance. This may take the form of an audit to evaluate the methodology and procedures as possible sources for the difficulty or may result in a recommendation to use a different method.

5.4.6 Selectivity

Selectivity is defined as: The capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. Target analytes are separated from non-target constituents and subsequently identified/detected through one or more of the following, depending on the analytical method: extractions (separation), digestions (separation), interelement corrections (separation), use of matrix modifiers (separation), specific retention times (separation and identification), confirmations with different columns or detectors (separation and identification), specific wavelengths (identification), specific mass spectra (identification), specific electrodes (separation and identification), etc..

5.4.7 Sensitivity

Sensitivity refers to the amount of analyte necessary to produce a detector response that can be reliably detected (Method Detection Limit) or quantified (Reporting Limit).

5.5 Criteria For Quality Indicators

The laboratory maintains a Quality Control Limit Summary (from LIMS) that contains tables that summarizes the precision and accuracy acceptability limits for analyses performed at TestAmerica Pittsburgh. This summary includes an effective date, is updated each time new limits are generated and is managed by the laboratory's QA department. Limits are archived within the LIMS when replaced. Unless otherwise noted, limits within these tables are laboratory generated. Some acceptability limits are derived from US EPA methods when they are required. Where US EPA method limits are not required, the laboratory has developed limits from evaluation of data from similar matrices. Criteria for development of control limits is contained in Section 24 and laboratory SOP No. PT-QA-021, *Laboratory Quality Control Program*.

5.6 Statistical Quality Control

Statistically-derived precision and accuracy limits are required by selected methods (such as SW-846) and programs. The laboratory routinely utilizes statistically-derived limits to evaluate method performance and determine when corrective action is appropriate. Analysts are restricted to using only the current limits within LIMS, controlled as discussed above. The

Quality Assurance department maintains an archive of all limits used within the laboratory. These limits are maintained in the LIMS as part of the analytical historical record. If a method defines the QC limits, the method limits are used. For further details refer to SOP No. PT-QA-021.

If a method, or program, defines the QC limits, the required limits are used, unless laboratory developed limits are tighter.

If a method requires the generation of historical limits, the lab develops such limits from recent data in the QC database of the LIMS following the guidelines described in Section 24 and laboratory SOP No. PT-QA-021. All calculations and limits are documented and dated when approved and effective. On occasion, a client may request contract-specified limits for a specific project.

Current QC limits are entered and maintained in the LIMS analyte database. As sample results and the related QC are entered into LIMS, the sample QC values are compared with the limits in LIMS to determine if they are within the acceptable range. The analyst then evaluates if the sample needs to be rerun or re-extracted/rerun or if a comment should be added to the report explaining the reason for the QC outlier.

5.6.1 QC Charts

The generation and use of QC Charts (Control Charts) are described in laboratory SOP No. PT-QA-021. The QA department evaluates control charts to determine if adjustments need to be made or for corrective actions to methods. All findings are documented and kept on file.

5.7 Quality System Metrics

In addition to the QC parameters discussed above, the entire Quality System is evaluated on a monthly basis through the use of specific metrics (refer to Section 16). These metrics are used to drive continuous improvement in the laboratory's Quality System.

5.8 Laboratory Certification/Accreditation

The Laboratory Quality System is designed to meet the requirements of all governing bodies through which it holds certification / accreditation.

- A list of certifications and accredited scopes is maintained by the QA Department, and current certificates are posted in the laboratory lobby. Expired certificates are maintained in the QA archive.
- Certification renewal is completed on an annual basis for most state agencies.
- The laboratory indicates clearly in its reports which certifications it holds. This list includes which test methods and analytes are not covered under the applicable certification.
- If certification is lost or suspended, the laboratory shall update the reporting information to reflect this.

SECTION 6

DOCUMENT CONTROL

6.1 Overview

The QA Department is responsible for the control of documents used in the laboratory to ensure that approved, up-to-date documents are in circulation and out-of-date (obsolete) documents are archived or destroyed. The following documents, at a minimum, must be controlled:

- Laboratory Quality Assurance Manual
- Laboratory Standard Operating Procedures (SOP)
- Laboratory Policies
- Work Instructions and Forms
- Logbooks and Calculation Spreadsheets
- Corporate Policies and Procedures distributed outside the intranet
- External documents that are used as part of the laboratory's Quality System

Corporate Quality posts Corporate Manuals, SOPs, Policies, Work Instructions, White Papers and Training Materials on the company intranet site. These Corporate documents are only considered controlled when they are read on the intranet site. Printed copies are considered uncontrolled unless the laboratory physically distributes them as controlled documents. A detailed description of the procedure for issuing, authorizing, controlling, distributing, and archiving Corporate documents is found in Corporate SOP No. CW-Q-S-001, *Corporate Document Control and Archiving*. The laboratory's internal document control procedure is defined in laboratory SOP No. PT-QA-010, *Document Development and Control*.

The laboratory QA Department also maintains access to various references and document sources integral to the operation of the laboratory. This includes reference methods and regulations. Instrument manuals (hard or electronic copies) are also maintained by the laboratory.

The laboratory maintains control of records for raw analytical data and supporting records such as audit reports and responses, logbooks, standard logs, training files, MDL studies, Proficiency Testing (PT) studies, certifications and related correspondence, and corrective action reports and Nonconformance Memos (NCMs). Raw analytical data consists of bound logbooks, instrument printouts, any other notes, magnetic media, electronic data and final reports.

6.2 Document Approval And Issue

The pertinent elements of a document control system for each document include a unique document title and number, pagination, the total number of pages of the item or and 'end of document' page, the effective date, revision number and the laboratory's name. The QA personnel are responsible for the maintenance of this system.

Controlled documents are authorized by the QA Department. In order to develop a new document, a technical or department manager submits an electronic or paper draft to the QA Department for suggestions and approval before use. Upon approval, QA personnel add the identifying version information to the document and retain that document as the official document on file. That document is then provided to all applicable operational units (may

include electronic access). Controlled documents are identified as such and records of their distribution are kept by the QA Department. Document control may be achieved by either electronic or hardcopy distribution.

The QA Department maintains a list of the official versions of controlled documents.

Quality System Policies and Procedures will be reviewed at a minimum of every two years, or more often as required, and revised as appropriate. Changes to documents occur when a procedural change warrants.

6.3 Procedures For Document Control Policy

For creation of or changes to SOPs and QA manual, refer to Corporate SOP No. CW-Q-S-002, *Writing a Standard Operating Procedure (SOP)* and laboratory SOP No. PT-QA-010. The laboratory SOP also defines the process of revising SOPs.

Uncontrolled copies must not be used within the laboratory. Controlled documents are marked as such, and posted to the intranet (OASIS) SharePoint site by the QA department. Controlled distribution is achieved electronically. Previous revisions and back-up data are stored on a restricted access drive by the QA department. Details of the numbering system, required format, and controlled distribution of documents are described in laboratory SOP No. PT-QA-010. Editable copies are stored on a restricted access drive.

Forms, worksheets, work instructions and information are organized by department by the QA office. Controlled electronic versions are distributed through the intranet and hard copies can be printed out as needed. Editable versions are stored on a restricted access drive. All forms used in the laboratory are tracked in the controlled documents database which can be accessed by the QA department and the IT group. The procedure for the care of these documents is in laboratory SOP No. PT-QA-010.

6.4 Obsolete Documents

All invalid or obsolete documents are removed from general laboratory access, or otherwise prevented from unintended use. The laboratory has specific procedures as described above to accomplish this. In general, obsolete documents are collected from employees according to distribution lists and are marked obsolete on the cover or destroyed. At least one copy of the obsolete document is archived according to laboratory SOP No. PT-QA-019, *Records Information Management*.

SECTION 7

SERVICE TO THE CLIENT

7.1 Overview

The laboratory has established procedures for the review of work requests and contracts, oral or written. The procedures include evaluation of the laboratory's capability and resources to meet the contract's requirements within the requested time period. All requirements, including the methods to be used, must be adequately defined, documented and understood. For many environmental sampling and analysis programs, testing design is site or program specific and does not necessarily "fit" into a standard laboratory service or product. It is the laboratory's intent to provide both standard and customized environmental laboratory services to our clients.

A thorough review of technical and QC requirements contained in contracts is performed to ensure project success. The appropriateness of requested methods, and the lab's capability to perform them must be established. Projects, proposals and contracts are reviewed for adequately defined requirements and the laboratory's capability to meet those requirements. Alternate test methods that are capable of meeting the clients' requirements may be proposed by the lab. A review of the lab's capability to analyze non-routine analytes is also part of this review process.

All projects, proposals and contracts are reviewed for the client's requirements in terms of compound lists, test methodology requested, sensitivity (detection and reporting levels), accuracy, and precision requirements (%Recovery and RPD). The reviewer ensures that the laboratory's test methods are suitable to achieve these requirements and that the laboratory holds the appropriate certifications and approvals to perform the work. The laboratory and any potential subcontract laboratories must be certified, as required, for all proposed tests.

The laboratory must determine if it has the necessary physical, personnel and information resources to meet the contract, and if the personnel have the expertise needed to perform the testing requested. Each proposal is checked for its impact on the capacity of the laboratory's equipment and personnel. As part of the review, the proposed turnaround time will be checked for feasibility.

Electronic or hard copy deliverable requirements are evaluated against the laboratory's capacity for production of the documentation.

If the laboratory cannot provide all services but intends to subcontract such services, whether to another TestAmerica facility or to an outside firm, this will be documented and discussed with the client prior to contract approval. (Refer to Section 8 for Subcontracting Procedures.)

The laboratory informs the client of the results of the review if it indicates any potential conflict, deficiency, lack of accreditation, or inability of the lab to complete the work satisfactorily. Any discrepancy between the client's requirements and the laboratory's capability to meet those requirements is resolved in writing before acceptance of the contract. It is necessary that the contract be acceptable to both the laboratory and the client. Amendments initiated by the client and/or TestAmerica, are documented in writing.

All contracts, QAPPs, Sampling and Analysis Plans (SAPs), contract amendments, and documented communications become part of the project record.

The same contract review process used for the initial review is repeated when there are amendments to the original contract by the client, and the participating personnel are informed of the changes.

7.2 Review Sequence And Key Personnel

Appropriate personnel will review the work request at each stage of evaluation.

For routine projects and other simple tasks, a review by the Project Manager (PM) is considered adequate. The PM confirms that the laboratory has any required certifications, that it can meet the clients' data quality and reporting requirements and that the lab has the capacity to meet the clients turn around needs. It is recommended that, where there is a sales person assigned to the account, an attempt should be made to contact that sales person to inform them of the incoming samples.

For new, complex or large projects, the proposed contract is given to the Client Relationship Manager or Proposal Team, who will decide which lab will receive the work based on the scope of work and other requirements, including certification, testing methodology, and available capacity to perform the work. The contract review process is outlined in TestAmerica's Corporate Policy No. CA-L-P-002, *Contract Compliance Policy*.

This review encompasses all facets of the operation. The scope of work is distributed to the appropriate personnel, as needed based on scope of contract, to evaluate all of the requirements shown above (not necessarily in the order below):

- Contract Administrator
- VP of Operations
- The Laboratory Project Management
- The Laboratory Director / Technical Manager
- Laboratory and/or Corporate Quality
- Laboratory and/or Corporate EH&S
- The laboratory Project Manager reviews the formal laboratory quote. The Laboratory Director makes final acceptance for their facility.

The Sales Director, Contract Administrator, Account Executive or Proposal Coordinator then submits the final proposal to the client.

In the event that one of the above personnel is not available to review the contract, his or her back-up will fulfill the review requirements.

The Contracts Director maintains copies of all signed contracts. In the Pittsburgh laboratory, copies of contracts are maintained in the laboratory network public drive by the sales/marketing personnel.

7.3 Documentation

Appropriate records are maintained for every contract or work request. All stages of the contract review process are documented and include records of any significant changes. Contracts review documentation is forwarded to the Human Resources Coordinator and is maintained in the network public drive.

The contract will be distributed to and maintained by the appropriate sales/marketing personnel and the Account Manager. A copy of the contract and formal quote will be filed with the laboratory PM and the Lab Director.

Records are maintained of pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract. The PM keeps a phone log or electronic mail of conversations with the client.

7.3.1 Project-Specific Quality Planning

Communication of contract specific technical and QC criteria is an essential activity in ensuring the success of site specific testing programs. To achieve this goal, the laboratory assigns a PM to each client. It is the PM's responsibility to ensure that project-specific technical and QC requirements are effectively evaluated and communicated to the laboratory personnel before and during the project. QA department involvement may be needed to assist in the evaluation of custom QC requirements.

PM's are the primary client contact and they ensure resources are available to meet project requirements. Although PM's do not have direct reports or staff in production, they coordinate opportunities and work with laboratory management and supervisory staff to ensure available resources are sufficient to perform work for the client's project. Project management is positioned between the client and laboratory resources.

Prior to work on a new project, the dissemination of project information and/or project opening meetings may occur to discuss schedules and unique aspects of the project. Items to be discussed may include the project technical profile, turnaround times, holding times, methods, analyte lists, reporting limits, deliverables, sample hazards, or other special requirements. The PM introduces new projects to the laboratory staff through project kick-off meetings or to the supervisory staff during production meetings. These meetings provide direction to the laboratory staff in order to maximize production and client satisfaction, while maintaining quality. In addition, project notes may be associated with each sample batch as a reminder upon sample receipt and analytical processing.

During the project, any change that may occur within an active project is agreed upon between the client/regulatory agency and the PM/laboratory. These changes (e.g., use of a non-standard method or modification of a method) and approvals must be documented prior to implementation. Documentation pertains to any document, e.g., letter, e-mail, variance, contract addendum, which has been signed by both parties.

Such changes are also communicated to the laboratory during production and operations meetings. Such changes are updated to the project notes and are introduced to the managers at these meetings. The laboratory staff is then introduced to the modified requirements via the PM or the individual laboratory Technical Manager. After the modification is implemented into the

laboratory process, documentation of the modification is made in the case narrative of the data report(s).

The laboratory strongly encourages client visits to the laboratory and for formal/informal information sharing session with employees in order to effectively communicate ongoing client needs as well as project specific details for customized testing programs.

7.4 Special Services

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. It is the laboratory's goal to meet all client requirements in addition to statutory and regulatory requirements. The laboratory has procedures to ensure confidentiality to clients (Section 25).

The laboratory's standard procedures for reporting data are described in Section 25. Special services are also available and provided upon request. These services include:

- Reasonable access for our clients or their representatives to the relevant areas of the laboratory for the witnessing of tests performed for the client
- Assist client-specified third party data validators as specified in the client's contract
- Supplemental information pertaining to the analysis of their samples

  Note: An additional charge may apply for additional data/information that was not requested prior to the time of sample analysis or previously agreed upon.

7.5 Client Communication

Project managers are the primary communication link to the clients. They shall inform their clients of any delays in project completion as well as any non-conformances in either sample receipt or sample analysis. Project management will maintain ongoing client communication throughout the entire client project.

Technical or Department Managers, or their designees, are available to discuss any technical questions or concerns that the client may have.

7.6 Reporting

The laboratory works with our clients to produce any special communication reports required by the contract.

7.7 Client Surveys

The laboratory assesses both positive and negative client feedback. The results are used to improve overall laboratory quality, client service and testing activities. TestAmerica's Sales and Marketing teams periodically develops lab and client specific surveys to assess client satisfaction. Survey results and both complaints and compliments are tracked in the monthly quality metrics report.

SECTION 8

SUBCONTRACTING OF TESTS

8.1 Overview

For the purpose of this quality manual, the phrase subcontract laboratory refers to a laboratory external to the TestAmerica laboratories. The phrase "work sharing" refers to internal transfers of samples between the TestAmerica laboratories. The term outsourcing refers to the act of subcontracting tests.

When contracting with our clients, the laboratory makes commitments regarding the services to be performed and the data quality for the results to be generated. When the need arises to outsource testing for our clients because project scope, changes in laboratory capabilities, capacity or unforeseen circumstances, we must be assured that the subcontractors or work sharing laboratories understand the requirements and will meet the same commitments we have made to the client. Refer to Corporate SOP No. CA-L-S-004, *Subcontracting*, and CA-C-S-001, *Worksharing Process*.

When outsourcing analytical services, the laboratory will assure, to the extent necessary, that the subcontract or work sharing laboratory maintains a program consistent with the requirements of this document, the requirements specified in TNI/ISO 17025 and/or the client's Quality Assurance Project Plan (QAPP). All QC guidelines specific to the client's analytical program are transmitted to the subcontractor and agreed upon before sending the samples to the subcontract facility. Additionally, work requiring accreditation will be placed with an appropriately accredited laboratory. The laboratory performing the subcontracted work will be identified in the final report, as will non-TNI accredited work where required.

Project Managers (PMs) and Account Executives (AE) for the Export Lab (TestAmerica laboratory that transfers samples to another laboratory) are responsible for obtaining client approval prior to subcontracting any samples. The laboratory will advise the client of a subcontract arrangement in writing and when possible approval from the client shall be retained in the project folder. Standard TestAmerica Terms & Conditions include the flexibility to subcontract samples within the TestAmerica laboratories. Therefore, additional advance notification to clients for intra-laboratory subcontracting is not necessary unless specifically required by a client contract.

Note: In addition to the client, some regulating agencies, (e.g, USDA) or contracts may require notification prior to placing such work**.** Client notification and approval must be documented.

8.2 Qualifying And Monitoring Subcontractors

Whenever a PM, Account Executive (AE) or Customer Service Manager (CSM) becomes aware of a client requirement or laboratory need where samples must be outsourced to another laboratory, the other laboratory(s) shall be selected based on the following:

- Subcontractors specified by the client – In these circumstances, the client assumes responsibility for the quality of the data generated from the use of a subcontractor.
- Subcontractors reviewed by TestAmerica – Firms which have been reviewed by the company and are known to meet standards for accreditations (e.g. State, TNI); technical specifications; legal and financial information.

A list of vendors is available on the TestAmerica intranet site.

All TestAmerica laboratories are pre-qualified for work sharing provided they hold the appropriate accreditations, can adhere to the project/program requirements. Client approval is not necessary unless specifically required by the contract. The originating laboratory is responsible for communicating all technical, quality, and deliverable requirements as well as other contract needs. (See Corporate SOP No. CA-C-S-001 for details).

8.2.1 When the potential sub-contract laboratory has not been previously approved, Account Executives or PMs may nominate a laboratory as a subcontractor based on need. The decision to nominate a laboratory must be approved by the Laboratory Director. The Laboratory Director requests that the Project Manager or Account Executive begin the process of approving the subcontract laboratory as outlined in Corporate SOP No. CA-L-S-004, Subcontracting. The client must provide acknowledgement that the samples can be sent to that facility (an e-mail is sufficient documentation or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented).

Once the appropriate accreditation and legal information is received by the laboratory, it is evaluated for acceptability (where applicable) and forwarded to the Corporate Quality Information Manager (QIM) for review. After the Corporate QIM reviews the documents for completeness, the information is forwarded to the Finance Department for formal signature and contracting with the laboratory. The approved vendor will be added to the approved subcontractor list on the intranet site and the finance group is concurrently notified for JD Edwards.

The client will assume responsibility for the quality of the data generated from the use of a subcontractor they have requested the lab to use. The qualified subcontractors on the intranet site are known to meet minimal standards. TestAmerica does not certify laboratories. The subcontractor is on our approved list and can only be recommended to the extent that we would use them.

8.3 Oversight and Reporting

8.3.1 The status and performance of qualified subcontractors will be monitored periodically by the Corporate Quality department. Any problems identified will be brought to the attention of TestAmerica's Corporate Finance, Legal or Corporate Quality personnel.

- Complaints shall be investigated. Documentation of the complaint, investigation and corrective action will be maintained in the subcontractor's file on the intranet site. Complaints are posted using the Vendor Performance Report.
- Information shall be updated on the intranet when new information is received from the subcontracted laboratories.

Subcontractors in good standing will be retained on the intranet listing. CSO personnel will notify all TestAmerica laboratories, Corporate Quality and Corporate Contracts if any laboratory requires removal from the intranet site. This notification will be posted on the intranet site and e-mailed to all CSO personnel, Laboratory Directors, QA Managers, and Sales Personnel.

Prior to initially sending samples to the subcontracted laboratory, the PM confirms their certification status to determine if it's current and scope-inclusive. The information is documented within the project records.

8.3.2 For continued use of a subcontractor, verification of certification is placed upon the subcontractor for the defined project. Samples are subcontracted under Chain of Custody with the program defined as 'Accreditation Required' and the following statement for verification upon sample receipt:

Note: Since laboratory accreditations are subject to change, TestAmerica Laboratories, Inc. places the ownership of method, analyte & accreditation compliance upon our subcontract laboratories. This sample shipment is forwarded under Chain of Custody. If the laboratory does not currently maintain accreditation in the State of Origin listed above for analytes/tests/matrix being analyzed, the samples must be shipped back to the TestAmerica laboratory or other instructions will be provided. Any changes to accreditation status should be brought to TestAmerica Laboratories, Inc. attention immediately. If all requested accreditations are current to date, return the signed Chain of Custody attesting to said compliance to TestAmerica Laboratories, Inc.

For TestAmerica laboratories, certifications can be viewed on the company's TotalAccess Database.

8.3.3 All subcontracted samples must be accompanied by a TestAmerica Chain of Custody (COC). A copy of the original COC sent by the client must be available in TALS for all samples workshared within TestAmerica. Client COCs are only forwarded to external subcontractors when samples are shipped directly from the project site to the subcontractor lab. Under routine circumstances, client COCs are not provided to external subcontractors.

Through communication with the subcontracted laboratory, the PM monitors the status of the subcontracted analyses, facilitates successful execution of the work, and ensures the timeliness and completeness of the analytical report.

Non-TNI accredited work must be identified in the subcontractor's report as appropriate. If TNI accreditation is not required, the report does not need to include this information.

Reports submitted from subcontractor laboratories are not altered and are included in their original form in the final project report. This clearly identifies the data as being produced by a subcontractor facility. If subcontract laboratory data is incorporated into the laboratories EDD (i.e., imported), the report must explicitly indicate which lab produced the data for which methods and samples.

Note: The results submitted by a TestAmerica work sharing laboratory may be transferred electronically and the results reported by the TestAmerica work sharing lab are identified on the final report. The report must explicitly indicate which lab produced the data for which methods and samples. The final report must include a copy of the completed COC for all work sharing reports.

8.4 Contingency Planning

The full qualification of a subcontractor may be waived ~~process temporarily~~ to meet emergency needs; however, this decision & justification must be documented in the project files, and the 'Purchase Order Terms And Conditions For Subcontracted Laboratory Services' must be sent with the samples and COC.

In the event this provision is utilized, the laboratory (e.g., PM) will be required to verify and document the applicable accreditations of the subcontractor. All other quality and accreditation requirements will still be applicable, but the subcontractor need not have signed a subcontract with TestAmerica at this time.

The use of any emergency subcontractor will require the PM to complete a JDE New Vendor Add Form in order to process payment to the vendor and add them to TALS. This form requires the user to define the subcontractor's category/s of testing and the reason for testing.

SECTION 9

PURCHASING SERVICES AND SUPPLIES

9.1 Overview

Evaluation and selection of suppliers and vendors is performed, in part, on the basis of the quality of their products, their ability to meet the demand for their products on a continuous and short term basis, the overall quality of their services, their past history, and competitive pricing. This is achieved through evaluation of objective evidence of quality furnished by the supplier, which can include certificates of analysis, recommendations, and proof of historical compliance with similar programs for other clients. To ensure that quality critical consumables and equipment conform to specified requirements, which may affect quality, all purchases from specific vendors are approved by a member of the supervisory or management staff. Capital expenditures are made in accordance with Corporate SOP No. CW-F-S-007, *Fixed Asset Acquisitions, Retention and Safeguarding*.

Contracts will be signed in accordance with TestAmerica's Corporate Policy No. CW-F-P-002, *Company-Wide Authorization Matrix*. Request for Proposals (RFP's) will be issued where more information is required from the potential vendors than just price. Process details are available in TestAmerica's Corporate Policy No. CW-F-P-004, *Procurement and Contracts Policy*. RFP's allow TestAmerica to determine if a vendor is capable of meeting requirements such as supplying all of the TestAmerica facilities, meeting required quality standards and adhering to necessary ethical and environmental standards. The RFP process also allows potential vendors to outline any additional capabilities they may offer.

9.2 Glassware

Glassware used for volumetric measurements must be Class A or verified for accuracy according to laboratory procedure. Pyrex (or equivalent) glass should be used where possible. For safety purposes, thick-wall glassware should be used where available.

9.3 Reagents, Standards & Supplies

Purchasing guidelines for equipment and reagents must meet the requirements of the specific method and testing procedures for which they are being purchased. Solvents and acids are pre-tested in accordance with TestAmerica's Corporate SOP No. CA-Q-S-001, *Solvent & Acid Lot Testing and Approval Program*. Approval information for the solvents and acids tested under Corporate SOP No. CA-Q-S-001 is stored on the TestAmerica intranet SharePoint, under Solvent Approvals. A master list of all tested materials, as well as the certificates of analysis for the materials, is stored in the same location. Additional approval and traceability instructions

are found in laboratory SOP No. PT-QA-006, *Procurement of Standards and Materials; Labeling and Traceability*.

9.3.1 Purchasing

Chemical reagents, solvents, glassware, and general supplies are ordered as needed to maintain sufficient quantities on hand. Materials used in the analytical process must be of a known quality. The wide variety of materials and reagents available makes it advisable to specify recommendations for the name, brand, and grade of materials to be used in any determination. This information is contained in the method SOP. The analyst completes the Material Request Sheet when requesting reagents, standards, or supplies, or they may check the item out of the on-site consignment system that contains items approved for laboratory use.

If an item is not in the consignment system, the analyst must obtain approval from the area team leader/supervisor and Laboratory Director prior to placing the order. The analyst must provide the master item number (from the master item list that has been approved by the Technical Manager), item description, package size, catalogue page number, and the quantity needed. If an item being ordered is not the exact item requested, approval must be obtained from the Technical Manager prior to placing the order. The responsible section manager places the order.

9.3.2 Receiving

It is the responsibility of the Sample Receiving department to receive the shipment. It is the responsibility of the analyst or manager who ordered the materials to document the date the materials were received. Once the ordered reagents or materials are received, the analyst or designee compares the information on the label or packaging to the original order to ensure that the purchase meets the quality level specified. This is documented through the addition of the received date and reviewers initials to the packing slip.

Lot numbers of solvents and acids are checked against the approved solvent/acid list. If the material is listed as unapproved, or is not listed, it is sequestered and returned to the vendor. Alternatively, the laboratory may test the material for the intended use, and if it is acceptable, document the approval on the approval list. Records of any testing performed locally are maintained by the QA department, and lots approvals and certificates of analysis are stored on the TestAmerica intranet Pittsburgh SharePoint site.

Materials may not be released for use in the laboratory until they have been inspected, verified as suitable for use, and the inspection/verification has been documented.

Safety Data Sheets (SDSs) are available online through the Company's intranet website. Anyone may review these for relevant information on the safe handling and emergency precautions of on-site chemicals.

9.3.3 Specifications

Methods in use in the laboratory specify the grade of reagent that must be used in the procedure. If the quality of the reagent is not specified, analytical reagent grade will be used. It is the responsibility of the analyst to check the procedure carefully for the suitability of grade of reagent.

Chemicals must not be used past the manufacturer's expiration date and must not be used past the expiration time noted in a method SOP. If expiration dates are not provided, the laboratory may contact the manufacturer to determine an expiration date.

The laboratory assumes a five year expiration date on inorganic dry chemicals and solvents unless noted otherwise by the manufacturer or by the reference source method. Chemicals/solvents should not be used past the manufacturer's or SOPs expiration date unless 'verified' (refer to item 3 listed below).

- An expiration date **cannot** be extended if the dry chemical/solvent is discolored or appears otherwise physically degraded, the dry chemical/solvent must be discarded.

- Expiration dates can be extended if the dry chemical/solvent is found to be satisfactory based on acceptable performance of quality control samples (Continuing Calibration Verification (CCV), Blanks, Laboratory Control Sample (LCS), etc.).

- If the dry chemical/solvent is used for the preparation of standards, the expiration dates can be extended 6 months if the dry chemical/solvent is compared to an unexpired independent source in performing the method and the performance of the dry chemical/solvent is found to be satisfactory. The comparison must show that the dry chemical/solvent meets CCV limits. The comparison studies are maintained with each lab department and copy forwarded to QA department. Recertification is documented in the LIMS.

Wherever possible, standards must be traceable to national or international standards of measurement or to national or international reference materials. Records to that effect are available to the user.

Compressed gases in use are checked for pressure and secure positioning daily. The minimum total pressure must be 500 psig or the tank must be replaced. To prevent a tank from going to dryness, close observation of the tank gauge must take place as pressure decreases towards 500psig, or the tank must be replaced. The quality of the gases must meet method or manufacturer specification or be of a grade that does not cause any analytical interference.

Water used in the preparation of standards or reagents must have a specific conductivity of less than 1- µmho /cm (or specific resistivity of greater than 1.0 megohm-cm) at 25°C. The specific conductivity is checked and recorded daily. If the water's specific conductivity is greater than the specified limit, the Facility Manager and appropriate Technical Managers/Supervisors must be notified immediately in order to notify all departments, decide on cessation (based on intended use) of activities, and make arrangements for correction.

The laboratory may purchase reagent grade (or other similar quality) water for use in the laboratory. This water must be certified "clean" by the supplier for all target analytes or otherwise verified by the laboratory prior to use. This verification is documented.

Standard lots are verified before first time use if the laboratory switches manufacturers or has historically had a problem with the type of standard.

Purchased bottleware used for sampling must be certified clean and the certificates must be maintained. If uncertified sampling bottleware is purchased, all lots must be verified clean prior to use. This verification must be maintained.

NOTE: Each bottleware type must be documented as clean down to the laboratory MDL for all target analytes for use with samples from Wisconsin.

Records of manufacturer's certification and traceability statements are maintained in files or binders in each laboratory section. These records include date of receipt, lot number (when applicable), and expiration date (when applicable). Incorporation of the item into the record indicates that the analyst has compared the new certificate with the previous one for the same purpose and that no difference is noted, unless approved and so documented by the Department Manager or QA Manager.

9.3.4 Storage

Reagent and chemical storage is important from the aspects of both integrity and safety. Light-sensitive reagents may be stored in brown-glass containers. Storage conditions are per the Corporate Environmental Health & Safety Manual (Corp. Doc. No. CW-E-M-001), method SOPs, or manufacturer instructions.

9.4 Purchase Of Equipment / Instruments / Software

When a new piece of equipment is needed, either for additional capacity or for replacing inoperable equipment, the analyst or supervisor makes a supply request to the Department Manager and/or the Laboratory Director. If they agree with the request, the procedures outlined in Corporate Policy No. CA-T-P-001, *Qualified Products List*, are followed. A decision is made as to which piece of equipment can best satisfy the requirements. The appropriate written requests are completed and purchasing places the order.

Upon receipt of a new or used piece of equipment, an identification name is assigned and added to the equipment list. IT must also be notified so that they can synchronize the instrument for back-ups. Its capability is assessed to determine if it is adequate or not for the specific application. For instruments, a calibration curve is generated, followed by MDLs, Demonstration of Capabilities (DOCs), and other relevant criteria (refer to Section 19).

For software, its operation must be deemed reliable and evidence of instrument verification must be retained by the IT Department. Software certificates supplied by the vendors are filed with the LIMS Administrator. The manufacturer's operation manual is retained in the laboratory in a designated area or near the instrument.

9.5 Services

Service to analytical instruments (except analytical balances) is performed on an as needed basis. Routine preventative maintenance is discussed in Section 20. The need for service is determined by analysts and/or Technical Managers. The service providers that perform the services are approved by the Laboratory or Technical Director.

Analytical balances are serviced and calibrated annually in accordance with laboratory SOP No. PT-QA-012, *Selection and Calibration of Balances and Weights*. The calibration and maintenance services are performed on-site, and the balances are returned to use immediately following successful calibration. When the calibration certificates are received (usually within 24 hours of the service), they are reviewed, and documentation of the review is filed with the certificates. If the calibration was unsuccessful, the balance is immediately removed from service and segregated pending either further maintenance or disposal.

Calibration services for support equipment such as thermometers, weight sets, autopipettors, etc, are obtained from vendors with current and valid ISO 17025 accreditation for calibration of the specific piece of equipment. Prior to utilizing the vendor's services, the vendor's accreditation status is verified. Once the equipment has been calibrated, the calibration certificates are reviewed by the QA department, and documentation of the review is filed with the calibration certificates. The equipment is then returned to service within the laboratory.

9.6 Suppliers

TestAmerica selects vendors through a competitive proposal / bid process, strategic business alliances or negotiated vendor partnerships (contracts). This process is defined in the Corporate Policy No. CW-F-P-004. The level of control used in the selection process is dependent on the anticipated spending amount and the potential impact on TestAmerica business. Vendors that provide test and measuring equipment, solvents, standards, certified containers, instrument related service contracts or subcontract laboratory services shall be subject to more rigorous controls than vendors that provide off-the-shelf items of defined quality that meet the end use requirements. The JD Edwards purchasing system includes all suppliers/vendors that have been approved for use.

Evaluation of suppliers is accomplished by ensuring the supplier ships the product or material ordered and that the material is of the appropriate quality. This is documented by signing off on packing slips or other supply receipt documents. The purchasing documents contain the data that adequately describe the services and supplies ordered.

Any issues of vendor performance are to be reported immediately by the laboratory staff to the Corporate Purchasing Group by completing a Vendor Performance Report.

The Corporate Purchasing Group will work through the appropriate channels to gather the information required to clearly identify the problem and will contact the vendor to report the problem and to make any necessary arrangements for exchange, return authorization, credit, etc.

As deemed appropriate, the Vendor Performance Reports will be summarized and reviewed to determine corrective action necessary, or service improvements required by vendors

The laboratory has access to a listing of all approved suppliers of critical consumables, supplies and services. This information is provided through the JD Edwards purchasing system.

9.6.1 New Vendor Procedure

TestAmerica employees who wish to request the addition of a new vendor must complete a J.D. Edwards Vendor Add Request Form available on OASIS.

New vendors are evaluated based upon criteria appropriate to the products or services provided as well as their ability to provide those products and services at a competitive cost. Vendors are also evaluated to determine if there are ethical reasons or potential conflicts of interest with TestAmerica employees that would make it prohibitive to do business with them as well as their financial stability. The QA Department and/or the Technical Director are consulted with vendor and product selection that have an impact on quality.

SECTION 10

COMPLAINTS

10.1 Overview

The laboratory considers an effective client complaint handling processes to be of significant business and strategic value. Listening to and documenting client concerns captures 'client knowledge' that enables our operations to continually improve processes and client satisfaction. An effective client complaint handling process also provides assurance to the data user that the laboratory will stand behind its data, service obligations and products.

A client complaint is any expression of dissatisfaction with any aspect of our business services (e.g., communications, responsiveness, data, reports, invoicing and other functions) expressed by any party, whether received verbally or in written form. Client inquiries, complaints or noted discrepancies are documented, communicated to management, and addressed promptly and thoroughly.

The laboratory has procedures for addressing both external and internal complaints with the goal of providing satisfactory resolution to complaints in a timely and professional manner.

The nature of the complaint is identified, documented and investigated, and an appropriate action is determined and taken. In cases where a client complaint indicates that an established policy or procedure was not followed, the QA Department must evaluate whether a special audit must be conducted to assist in resolving the issue. A written confirmation or letter to the client, outlining the issue and response taken is recommended as part of the overall action taken.

The process of complaint resolution and documentation utilizes the procedures outlined in Section 12 (Corrective Actions) and is documented following laboratory SOP No. PT-QA-016, *Non-Conformance and Corrective Action System*.

10.2 External Complaints

An employee that receives a complaint initiates the complaint resolution process by first documenting the complaint in the database, according to laboratory SOP No. PT-QA-016.

Complaints fall into two categories: correctable and non-correctable. An example of a correctable complaint would be one where a report re-issue would resolve the complaint. An example of a non-correctable complaint would be one where a client complains that their data was repeatedly late. Non-correctable complaints should be reviewed for preventive action measures to reduce the likelihood of future occurrence and mitigation of client impact.

The general steps in the complaint handling process are:

- Receiving and Documenting Complaints
- Complaint Investigation and Service Recovery
- Process Improvement

The laboratory shall inform the initiator of the complaint of the results of the investigation and the corrective action taken, if any.

10.3 Internal Complaints

Internal complaints include, but are not limited to: errors and non-conformances, training issues, internal audit findings, and deviations from methods. Corrective actions may be initiated by any staff member who observes a nonconformance and shall follow the procedures outlined in Section 12. In addition, Corporate Management, Sales and Marketing and IT may initiate a complaint by contacting the laboratory or through the corrective action system described in Section 12.

10.4 Management Review

The number and nature of client complaints is reported by the QA Manager to the laboratory and Quality Director in the QA Monthly report. Monitoring and addressing the overall level and nature of client complaints and the effectiveness of the solutions is part of the Annual Management Review (Section 16).

SECTION 11

CONTROL OF NON-CONFORMING WORK

11.1 Overview

When data discrepancies are discovered or deviations and departures from laboratory SOPs, policies and/or client requests have occurred, corrective action is taken immediately. First, the laboratory evaluates the significance of the nonconforming work. Then, a corrective action plan is initiated based on the outcome of the evaluation. If it is determined that the nonconforming work is an isolated incident, the plan could be as simple as adding a qualifier to the final results and/or making a notation in the case narrative. If it is determined that the nonconforming work is a systematic or improper practices issue, the corrective action plan could include a more in depth investigation and a possible suspension of an analytical method. In all cases, the actions taken are documented using the laboratory's corrective action system (refer to Section 12).

Due to the frequently unique nature of environmental samples, sometimes departures from documented policies and procedures are needed. When an analyst encounters such a situation, the problem is presented to their manager for advice. The maanger may elect to discuss it with the Laboratory Director or QA Manager or have a PM contact the client to decide on a logical course of action. Once an approach is agreed upon, the analyst documents it using the laboratories non-conformance/corrective action system described in Section 12. This information can then be supplied to the client in the form of a case narrative with the report.

Project Management may encounter situations where a client may request that a special procedure be applied to a sample that is not standard lab practice. Based on a technical evaluation, the lab may accept or opt to reject the request based on technical or ethical merit. An example might be the need to report a compound that the lab does not normally report. The lab would not have validated the method for this compound following the procedures in Section 19. The client may request that the compound be reported based only on the calibration. Such a request would need to be approved by the Laboratory Director and QA Manager, documented and included in the project folder. Deviations **must** also be noted on the final report with a statement that the compound is not reported in compliance with TNI (or the analytical method) requirements and the reason. Data being reported to a non-TNI state would need to note the change made to how the method is normally run.

11.2 Responsibilities And Authorities

Under certain circumstances, the Laboratory Director, a Technical Manager, or a member of the QA team may authorize departures from documented procedures or policies. The departures may be a result of procedural changes due to the nature of the sample; a one-time procedure for a client; QC failures with insufficient sample to reanalyze, etc. In most cases, the client will be informed of the departure prior to the reporting of the data. Any departures must be well documented using the laboratory's corrective action procedures. This information is documented on a Nonconformance Memo (NCM) and may also be documented in logbooks and/or data review checklists as appropriate. Any impacted data must be referenced in a case narrative and/or flagged with an appropriate data qualifier.

Any misrepresentation or possible misrepresentation of analytical data discovered by any laboratory staff member must be reported to facility Senior Management within 24-hours. The Senior Management staff is comprised of the Laboratory Director, the QA Manager, and the Technical Managers. The reporting of issues involving alleged violations of the company's Data Integrity or Manual Integration procedures must be conveyed to an ECO (e.g., the VP-QA/EHS) and the laboratory's Quality Director within 24 hours of discovery.

Whether an inaccurate result was reported due to calculation or quantitation errors, data entry errors, improper practices, or failure to follow SOPs, the data must be evaluated to determine the possible effect.

The Laboratory Director, QA Manager, ECOs, VP of Operations, and the Quality Directors have the authority and responsibility to halt work, withhold final reports, or suspend an analysis for due cause as well as authorize the resumption of work.

11.3 Evaluation Of Significance And Actions Taken

For each nonconforming issue reported, an evaluation of its significance and the level of management involvement needed is made. This includes reviewing its impact on the final data, whether or not it is an isolated or systematic issue, and how it relates to any special client requirements.

Corporate SOP No. CW-Q-S-005, *Data Recalls*, is the procedure to be followed when it is discovered that erroneous or biased data may have been reported to clients or regulatory agencies.

Corporate SOP No. CW-L-S-002, *Internal Investigations*, is the procedure to be followed for investigation and correction of situations involving alleged incidents of misconduct or violation of the company's ethics policy.

Laboratory level decisions are documented and approved using the laboratory's standard nonconformance/corrective action reporting in lieu of the data recall determination form contained in TestAmerica's Corporate SOP No. CW-Q-S-005.

11.4 Prevention Of Nonconforming Work

If it is determined that the nonconforming work could recur, further corrective actions must be made following the laboratory's corrective action system. Periodically as defined by the laboratory's preventive action schedule, or on a monthly basis, the QA Department evaluates non-conformances to determine if any nonconforming work has been repeated multiple times. If so, the laboratory's corrective action process must be followed.

11.5 Method Suspension/Restriction (Stop Work Procedures)

In some cases, it may be necessary to suspend/restrict the use of a method or target compound which constitutes significant risk and/or liability to the laboratory. Suspension/restriction procedures can be initiated by any of the persons noted in Section 11.2, Paragraph 4.

Prior to suspension/restriction, confidentiality will be respected, and the problem with the required corrective and preventive action will be stated in writing and presented to the Laboratory Director.

The Laboratory Director shall arrange for the appropriate personnel to meet with the QA Manager as needed. This meeting shall be held to confirm that there is a problem, that suspension/restriction of the method is required and will be concluded with a discussion of the steps necessary to bring the method/target or test fully back on line. In some cases, that may not be necessary if all appropriate personnel have already agreed there is a problem and there is agreement on the steps needed to bring the method, target or test fully back on line. The QA Manager will also initiate a corrective action report as described in Section 12 if one has not already been started. A copy of any meeting notes and agreed upon steps should be faxed or e-mailed by the laboratory to the appropriate VP of Operations and member of Corporate QA. This fax/e-mail acts as notification of the incident.

After suspension/restriction, the lab will hold all reports to clients pending review. No faxing, mailing or distributing through electronic means may occur. The report must not be posted for viewing on the internet. It is the responsibility of the Laboratory Director to hold all reporting and to notify all relevant laboratory personnel regarding the suspension/restriction (e.g., Project Management, Log-in, etc.). Clients will NOT generally be notified at this time. Analysis may proceed in some instances depending on the non-conformance issue.

Within 72 hours, the QA Manager will determine if compliance is now met and reports can be released, OR determine the plan of action to bring work into compliance, and release work. A team, with all principals involved (Laboratory Director, Technical Manager, QA Manager) can devise a start-up plan to cover all steps from client notification through compliance and release of reports. Project Management, and the Directors of Client Services and Sales and Marketing must be notified if clients must be notified or if the suspension/restriction affects the laboratory's ability to accept work. The QA Manager must approve start-up or elimination of any restrictions after all corrective action is complete. This approval is given by final signature on the completed corrective action report.

SECTION 12

CORRECTIVE ACTION

12.1 Overview

A major component of TestAmerica's Quality Assurance (QA) Program is the problem investigation and feedback mechanism designed to keep the laboratory staff informed on quality related issues and to provide insight to problem resolution. When nonconforming work or departures from policies and procedures in the quality system or technical operations are identified, the corrective action procedure provides a systematic approach to assess the issues, restore the laboratory's system integrity, and prevent reoccurrence. Corrective actions are documented using Non-Conformance Memos (NCM) in LIMS or the Corrective Action Reports (CAR) using the corrective action database (refer to Figure 12-1).

12.2 General

Problems within the quality system or within analytical operations may be discovered in a variety of ways, such as QC sample failures, internal or external audits, proficiency testing (PT) performance, client complaints, staff observation, etc.

The purpose of a corrective action system is to:

- Identify non-conformance events and assign responsibility(s) for investigating.
- Resolve non-conformance events and assign responsibility for any required corrective action.
- Identify systematic problems before they become serious.
- Identify and track client complaints and provide resolution.

12.2.1 Non-Conformance Memo (NCM) - is used to document the following types of corrective actions:

- Deviations from an established procedure or SOP
- QC outside of limits (non-matrix related)
- Isolated reporting / calculation errors
- Client Complaints
- Discrepancies in materials / goods received vs. manufacturer packing slips
- Anomalies that occur during sample receipt, preparation or analysis

12.2.2 Corrective Action Report (CAR) - is used to document the following types of corrective actions:

- Questionable trends that are found in the review of NCMs
- Issues found while reviewing NCMs that warrant further investigation
- Internal and external audit findings
- Failed or Unacceptable PT results
- Corrective actions that cross multiple departments in the laboratory
- Systematic reporting / calculation errors.
- Client complaints

- Data recall investigations
- Identified poor process or method performance trends
- Excessive revised reports

This will provide background documentation to enable root cause analysis and preventive action.

12.3 Closed Loop Corrective Action Process

Any employee in the company can initiate a corrective action. There are four main components to a closed-loop corrective action process once an issue has been identified: Cause Analysis, Selection and Implementation of Corrective Actions (both short and long term), Monitoring of the Corrective Actions, and Follow-up.

12.3.1 Cause Analysis

- Upon discovery of a non-conformance event, the event must be defined and documented. An NCM or CAR must be initiated. Someone is assigned to investigate the issue and the event is investigated for root cause. Table 12-1 provides some general guidelines on determining responsibility for assessment.
- The cause analysis step is the key to the process as a long term corrective action cannot be determined until the cause is determined.
- If the root cause is not readily obvious, the Technical Director, Laboratory Director, Technical Manager, or QA Manager (or QA designee) is consulted.

12.3.2 Selection and Implementation of Corrective Actions

- Where corrective action is needed, the laboratory shall identify potential corrective actions. The action(s) most likely to eliminate the problem and prevent recurrence are selected and implemented. Responsibility for implementation is assigned.
- Corrective actions shall be to a degree appropriate to the magnitude of the problem identified through the cause analysis.
- Whatever corrective action is determined to be appropriate, the laboratory shall document and implement the changes. The NCM or CAR is used for this documentation.

12.3.3 Root Cause Analysis

Root Cause Analysis is a class of problem solving (investigative) methods aimed at identifying the basic or causal factor(s) that underlie variation in performance or the occurrence of a significant failure. The root cause may be buried under seemingly innocuous events, many steps preceding the perceived failure. At first glance, the immediate response is typically directed at a symptom and not the cause. Typically, root cause analysis would be best with three or more incidents to triangulate a weakness. Corporate SOP No. CA-Q-S-009, *Root Cause Analysis*, describes this procedure.

Systematically analyze and document the Root Causes of the more significant problems that are reported. Identify, track, and implement the corrective actions required to reduce the likelihood of recurrence of significant incidents. Trend the Root Cause data from these incidents

to identify Root Causes that, when corrected, can lead to dramatic improvements in performance by eliminating entire classes of problems.

Identify the one event associated with problem and ask why this event occurred. Brainstorm the root causes of failures; for example, by asking why events occurred or conditions existed; and then why the cause occurred 5 consecutive times until you get to the root cause. For each of these sub events or causes, ask why it occurred. Repeat the process for the other events associated with the incident.

Root cause analysis does not mean the investigation is over. Look at technique, or other systems outside the normal indicators. Often creative thinking will find root causes that ordinarily would be missed, and continue to plague the laboratory or operation.

12.3.4 Monitoring of the Corrective Actions

- The Technical Manager and QA Manager are responsible to ensure that the corrective action taken was effective.
- Ineffective actions are documented and re-evaluated until acceptable resolution is achieved. Technical Managers are accountable to the Laboratory Director to ensure final acceptable resolution is achieved and documented appropriately.
- Each NCM and CAR is entered into a database for tracking purposes and a monthly summary of all NCMs is reviewed to aid in ensuring that the appropriate corrective actions have taken effect.
- TestAmerica laboratories uses the Incident/Corrective Action Tracker (iCAT) database for tracking incidents requiring corrective action. An incident is an event triggering the need for one or more corrective actions as distinct from a corrective action, a potential deficiency stemming from an incident that requires investigation and possibly fixing. The database is independent of TALS, available to all local and Corporate managers, and capable of notifying and tracking multiple corrective actions per event, dates, and personnel. iCAT allows associated document upload, categorization (such as, external/internal audit, client service concerns, data quality issues, proficiency testing, etc.), and trend analysis. Refer to Figure 12-1.
- The QA Manager reviews monthly NCMs and CARs for trends. Highlights are included in the QA monthly report (refer to Section 16). If a significant trend develops that adversely affects quality, an audit of the area is performed and corrective action implemented.
- Any out-of-control situations that are not addressed acceptably at the laboratory level may be reported to the Corporate Quality Director by the QA Manager, indicating the nature of the out-of-control situation and problems encountered in solving the situation.

12.3.5 Follow-up Audits

- Follow-up audits may be initiated by the QA Manager and shall be performed as soon as possible when the identification of a nonconformance casts doubt on the laboratory's compliance with its own policies and procedures, or on its compliance with state or federal requirements.
- These audits often follow the implementation of the corrective actions to verify effectiveness. An additional audit would only be necessary when a critical issue or risk to business is discovered.

(Also refer to Section 15.1.4, Special Audits.)

12.4 Technical Corrective Actions

In addition to providing acceptance criteria and specific protocols for technical corrective actions in the method SOPs, the laboratory has general procedures to be followed to determine when departures from the documented policies and procedures and quality control have occurred (refer to Section 11). The documentation of these procedures is through the use of an NCM or CAR.

Table 12-1 includes examples of general technical corrective actions. For specific criteria and corrective actions, refer to the analytical methods or specific method SOPs. The laboratory may also maintain Work Instructions on these items that are available upon request.

Table 12-1 provides some general guidelines for identifying the individual(s) responsible for assessing each QC type and initiating corrective action. The table also provides general guidance on how a data set should be treated if associated QC measurements are unacceptable. Specific procedures are included in Method SOPs, Work Instructions, QAM Sections 19 and 20. All corrective actions are reviewed monthly, at a minimum, by the QA Manager and highlights are included in the QA monthly report.

To the extent possible, samples shall be reported only if all quality control measures are acceptable. If the deficiency does not impair the usability of the results, data will be reported with an appropriate data qualifier and/or the deficiency will be noted in the case narrative. Where sample results may be impaired, the Project Manager is notified by an NCM and appropriate corrective action (e.g., reanalysis) is taken and documented.

12.5 Basic Corrections

When mistakes occur in records, each mistake shall be crossed-out, [not obliterated (e.g. no white-out)], and the correct value entered alongside. All such corrections shall be initialed (or signed) and dated by the person making the correction. In the case of records stored electronically, the original “uncorrected” file must be maintained intact and a second “corrected” file is created.

This same process applies to adding additional information to a record. All additions made later than the initial must also be initialed (or signed) and dated.

When corrections are due to reasons other than obvious transcription errors, the reason for the corrections (or additions) shall also be documented.

Table 12-1

Example – General Corrective Action Procedures

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Initial Instrument Blank *(Analyst)*	- Instrument response < MDL	- Prepare another blank. - If same response, determine cause of contamination: reagents, environment, instrument equipment failure, etc..
Initial Calibration Standards *(Analyst, Technical Manager(s))*	- Correlation coefficient > 0.99 or standard concentration value - Read-back errors within acceptance range - % Recovery within acceptance range - See details in Method SOP	- Reanalyze standards. - If still unacceptable, remake standards and recalibrate instrument.
Independent Calibration Verification (Second Source) *(Analyst, Technical Manager(s))*	- % Recovery within control limits	- Remake and reanalyze standard. - If still unacceptable, then remake calibration standards or use new primary standards and recalibrate instrument.
Continuing Calibration Standards *(Analyst, Data Reviewer)*	% Recovery within control limits	- Reanalyze standard. - If still unacceptable, then recalibrate and rerun affected samples.
Matrix Spike / Matrix Spike Duplicate (MS/MSD) *(Analyst, Data Reviewer)*	- % Recovery within limits documented in LIMS	- If the acceptance criteria for duplicates or matrix spikes are not met because of matrix interferences, the acceptance of the analytical batch is determined by the validity of the LCS. - If the LCS is within acceptable limits the batch is acceptable. - The results of the duplicates, matrix spikes and the LCS are reported with the data set. - For matrix spike or duplicate results outside criteria the data for that sample shall be reported with qualifiers.

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Laboratory Control Sample (LCS) *(Analyst, Data Reviewer)*	- % Recovery within limits specified in LIMS	- Batch must be re-prepared and re-analyzed. This includes any allowable marginal exceedance. When not using marginal exceedances, the following exceptions apply: 1) when the acceptance criteria for the positive control are exceeded high (i.e., high bias) and there are associated samples that are non-detects, then those non-detects may be reported with data qualifying codes; 2) when the acceptance criteria for the positive control are exceeded low (i.e., low bias), those sample results may be reported if they exceed a maximum regulatory limit/decision level with data qualifying codes. **Note:** If there is insufficient sample or the holding time cannot be met, contact client and report with flags.
Surrogates *(Analyst, Data Reviewer)*	- % Recovery within limits of method or within three standard deviations of the historical mean	- Individual sample must be repeated. Place comment in LIMS. - Surrogate results outside criteria shall be reported with qualifiers.
Method Blank (MB) *(Analyst, Data Reviewer)*	< Reporting Limit [1] For common lab contaminants, no analytes detected at greater than and equal to RL.	- Reanalyze blank. - If still positive, determine source of contamination. If necessary, reprocess (i.e. digest or extract) entire sample batch. Report blank results. - Qualify the result(s) if the concentration of a targeted analyte in the MB is at or above the reporting limit and is > 1/10 of the amount measured in the sample.
Proficiency Testing (PT) Samples *(QA Manager, Technical Manager(s))*	- Criteria supplied by PT Supplier	- Any failures or warnings must be investigated for cause. Failures may result in the need to repeat a PT sample to show the problem is corrected.
Internal / External Audits *(QA Manager, Technical Manager(s), Laboratory Director)*	- Defined in Quality System documentation such as SOPs, QAM, etc.	- Non-conformances must be investigated through CAR system and necessary corrections must be made.
Reporting / Calculation Errors (Depends on issue – possible individuals include: Analysts, Data Reviewers, Project Managers, *Technical Manager(s)*, QA Manager, Corporate QA, Corporate Management)	- Corporate SOP CW-Q-S-005, Data Recall	- Corrective action is determined by type of error. Follow the procedures in Corporate SOP CW-L-S-002 or laboratory SOP PT-QA-016.

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Client Complaints *(Project Managers, Lab Director, Sales and Marketing)*	-	- Corrective action is determined by the type of complaint. For example, a complaint regarding an incorrect address on a report will result in the report being corrected and then follow-up must be performed on the reasons the address was incorrect (e.g., database needs to be updated).
QA Monthly Report (Refer to Section 16 for an example) (QA Manager, Lab Director, *Technical Manager(s)*)	- QAM, SOPs	- Corrective action is determined by the type of issue. For example, CARs for the month are reviewed and possible trends are investigated.
Health and Safety Violation (Safety Officer, Lab Director, *Technical Manager(s)*)	- Environmental Health and Safety (EHS) Manual	- Non-conformance is investigated and corrected through CAR system.

Note:

1. Except as noted below for certain compounds, the method blank should be below the reporting limit unless there is a client specific requirement or method requirement to be evaluated to a lower level. Concentrations up to five times the reporting limit will be allowed for the ubiquitous laboratory and reagent contaminants: methylene chloride, toluene, acetone, 2-butanone and phthalates provided they appear in similar levels in the reagent blank and samples. This allowance presumes that the detection limit is significantly below any regulatory limit to which the data are to be compared and that blank subtraction will not occur. For benzene and ethylene dibromide (EDB) and other analytes for which regulatory limits are extremely close to the detection limit, the method blank must be below the method detection limit.

Figure 12-1

Example – Corrective Action Report (iCAT)

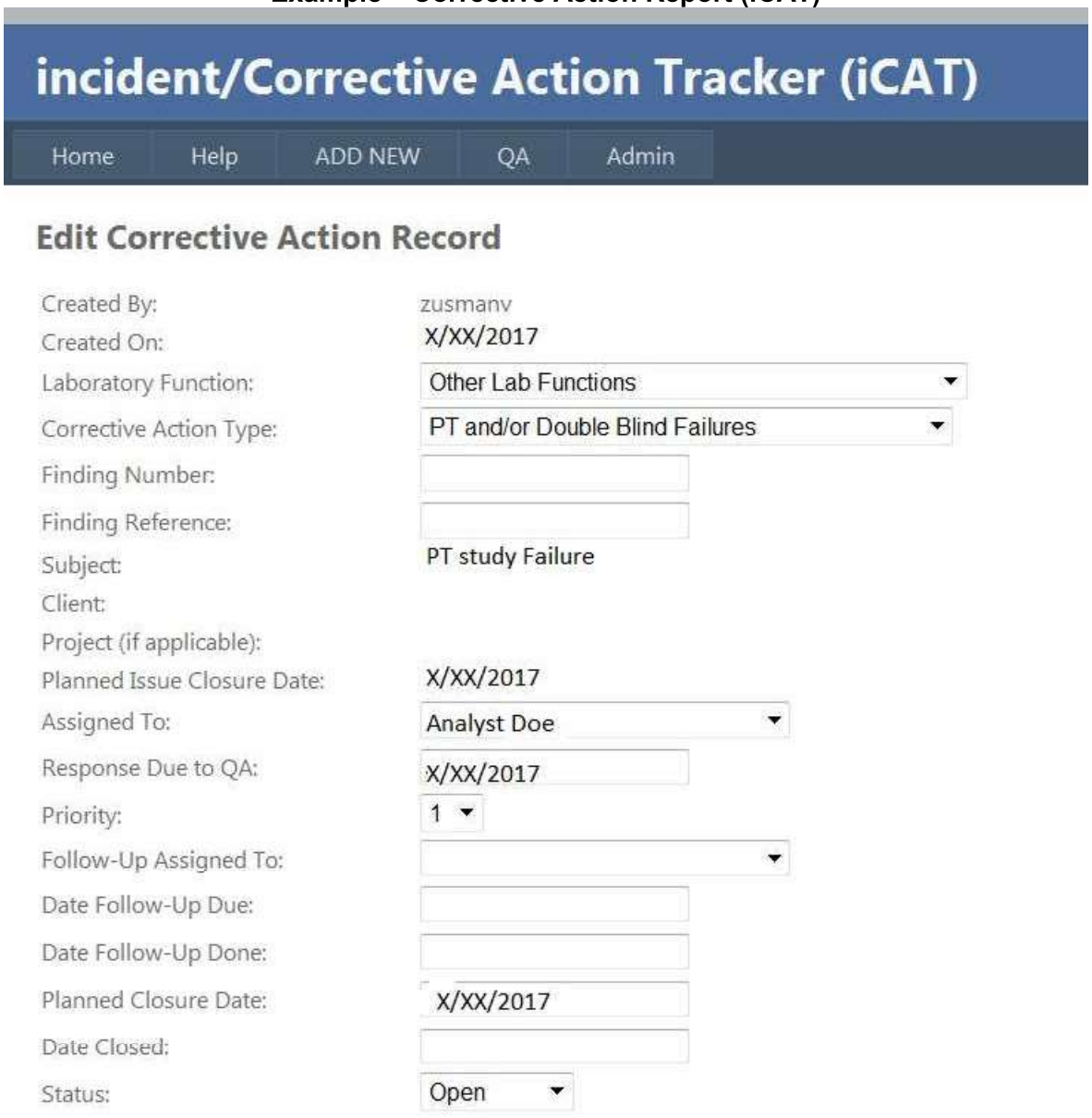


Figure 12-1

Example – Corrective Action Report (iCAT) Cont.

Describe the Required Action:

Investigation/Response:

Root Cause:

Corrective Action Plan:

Select for Notification

Selected	Name	Title
☐		

SECTION 13

PREVENTIVE ACTION / IMPROVEMENT

13.1 Overview

The laboratory's preventive action programs improve or eliminate potential causes of nonconforming product and/or nonconformance to the quality system. This preventive action process is a proactive and continuous process if improvement activities that can be initiated through feedback from clients, employees, business providers, and affiliates. The QA Department has the overall responsibility to ensure that the preventive action process is in place, and that relevant information on actions is submitted for management review.

Dedicating resources to an effective preventive action system emphasizes the laboratory's commitment to its Quality Program. It is beneficial to identify and address negative trends before they develop into complaints, problems and corrective actions. Additionally, the laboratory continually strives to improve customer service and client satisfaction through continuous improvements to laboratory systems.

Opportunities for improvement may be discovered through any of the following:

- management system reviews
- review of the monthly QA Metrics Report
- trending NCMs
- review of control charts and QC results
- trending proficiency testing (PT) results
- trending client complaints
- review of process operations
- staff observation and suggestions

The monthly Management Systems Metrics Report shows performance indicators in all areas of the laboratory and quality system. These areas include revised reports, corrective actions, audit findings, internal auditing and data authenticity audits, client complaints, PT samples, holding time violations, SOPs, ethics training, etc. The metrics report is reviewed monthly by laboratory management, Corporate QA and TestAmerica's Executive Committee. These metrics are used in evaluating the management and quality system performance on an ongoing basis and provide a tool for identifying areas for improvement.

Items identified as continuous improvement opportunities to the management system may be issued as goals from the annual management systems review, recommendations from internal audits, white papers, Lesson Learned, Technical Services audit report, Technical Best Practices, or as Corporate or management initiatives.

The laboratory's corrective action process is integral to implementation of preventive actions. A critical piece of the corrective action process is the implementation of actions to prevent further occurrence of a non-compliance event. Historical review of corrective action and non-conformances provides a valuable mechanism for identifying preventive action opportunities.

13.1.1 The following elements are part of a preventive action/process improvement system:

- Identification of an opportunity for preventive action or process improvement
- Process for the preventive action or improvement
- Define the measurements of the effectiveness of the process once undertake

- Execution of the preventive action or improvement
- Evaluation of the plan using the defined measurements
- Verification of the effectiveness of the preventive action or improvement
- Close-Out by documenting any permanent changes to the Quality System as a result of the Preventive Action or Process Improvement. Documentation of Preventive Action/ Process Improvement is incorporated into the monthly QA reports, corrective action process and management review.

13.1.2 Any Preventive Actions/ Process Improvements undertaken or attempted shall be taken into account during the Annual Management Systems Review (Section 16). A highly detailed report is not required; however a summary of success and failure within the preventive action program is sufficient to provide management with a measurement for evaluation.

13.2 Management Of Change

The Management of Change process is designed to manage significant events and changes that occur within the laboratory. Through these procedures, the potential risks inherent with a new event or change are identified and evaluated. The risks are minimized or eliminated through pre-planning and the development of preventive measures. The types of indicators monitored under this collective system include:

Change Type	Examples
Facility Changes	-movement of prep or instrument groups to a new location in the laboratory -introduction of significant changes in air handling or gas and solvent delivery systems -significant room additions or renovations -significant electrical or network upgrades or changes
Major Accreditation Changes	-voluntary surrender of accreditations no longer deemed necessary to the laboratory -loss of accreditation -addition of new accreditation programs
Reagents and Waste Streams	- new chemicals/reagents not previously used in the laboratory -deletion of chemicals/reagents that will mean they are no longer used at all in the laboratory -major changes to the volume of chemicals/reagents being used - a new waste stream must be developed Note: See EHS for changes in waste streams
Addition or Deletion of Laboratory Capabilities	-implementation of new regulated methods -“retiring” of active methods -method development for “in-house” methods Note: New regulatory methods and method development require specific processes and documentation before the process can begin or the method can enter production. See QA and EHS for requirements.
LIMS changes	-large system upgrades -additions of new capabilities Note: These changes are handled on a Corporate level
Key Personnel Changes	-key personnel promotions and their effect on that individuals group (experience, productivity, leadership, manpower) -key personnel losses -impact of new personnel that may add new experience or capabilities to the laboratory
New Types of Instrumentation	-addition of a new instrument class/technology -significant instrument upgrades that impact sensitivity, productivity or capability Note: New instrumentation requires collection and submission of instrument IDOC information before entering production. See QA for requirements.

Changes in Quality Systems and Policies	-implementation of a new Corrective Action System -changes to the Internal Audit program -implementation of uploads for Proficiency Testing samples

SECTION 14

CONTROL OF RECORDS

The laboratory maintains a records management system appropriate to its needs and that complies with applicable standards or regulations as required. The system produces unequivocal, accurate records that document all laboratory activities. The laboratory retains all original observations, calculations and derived data, calibration records and a copy of the analytical report for a minimum of five years after it has been issued. Exceptions for programs with longer retention requirements are discussed in section 14.1.2.

14.1 Overview

The laboratory has established procedures for identification, collection, indexing, access, filing, storage, maintenance and disposal of quality and technical records. A record index is listed in Table 14-1. More detailed information on retention of specific records is provided in Corporate Policy No.CW-L-P-001, *Records Retention Policy*, and Work Instruction No. CW-L-WI-001, *TestAmerica Records Retention/Storage Schedule*. Quality records are maintained by the Quality Assurance (QA) department electronically on the Pittsburgh laboratory's designated network drive which is backed up as part of the regular network backup. Records are of two types; either electronic or hard copy paper formats, depending on whether the record is computer or hand generated (some records may be in both formats). Technical records are maintained by the CSO group, HR, and the QA department and as outlined in laboratory SOP No. PT-QA-019.

Table 14-1 Record Index[1]

	Record Types [1]:	Retention Time:
Technical Records	- Raw Data - Logbooks[2] - Standards - Certificates - Analytical Records - MDLs/IDLs/DOCs - Lab Reports	5 Years from analytical report issue*
Official Documents	- Quality Assurance Manual (QAM) - Work Instructions - Policies - SOPs - Policy Memorandums - Manuals - Published Methods	Indefinitely
QA Records	- Certifications - Method and Software Validation / Verification Data	Indefinitely

	Record Types [1]:	Retention Time:
QA Records	- Internal & External Audits/Responses - Corrective/Preventive Actions - Management Reviews - Data Investigation	5 Years from archival* **Data Investigation:** 5 years or the life of the affected raw data storage whichever is greater (beyond 5 years if ongoing project or pending investigation)
Project Records	- Sample Receipt & COC Documents - Contracts and Amendments - Correspondence - QAPP - SAP - Telephone Logbooks - Lab Reports	5 Years from analytical report issue*
Administrative Records	Financial and Business Operations	Refer to CW-L-WI-001
	EH&S Manual, Permits	Indefinitely
	Disposal Records	Indefinitely
	Employee Handbook	Indefinitely
	Personnel files, Employee Signature & Initials, Administrative Training Records (e.g., Ethics)	Refer to HR Manual
	Administrative Policies	Indefinitely
	Technical Training Records	7 years
	Legal Records	Indefinitely
	HR Records	Refer to CW-L-WI-001
	IT Records	Refer to CW-L-WI-001
	Corporate Governance Records	Refer to CW-L-WI-001
	Sales & Marketing	5 years
	Real Estate	Indefinitely

[1] Record Types encompass hardcopy and electronic records.
[2] Examples of Logbook types: Maintenance, Instrument Run, Preparation (standard and samples), Standard and Reagent Receipt, Archiving, Balance Calibration, Temperature (hardcopy or electronic records).
* Exceptions listed in Table 14-2.

14.1.1 All records are stored and retained in such a way that they are secure and readily retrievable at the laboratory facility or an offsite location that provides a suitable environment to prevent damage or deterioration and to prevent loss at the laboratory or the Iron Mountain data storage facility. All records shall be protected against fire, theft, loss, environmental deterioration, and vermin. In the case of electronic records, electronic or magnetic sources, storage media are protected from deterioration caused by magnetic fields and/or electronic deterioration.

Access to the data is limited to laboratory and company employees and shall be documented with an access log**.** Records archived off-site are stored in a secure location where a record is maintained of any entry into the storage facility. Whether on-site or off-site storage is used, logs are maintained in each storage box to note removal and return of records. Retention of records are maintained on-site at the laboratory for at least 1 year after their generation and moved offsite for the remainder of the required storage time. Records are maintained for a minimum of five years unless otherwise specified by a client or regulatory requirement.

For raw data and project records, record retention shall be calculated from the date the project report is issued. For other records, such as Controlled Documents, QA, or Administrative Records, the retention time is calculated from the date the record is formally retired. Records related to the programs listed in Table 14-2 have lengthier retention requirements and are subject to the requirements in Section 14.1.3.

14.1.2 Programs with Longer Retention Requirements

Some regulatory programs have longer record retention requirements than the standard record retention time. These are detailed in Table 14-2 with their retention requirements. In these cases, the longer retention requirement is enacted. If special instructions exist such that client data cannot be destroyed prior to notification of the client, the container or box containing that data is marked as to who to contact for authorization prior to destroying the data.

Table 14-2 Special Record Retention Requirements

Program	[1]Retention Requirement
Drinking Water – All States	10 years (lab reports and raw data)
Commonwealth of MA – All environmental data 310 CMR 42.14	10 years
FIFRA – 40 CFR Part 160	Retain for life of research or marketing permit for pesticides regulated by EPA
Housing and Urban Development (HUD) Environmental Lead Testing	10 years
Alaska	10 years
Louisiana – All	10 years
Michigan Department of Environmental Quality – all environmental data	10 years
Ohio VAP	10 years and State contact prior to disposal
TSCA - 40 CFR Part 792	10 years after publication of final test rule or negotiated test agreement
OSHA	30 years

[1]Note: Extended retention requirements must be noted with the archive documents or addressed in facility-specific records retention procedures.

14.1.3 The laboratory has procedures to protect and back-up records stored electronically and to prevent unauthorized access to or amendment of these records. All analytical data is maintained as hard copy or in a secure readable electronic format. For analytical reports that are maintained as copies in PDF format, refer to Section 19.14.1 and laboratory SOP No. PT-QA-019, Records Information Management, for more information.

14.1.4 The record keeping system allows for historical reconstruction of all laboratory activities that produced the analytical data, as well as rapid recovery of historical data (Records stored off site should be accessible within 2 days of a request for such records). The history of the sample from when the laboratory took possession of the samples must be readily understood through the documentation. This shall include inter-laboratory transfers of samples and/or extracts.

- The records include the identity of personnel involved in sampling, sample receipt, preparation, or testing. All analytical work contains the initials (at least) of the personnel involved. The laboratory's copy of the chain of custody is stored with the invoice and the work order sheets generated by the LIMS. Details of the COC linking procedure are described in SOP No. PT-SR-001. The chain of custody would indicate the name of the sampler. Any sampling notes provided with the chain of custody are also scanned into LIMS.
- All information relating to the laboratory facilities equipment, analytical test methods, and related laboratory activities, such as sample receipt, sample preparation, or data verification are documented.
- The record keeping system facilitates the retrieval of all working files and archived records for inspection and verification purposes (e.g., set format for naming electronic files, set format for what is included with a given analytical data set are described in SOP No. PT-QA-019. Instrument data is stored sequentially by instrument. Run logs are maintained for each instrument; a copy of each day's run long is stored in the electronic files along with the data to aid in re-constructing an analytical sequence. Where an analysis is performed without an instrument, bound logbooks or bench sheets are used to record and file data or the data is entered directly into the LIMS as the analysis is done. Standard and reagent information is recorded in electronic standard log in LIMS, and is associated with each preparation and analytical batch for which they are used.
- Changes to hardcopy records shall follow the procedures outlined in Section 12 and 19. Changes to electronic records in LIMS or instrument data are recorded in audit trails.
- The reason for a signature or initials on a document is clearly indicated in the records such as "sampled by," "prepared by," "reviewed by", or "analyzed by".
- All generated data, except those that are generated by automated data collection systems, are recorded directly, promptly and legibly in permanent dark ink.
- Hard copy data may be scanned into PDF format for record storage as long as the scanning process can be verified in order to ensure that no data is lost and the data files and storage media must be tested to verify the laboratory's ability to retrieve the information prior to the destruction of the hard copy that was scanned. The procedure for this verification can be found in SOP No. PT-QA-019.
- Also refer to Section 19.14.1 'Computer and Electronic Data Related Requirements'.

14.2 Technical And Analytical Records

14.2.1 The laboratory retains records of original observations, derived data and sufficient information to establish an audit trail, calibration records, staff records and a copy of each analytical report issued, for a minimum of five years unless otherwise specified by a client or regulatory requirement. The records for each analysis shall contain sufficient information to enable the analysis to be repeated under conditions as close as possible to the original. The records shall include the identity of laboratory personnel responsible for the sampling, performance of each analysis and reviewing results.

14.2.2 Observations, data and calculations are recorded real-time and are identifiable to the specific task.

14.2.3 Changes to hardcopy records shall follow the procedures outlined in Section 12 and 19. Changes to electronic records in LIMS or instrument data are recorded in audit trails.

The essential information to be associated with analysis, such as strip charts, tabular printouts, computer data files, analytical notebooks, and run logs, include:

- Laboratory sample ID code;
- Date of analysis; Time of Analysis is also required if the holding time is seventy-two (72) hours or less, or when time critical steps are included in the analysis (e.g., drying times, incubations, etc.); instrumental analyses have the date and time of analysis recorded as part of their general operations. Where a time critical step exists in an analysis, location for such a time is included as part of the documentation in a specific logbook, on a benchsheet or in LIMS.
- Instrumentation identification and instrument operating conditions/parameters. Operating conditions/parameters are typically recorded in instrument maintenance logs where available.
- analysis type;
- all manual calculations and manual integrations;
- analyst's or operator's initials/signature;
- sample preparation including cleanup, separation protocols, incubation periods or subculture, ID codes, volumes, weights, instrument printouts, meter readings, calculations, reagents;
- test results;
- standard and reagent origin, receipt, preparation, and use;
- calibration criteria, frequency and acceptance criteria;
- data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions;
- quality control protocols and assessment;
- electronic data security, software documentation and verification, software and hardware audits, backups, and records of any changes to automated data entries; and
- Method performance criteria including expected quality control requirements. These are indicated both in the LIMS and on specific analytical report formats.

14.2.4 All logbooks used during receipt, preparation, storage, analysis, and reporting of samples or monitoring of support equipment shall undergo a documented supervisory or peer review on a monthly basis.

14.3 Laboratory Support Activities

In addition to documenting all the above-mentioned activities, the following are retained QA records and project records (previous discussions in this section relate where and how these data are stored):

- all original raw data, whether hard copy or electronic, for calibrations, samples and quality control measures, including analysts' work sheets and data output records (chromatograms, strip charts, and other instrument response readout records);
- a written description or reference to the specific test method used which includes a description of the specific computational steps used to translate parametric observations into a reportable analytical value;
- copies of final reports;
- archived SOPs;
- correspondence relating to laboratory activities for a specific project;

- all corrective action reports, audits and audit responses;
- proficiency test results and raw data; and
- results of data review, verification, and crosschecking procedures

14.3.1 Sample Handling Records

Records of all procedures to which a sample is subjected while in the possession of the laboratory are maintained. These include but are not limited to records pertaining to:

- sample preservation including appropriateness of sample container and compliance with holding time requirement;
- sample identification, receipt, acceptance or rejection and login;
- sample storage and tracking including shipping receipts, sample transmittal / COC forms; and
- procedures for the receipt and retention of samples, including all provisions necessary to protect the integrity of samples.

14.4 Administrative Records

The laboratory also maintains the administrative records in either electronic or hard copy form. Refer to Table 14-1.

14.5 Records Management, Storage And Disposal

All records (including those pertaining to test equipment), certificates and reports are safely stored, held secure and in confidence to the client. Certification related records are available upon request.

All information necessary for the historical reconstruction of data is maintained by the laboratory. Records that are stored only on electronic media must be supported by the hardware and software necessary for their retrieval.

Records that are stored or generated by computers or personal computers have hard copy, write-protected backup copies, or an electronic audit trail controlling access.

The laboratory has a record management system (a.k.a., document control) for control of laboratory notebooks/benchsheets, instrument/equipment logbooks, and records for data reduction, validation and reporting. Laboratory notebooks are issued on a per analysis basis, as needed, and are numbered sequentially. All sample data are recorded in LIMS. Bench sheets are filed sequentially. Standards are maintained in the electronic standards in LIMS. Records are considered archived when noted as such in the records management system (a.k.a., document control).

14.5.1 Transfer of Ownership

In the event that the laboratory transfers ownership or goes out of business, the laboratory shall ensure that the records are maintained or transferred according to client's instructions. Upon ownership transfer, record retention requirements shall be addressed in the ownership transfer agreement and the responsibility for maintaining archives is clearly established. In addition, in cases of bankruptcy, appropriate regulatory and state legal requirements concerning laboratory records must be followed. In the event of the closure of the laboratory, all records will revert to the control of the Corporate headquarters. Should the entire company cease to exist, as much notice as possible will be given to clients and the accrediting bodies who have worked with the

laboratory during the previous 5 years of such action.

14.5.2 Records Disposal

Records are removed from the archive and destroyed after 5 years unless otherwise specified by a client or regulatory requirement. On a project specific or program basis, clients may need to be notified prior to record destruction. Records are destroyed in a manner that ensures their confidentiality such as shredding, mutilation or incineration. (Refer to Tables 14-1 and 14-2).

Electronic copies of records must be destroyed by erasure or physically damaging off-line storage media so no records can be read.

If a third party records management company is hired to dispose of records, a "Certificate of Destruction" is required.

SECTION 15

AUDITS

15.1 Internal Audits

Internal audits are performed to verify that laboratory operations comply with the requirements of the lab's quality system and with the external quality programs under which the laboratory operates. Audits are planned and organized by the QA staff. Personnel conducting the audits should be independent of the area being evaluated. Auditors will have sufficient authority, access to work areas, and organizational freedom necessary to observe all activities affecting quality and to report the assessments to laboratory management and when requested to Corporate management.

Audits are conducted and documented as described in the Corporate SOP No. CW-Q-S-003, *Internal Auditing*. More detail on the specific elements for internal audits and data audit is described in Pittsburgh Laboratory SOP No. PT-QA-002, *Internal Auditing*. The types and frequency of routine internal audits are shown in Table 15-1. Special or ad hoc assessments may be conducted as needed under the direction of the QA staff.

Table 15-1 Types of Internal Audits and Frequency

Description	Performed by	Frequency
Quality Systems Audits	QA Department, QA approved designee, or Corporate QA	All areas of the laboratory annually
Method Audits QA Technical Audits	Joint responsibility: a) QA Manager or designee b) Technical Manager or Designee (Refer to CW-Q-S-003)	50% of methods annually

Description	Performed by	Frequency
SOP Method Compliance	Joint responsibility: c) QA Manager or designee d) Technical Manager or Designee (Refer to CW-Q-S-003)	Every 2 years
Special	QA Department or Designee	Surveillance or spot checks performed as needed, e.g., to confirm corrective actions from other audits.
Performance Testing	Analysts with QA oversight	Two successful per year for each TNI field of testing or as dictated by regulatory requirements

15.1.1 Annual Quality Systems Audit

An annual quality systems audit is required to ensure compliance to analytical methods and SOPs, TestAmerica's Data Integrity and Ethics Policies, TNI quality systems, client and state requirements, and the effectiveness of the internal controls of the analytical process, including, but not limited to, data review, quality controls, preventive action and corrective action. The completeness of earlier corrective actions is assessed for effectiveness & sustainability. The audit is divided into sections for each operating or support area of the lab, and each section is comprehensive for a given area. The area audits may be performed on a rotating schedule throughout the year to ensure adequate coverage of all areas. This schedule may change as situations in the laboratory warrant.

Effectiveness of training will be determined during our annual QA systems evaluation. Evidence of successful training includes:

- Audit and surveillance results, control charts, proficiency testing results, data analysis, corrective and preventive actions, customer feedback, and management reviews in efforts to monitor trends and continually improve the quality system:
- Adequate documentation of training within operational areas, including one-on-one technical training for individual technologies, and particularly for people cross-trained.
- Analysts knowledge of QA Manual and SOPs. Analysts following SOPs, i.e., practice matches SOPs.
- Analysts regularly communicate to supervisors and QA if SOPs need revision.

15.1.2 QA Technical Audits

QA technical audits assess data authenticity and analyst integrity. These audits are based on client projects, associated sample delivery groups, and the methods performed. Reported results are compared to raw data to verify the authenticity of results. The validity of calibrations and QC results are compared to data qualifiers, footnotes, and case narratives. Documentation is assessed by examining run logs and records of manual integrations. Manual calculations are checked. Where possible, electronic audit miner programs (e.g., Chrom AuditMiner) are used to identify unusual manipulations of the data deserving closer scrutiny. QA technical audits will include all methods within a two-year period. All analysts and data reviewers should be reviewed over the course of a two year period through at least one QA Technical Audit.

15.1.3 SOP Method Compliance

Compliance of all SOPs with the source methods and compliance of the operational groups with the SOPs will be assessed by the QA department, Technical Manager, or qualified designee at least every two years. It is also recommended that the work of each newly hired analyst is assessed within 3 months of working independently, (e.g., completion of method IDOC). In addition, as analysts add methods to their capabilities, reviews (new IDOC) of the analyst work products will be performed within 3 months of completing the documented training.

15.1.4 Special Audits

Special audits are conducted on an as needed basis, generally as a follow up to specific issues such as client complaints, corrective actions, PT results, data audits, system audits, validation comments, regulatory audits or suspected ethical improprieties. Special audits are focused on a specific issue, and report format, distribution, and timeframes are designed to address the nature of the issue.

15.1.5 Performance Testing

The laboratory participates semi-annually in performance audits conducted through the analysis of PT samples provided by a third party. The laboratory generally participates in the following types of PT studies: Water Pollution Program, Water Supply Program, Hazardous Waste Program, client supplied PTs and Lab internal PTs.

It is TestAmerica's policy that PT samples be treated as typical samples in the production process. Furthermore, where PT samples present special or unique problems, in the regular production process they may need to be treated differently, as would any special or unique request submitted by any client. The QA Manager must be consulted and in agreement with any decisions made to treat a PT sample differently due to some special circumstance.

Unacceptable PT results are required to be entered into the laboratory's Corrective Action system (iCAT). In some cases it may be necessary for blind QC samples to be submitted to the laboratory to show a return to control.

15.2 EXTERNAL AUDITS

External audits are performed when certifying agencies or clients conduct on-site inspections or submit performance testing samples for analysis. It is TestAmerica's policy to cooperate fully with regulatory authorities and clients. The laboratory makes every effort to provide the auditors with access to personnel, documentation, and assistance. Laboratory supervisors are responsible for providing corrective actions to the QA Manager who coordinates the response for any deficiencies discovered during an external audit. Audit responses are due in the time allotted by the client or agency performing the audit. When requested, a copy of the audit report and the labs corrective action plan will be forwarded to Corporate Quality.

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. The client may only view data and systems related directly to the client's work. All efforts are made to keep other client information confidential.

15.2.1 Confidential Business Information (CBI) Considerations

During on-site audits, auditors may come into possession of information claimed as business confidential. A business confidentiality claim is defined as "a claim or allegation that business information is entitled to confidential treatment for reasons of business confidentiality or a request for a determination that such information is entitled to such treatment." When information is claimed as business confidential, the laboratory must place on (or attach to) the information at the time it is submitted to the auditor, a cover sheet, stamped or typed legend or other suitable form of notice, employing language such as "trade secret", "proprietary" or "company confidential". Confidential portions of documents otherwise non-confidential must be clearly identified. CBI may be purged of references to client identity by the responsible laboratory official at the time of removal from the laboratory. However, sample identifiers may not be obscured from the information. Additional information regarding CBI can be found in within the 2009 TNI standards.

15.3 Audit Findings

Audit findings are documented using the corrective action process database (iCAT system). The laboratory's corrective action responses for both types of audits may include action plans that could not be completed within a predefined timeframe. In these instances, a completion date must be set and agreed to by operations management and the QA Manager.

Developing and implementing corrective actions to findings is the responsibility of the Technical Manager where the finding originated. Findings that are not corrected by specified due dates are reported monthly to management in the QA monthly report. When requested a copy of the audit report and the labs corrective action plan will be forwarded to Corporate Quality.

If any audit finding casts doubt on the effectiveness of the operations or on the correctness or validity of the laboratory's test results, the laboratory shall take timely corrective action, and shall notify clients in writing if the investigations show that the laboratory results have been affected. Once corrective action is implemented, a follow-up audit is scheduled to ensure that the problem has been corrected.

Clients must be notified promptly, in writing, of any event such as the identification of defective measuring or test equipment that casts doubt on the validity of results given in any test report or amendment to a test report. The investigation must begin within 24-hours of discovery of the problem and all efforts are made to notify the client within two weeks after completion of the investigation.

SECTION 16

MANAGEMENT REVIEWS

16.1 Quality Assurance Report

A comprehensive QA Report shall be prepared each month by the laboratory's QA Department and forwarded to the Laboratory Director, Technical Managers, their Quality Director as well as the VP of Operations. All aspects of the QA system are reviewed to evaluate the suitability of policies and procedures. During the course of the year, the Laboratory Director, VP of Operations, or Corporate QA may request that additional information be added to the report.

On a monthly basis, Corporate QA compiles information from all the monthly laboratory reports. The Corporate Quality Directors prepare a report that includes a compilation of all metrics and notable information and concerns regarding the QA programs within the laboratories. The report also includes a listing of new regulations that may potentially impact the laboratories. This report is presented to the Senior Management Team and VPs of Operations.

16.2 Annual Management Review

The senior lab management team (Laboratory Director, QA Manager, and Technical Managers) conducts a review annually of its quality systems and LIMS to ensure its continuing suitability and effectiveness in meeting client and regulatory requirements and to introduce any necessary changes or improvements. It will also provide a platform for defining goals & objectives and action items that feed into the laboratory planning system. Corporate Operations and Corporate QA personnel is to be included in this meeting at the discretion of the Laboratory Director. The LIMS review consists of examining any audits, complaints or concerns that have been raised through the year that are related to the LIMS. The laboratory will summarize any critical findings that cannot be solved by the lab and report them to Corporate IT.

The Management System Review (see Corporate SOP No. CW-Q-S-004, *Management System Review*, and Work Instruction No. CW-Q-WI-003) uses information generated during the preceding year to assess the "big picture" by ensuring that routine actions taken and reviewed on a monthly basis are not components of larger systematic concerns. The monthly review should keep the quality systems current and effective, therefore, the annual review is a formal senior management process to review specific existing documentation. Significant issues from the following documentation are compiled or summarized by the QA Manager prior to the review meeting:

- Matters arising from the previous annual review
- Prior Monthly QA Reports issues
- Laboratory QA Metrics
- Review of report reissue requests
- Review of client feedback and complaints
- Issues arising from any prior management or staff meetings
- Minutes from prior senior lab management meetings - Issues that may be raised from these meetings include:

    - Adequacy of staff, equipment and facility resources.
    - Adequacy of policies and procedures.
    - Future plans for resources and testing capability and capacity.

- The annual internal double blind PT program sample performance
- Compliance to the Ethics Policy and Data Integrity Plan, including any evidence/incidents of inappropriate actions or vulnerabilities related to data Integrity
- Review of Corrective and Preventative Actions, assessments by external bodies and recommendations for improvement

A report is generated by the QA Manager and management. The report is distributed to the appropriate VP of Operation and the Quality Director. The report includes, but is not limited to:

- The date of the review and the names and titles of participants
- A reference to the existing data quality related documents and topics that were reviewed
- Quality system or operational changes or improvements that will be made as a result of the review [e.g., an implementation schedule including assigned responsibilities for the changes (Action Table)]

Changes to the quality systems requiring update to the laboratory QA Manual shall be included in the next revision of the QA Manual.

16.3 Potential Integrity Related Managerial Reviews

Potential integrity issues (data or business related) must be handled and reviewed in a confidential manner until such time as a follow-up evaluation, full investigation, or other appropriate actions have been completed and issues clarified. TestAmerica's Corporate Internal Investigation and Data Recall SOPs shall be followed (SOP No. CW-L-S-002 and CW-Q-S-005). All investigations that result in finding of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients.

TestAmerica's President and CEO, Executive VP of Operations, VP of Client & Technical Services, VPs of Operation, and Quality Directors receive a monthly report from the VP-QA/EHS summarizing any current data integrity or data recall investigations. The VP's of Operation are also made aware of progress on these issues for their specific labs.

SECTION 17

PERSONNEL

17.1 Overview

The laboratory's management believes that its highly qualified and professional staff is the single most important aspect in assuring a high level of data quality and service. The staff consists of professionals and support personnel as outlined in the organization chart in Figure 4-1.

All personnel must demonstrate competence in the areas where they have responsibility. Any staff that is undergoing training shall have appropriate supervision until they have demonstrated their ability to perform their job function on their own. Staff shall be qualified for their tasks based on appropriate education, training, experience and/or demonstrated skills as required.

The laboratory employs sufficient personnel with the necessary education, training, technical knowledge and experience for their assigned responsibilities.

All personnel are responsible for complying with all QA/QC requirements that pertain to the laboratory and their area of responsibility. Each staff member must have a combination of experience and education to adequately demonstrate a specific knowledge of their particular area of responsibility. Technical staff must also have a general knowledge of lab operations, test methods, QA/QC procedures and records management.

Laboratory management is responsible for formulating goals for lab staff with respect to education, training and skills and ensuring that the laboratory has a policy and procedures for identifying training needs and providing training of personnel. The training shall be relevant to the present and anticipated responsibilities of the lab staff.

The laboratory only uses personnel that are employed by or under contract to, the laboratory. Contracted personnel, when used, must meet competency standards of the laboratory and work in accordance to the laboratory's quality system.

17.2 Education And Experience Requirements For Technical Personnel

The laboratory makes every effort to hire analytical staffs that possess a college degree (AA, BA, BS) in an applied science with some chemistry in the curriculum. Exceptions can be made based upon the individual's experience and ability to learn. For supervisory positions, the Pennsylvania DEP has education and experience requirements that must be met by the Pittsburgh laboratory personnel, and these are reflected in Table 17-1 below. Selection of qualified candidates for laboratory employment begins with documentation of minimum education, training, and experience prerequisites needed to perform the prescribed task. Minimum education and training requirements for TestAmerica employees are outlined in job descriptions and are generally summarized for analytical staff in the table below.

The laboratory maintains job descriptions for all personnel who manage, perform or verify work affecting the quality of the environmental testing the laboratory performs. Job Descriptions are located on the TestAmerica intranet site's Human Resources web-page (Also see Section 4 for position descriptions/responsibilities).

Experience and specialized training are occasionally accepted in lieu of a college degree (basic lab skills such as using a balance, pipette or quantitation techniques, etc., are also considered).

Table 17-1 General Requirements for Analytical Staff

Specialty	Education	Experience
Extractions, Digestions, some electrode methods (pH, DO, Redox, etc.), or Titrimetric and Gravimetric Analyses	H.S. Diploma	On the job training (OJT)
GFAA, CVAA, FLAA, Single component or short list Chromatography (e.g., Fuels, BTEX-GC, IC	A college degree in an applied science or 2 years of college and at least 1 year of college chemistry	Or 2 years prior analytical experience is required

Specialty	Education	Experience
ICP, ICPMS, Long List or complex chromatography (e.g., Pesticides, PCB, Herbicides, HPLC, etc.), GCMS	A college degree in an applied science or 2 years of college chemistry	or 5 years of prior analytical experience
Spectra Interpretation	A college degree in an applied science or 2 years of college chemistry	And 2 years relevant experience Or 5 years of prior analytical experience
Technical Manager (s) – **General**	Bachelors Degree in an applied science or engineering with 24 semester hours in chemistry An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years' experience in environmental analysis of representative analytes for which they will oversee
Technical Manager (s) – **Wet Chem** only (no advanced instrumentation)	Associates degree in an applied science or engineering or 2 years of college with 16 semester hours in chemistry	And 2 years relevant experience
Technical Managers - **Microbiology**	Bachelors degree in applied science with at least 16 semester hours in general microbiology and biology An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years of relevant experience
Technical Managers – **Microbiology** limited to analysis of fecal coliforms, total coliforms or heterotrophic bacteria	Associates degree in an applied science or engineering and at least 4 credit hours in biology	And 2 years of relevant experience

When an analyst does not meet these requirements, they can perform a task under the direct supervision of a qualified analyst, peer reviewer or Technical Manager, and are considered an analyst in training. The person supervising an analyst in training is accountable for the quality of the analytical data and must review and approve data and associated corrective actions.

17.3 Training

The laboratory is committed to furthering the professional and technical development of employees at all levels.

Orientation to the laboratory's policies and procedures, in-house method training, and employee attendance at outside training courses and conferences all contribute toward employee proficiency.

Table 17-2 Employee Training Examples

Required Training	Time Frame	Employee Type
Environmental Health & Safety	Prior to lab work	All
Ethics – New Hires	1 week of hire	All
Ethics – Comprehensive	90 days of hire	All
Data Integrity	30 days of hire	Technical and PMs
Quality Assurance	90 days of hire	All
Ethics – Comprehensive Refresher	Annually	All
Initial Demonstration of Capability (DOC)	Prior to unsupervised method performance	Technical

The laboratory maintains records of relevant authorization/competence, education, professional qualifications, training, skills and experience of technical personnel (including contracted personnel) as well as the date that approval/authorization was given. These records are kept on file at the laboratory. Also refer to "Demonstration of Capability" in Section 19.

The training of technical staff is kept up to date by:

- Each employee must have documentation in their training file that they have read, understood and agreed to follow the most recent version of the laboratory QA Manual and SOPs in their area of responsibility. This documentation is updated as SOPs are updated.
- Documentation from any training courses or workshops on specific equipment, analytical techniques or other relevant topics are maintained in their training file.
- Documentation of proficiency (refer to Section 19).
- An Ethics Agreement signed by each staff member (renewed each year) and evidence of annual ethics training.
- A Confidentiality Agreement signed by each staff member signed at the time of employment.
- Human Resources maintains documentation and attestation forms on employment status & records; benefit programs; timekeeping/payroll; and employee conduct (e.g., ethics violations). This information is maintained in the employee's secured personnel file.

Evidence of successful training could include such items as:

- Adequate documentation of training within operational areas, including one-on-one technical training for individual technologies, and particularly for people cross-trained.
- Analysts knowledge to refer to QA Manual for quality issues.
- Analysts following SOPs, i.e., practice matches SOPs.
- Analysts regularly communicate to supervisors and QA if SOPs need revision, rather than waiting for auditors to find problems.

Further details of the laboratory's training program are described in the Pittsburgh Laboratory SOP No. PT-QA-001, *Employee Orientation and Training*.

17.4 Data Integrity And Ethics Training Program

Establishing and maintaining a high ethical standard is an important element of a Quality System. Ethics and data integrity training is integral to the success of TestAmerica and is provided for each employee at TestAmerica. It is a formal part of the initial employee orientation within 1 week of hire followed by technical data integrity training within 30 days, comprehensive training within 90 days, and an annual refresher for all employees. Senior management at each facility performs the ethics training for their staff.

In order to ensure that all personnel understand the importance TestAmerica places on maintaining high ethical standards at all times; TestAmerica has established a Corporate Policy No. CW-L-P-004, *Ethics Policy*, and an Ethics Statement. All initial and annual training is documented by signature on the signed Ethics Statement demonstrating that the employee has participated in the training and understands their obligations related to ethical behavior and data integrity.

Violations of this Ethics Policy will not be tolerated. Employees who violate this policy will be subject to disciplinary actions up to and including termination. Criminal violations may also be referred to the Government for prosecution. In addition, such actions could jeopardize TestAmerica's ability to do work on Government contracts, and for that reason, TestAmerica has a Zero Tolerance approach to such violations.

Employees are trained as to the legal and environmental repercussions that result from data misrepresentation. Key topics covered in the presentation include:

- Organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting
- Ethics Policy
- How and when to report ethical/data integrity issues and confidential reporting
- Record keeping
- Discussion regarding data integrity procedures
- Specific examples of breaches of ethical behavior (e.g. peak shaving, altering data or computer clocks, improper macros, etc., accepting/offering kickbacks, illegal accounting practices, unfair competition/collusion)
- Internal monitoring, investigations, and data recalls
- Consequences for infractions, including potential for immediate termination, debarment, or criminal prosecution
- Importance of proper written narration / data qualification by the analyst and project manager with respect to those cases where the data may still be usable but are in one sense or another partially deficient

Additionally, a data integrity hotline (1-800-736-9407) is maintained by TestAmerica and administered by the Corporate Quality Department.

SECTION 18

ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS

18.1 Overview

The laboratory is a 33,000 ft^2 secure laboratory facility with controlled access and designed to accommodate an efficient workflow and to provide a safe and comfortable work environment for employees. All visitors sign in and are escorted by laboratory personnel. Access is controlled by various measures.

The laboratory is equipped with structural safety features. Each employee is familiar with the location, use, and capabilities of general and specialized safety features associated with their workplace. The laboratory provides and requires the use of protective equipment including safety glasses, protective clothing, gloves, etc., OSHA and other regulatory agency guidelines regarding required amounts of bench and fume hood space, lighting, ventilation (temperature and humidity controlled), access, and safety equipment are met or exceeded.

Traffic flow through sample preparation and analysis areas is minimized to reduce the likelihood of contamination. Adequate floor space and bench top area is provided to allow unencumbered sample preparation and analysis space. Sufficient space is also provided for storage of reagents and media, glassware, and portable equipment. Ample space is also provided for refrigerated sample storage before analysis and archival storage of samples after analysis. Laboratory HVAC and deionized water systems are designed to minimize potential trace contaminants.

The laboratory is separated into specific areas for sample receiving, sample preparation, volatile organic sample analysis, non-volatile organic sample analysis, inorganic sample analysis, microbiological sample analysis, and administrative functions.

18.2 Environment

Laboratory accommodation, test areas, energy sources, lighting are adequate to facilitate proper performance of tests. The facility is equipped with heating, ventilation, and air conditioning (HVAC) systems appropriate to the needs of environmental testing performed at this laboratory.

The environment in which these activities are undertaken does not invalidate the results or adversely affect the required accuracy of any measurements.

The laboratory provides for the effective monitoring, control and recording of environmental conditions that may affect the results of environmental tests as required by the relevant specifications, methods, and procedures. Such environmental conditions include humidity, voltage, temperature, and vibration levels in the laboratory. Systems are controlled and monitored to assure constant and consistent test conditions.

When any of the method or regulatory required environmental conditions change to a point where they may adversely affect test results, analytical testing will be discontinued until the environmental conditions are returned to the required levels.

Environmental conditions of the facility housing the computer network and LIMS are regulated to protect against raw data loss.

18.3 Work Areas

There is effective separation between neighboring areas when the activities therein are incompatible with each other. Examples include:

- Microbiological culture handling and sample incubation areas
- Volatile organic chemical handling areas, including sample preparation and waste disposal, and volatile organic chemical analysis areas

Access to and use of all areas affecting the quality of analytical testing is defined and controlled by secure access to the laboratory building as described below in the Building Security section.

Adequate measures are taken to ensure good housekeeping in the laboratory and to ensure that any contamination does not adversely affect data quality. These measures include regular cleaning to control dirt and dust within the laboratory. Work areas are available to ensure an unencumbered work area. Work areas include:

- Access and entryways to the laboratory
- Sample receipt areas
- Sample storage areas
- Chemical and waste storage areas
- Data handling and storage areas
- Sample processing areas
- Sample analysis areas

Refer to the following documents and procedures for specific requirements for microbiological laboratory facilities:

- Standard Methods, 9020B, Sec. 2
- TNI V1M5, 1.7.3.7.a

18.4 Floor Plan

A floor plan can be found in Appendix 1.

18.5 Building Security

Building keys and alarm codes are distributed to employees as necessary.

Visitors to the laboratory sign in and out in a visitor's logbook. A visitor is defined as any person who visits the laboratory who is not an employee of the laboratory. In addition to signing into the laboratory, the Environmental, Health and Safety Manual contains requirements for visitors and vendors. There are specific safety forms that must be reviewed and signed. Visitors (with the exception of company employees) are escorted by laboratory personnel at all times, or the location of the visitor is noted in the visitor's logbook.

SECTION 19

TEST METHODS AND METHOD VALIDATION

19.1 Overview

The laboratory uses methods that are appropriate to meet our clients' requirements and that are within the scope of the laboratory's capabilities. These include sampling, handling, transport, storage and preparation of samples, and, where appropriate, an estimation of the measurement of uncertainty as well as statistical techniques for analysis of environmental data.

Instructions are available in the laboratory for the operation of equipment as well as for the handling and preparation of samples. All instructions, Standard Operating Procedures (SOPs), reference methods and manuals relevant to the working of the laboratory are readily available to all staff. Deviations from published methods are documented (with justification) in the laboratory's approved SOPs. SOPs are submitted to clients for review at their request. Significant deviations from published methods require client approval and regulatory approval where applicable.

19.2 Standard Operating Procedures (SOPs)

The laboratory maintains SOPs that accurately reflect all phases of the laboratory such as assessing data integrity, corrective actions, handling customer complaints as well as all analytical methods and sampling procedures. The method SOPs are derived from the most recently promulgated/approved, published methods and are specifically adapted to the laboratory facility. Modifications or clarifications to published methods are clearly noted in the SOPs. All SOPs are controlled in the laboratory. A SOP list is included in Appendix 4. The most current list of SOPs is maintained in the QA SOP directory, Work Instruction PT-QA-WI-002.

- All SOPs contain a revision number, effective date, and appropriate approval signatures. Controlled copies are available to all staff.
- Procedures for writing an SOP are incorporated by reference to TestAmerica's Corporate SOP No. CW-Q-S-002, *Writing a Standard Operating Procedure*, or Pittsburgh SOP No. PT-QA-010, *Document Development and Control*.
- SOPs are reviewed at a minimum of every 2 years, and where necessary, revised to ensure continuing suitability and compliance with applicable requirements. SOPs related to drinking water testing are reviewed every year.

19.3 Laboratory Methods Manual

For each test method, the laboratory shall have available the published referenced method as well as the laboratory developed SOP.

Note: If more stringent standards or requirements are included in a mandated test method or regulation than those specified in this manual, the laboratory shall demonstrate that such requirements are met. If it is not clear which requirements are more stringent, the standard from the method or regulation is to be followed. Any exceptions or deviations from the referenced methods or regulations are noted in the specific analytical SOP.

The laboratory maintains an SOP Index (PT-QA-WI-002) for both technical and non-technical SOPs. Technical SOPs are maintained to describe a specific test method. Non-technical SOPs are maintained to describe functions and processes not related to a specific test method.

19.4 Selection Of Methods

Since numerous methods and analytical techniques are available, continued communication between the client and laboratory is imperative to assure the correct methods are utilized. Once client methodology requirements are established, this and other pertinent information is summarized by the Project Manager. These mechanisms ensure that the proper analytical methods are applied when the samples arrive for log-in. For non-routine analytical services (e.g., special matrices, non-routine compound lists), the method of choice is selected based on client needs and available technology. The methods selected should be capable of measuring the specific parameter of interest, in the concentration range of interest, and with the required precision and accuracy.

19.4.1 Sources of Methods

Routine analytical services are performed using standard EPA-approved methodology. In some cases, modification of standard approved methods may be necessary to provide accurate analyses of particularly complex matrices. When the use of specific methods for sample analysis is mandated through project or regulatory requirements, only those methods shall be used.

When clients do not specify the method to be used or methods are not required, the methods used will be clearly validated and documented in an SOP and available to clients and/or the end user of the data.

The analytical methods used by the laboratory are those currently accepted and approved by the U. S. EPA and the state or territory from which the samples were collected. Reference methods include:

- *Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act; Analysis and Sampling Procedures; 40CFR Part 136 as amended by Method Update Rule, Most Recent Publication*
- *Methods for Chemical Analysis of Water and Wastes, EPA 600 (4-79-020), 1983*
- *Methods for the Determination of Inorganic Substances in Environmental Samples, EPA-600/R-93/100, August 1993*
- *Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91/010, June 1991. Supplement I: EPA-600/R-94/111, May 1994*
- *Standard Methods for the Examination of Water and Wastewater, 18th/19th /20th /on-line edition; Eaton, A.D. Clesceri, L.S. Greenberg, A.E. Eds; American Water Works Association, Water Pollution Control Federation, American Public Health Association: Washington, D.C.*
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008, Final Update V, August 2015*
- *Annual Book of ASTM Standards, American Society for Testing & Materials (ASTM), Philadelphia, PA.*

- *Code of Federal Regulations (CFR) 40, Parts 136, 141, 172, 173, 178, 179 and 261*
- *Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities – Testing Manual, U.S. Army Corps of Engineers, January, 2003*

The laboratory reviews updated versions to all the aforementioned references for adaptation based upon capabilities, instrumentation, etc., and implements them as appropriate. As such, the laboratory strives to perform only the latest versions of each approved method as regulations allow or require.

Other reference procedures for non-routine analyses may include methods established by specific states (e.g., Underground Storage Tank methods), ASTM or equipment manufacturers. Sample type, source, and the governing regulatory agency requiring the analysis will determine the method utilized.

The laboratory shall inform the client when a method proposed by the client may be inappropriate or out of date. After the client has been informed, and they wish to proceed contrary to the laboratory's recommendation, it will be documented.

19.4.2 Demonstration of Capability

Before the laboratory may institute a new method and begin reporting results, the laboratory shall confirm that it can properly operate the method. In general, this demonstration does not test the performance of the method in real world samples, but in an applicable and available clean matrix sample. If the method is for the testing of analytes that are not conducive to spiking, demonstration of capability may be performed on quality control samples.

A demonstration of capability (DOC) is performed whenever there is a change in instrument type (e.g., new instrumentation), matrix, method or personnel (e.g., analyst hasn't performed the test within the last 12 months). The IDOC must meet the control limits specified in the reference method, if any, or meet method LCS criteria if no IDOC specific controls are provided. (see laboratory SOP No. PT-QA-001, *Employee Orientation and Training*, for details)

Note: The laboratory shall have a DOC for all analytes included in the methods that the laboratory performs, and proficiency DOCs for each analyst shall include all analytes that the laboratory routinely performs. Addition of non-routine analytes does not require new DOCs for all analysts if those analysts are already qualified for routine analytes tested using identical chemistry and instrument conditions.

The initial demonstration of capability must be thoroughly documented and approved by the Technical Director or Lab Director and QA Manager prior to independently analyzing client samples. All associated documentation must be retained in accordance with the laboratories archiving procedures.

The laboratory must have an approved SOP, demonstrate satisfactory performance, and conduct an MDL study (when applicable). There may be other requirements as stated within the published method or regulations (i.e., retention time window study).

Note: In some instances, a situation may arise where a client requests that an unusual analyte be reported using a method where this analyte is not normally reported. If the analyte is being reported for regulatory purposes, the method must meet all procedures outlined within this QA Manual (SOP, MDL, and DOC). If the client states that the information is not for regulatory purposes, the result may be reported as long as the following criteria are met:

- The instrument is calibrated for the analyte to be reported using the criteria for the method and ICV/CCV criteria are met (unless an ICV/CCV is not required by the method or criteria are per project DQOs).
- The laboratory's nominal or default reporting limit (RL) is equal to the quantitation limit (QL), must be at or above the lowest non-zero standard in the calibration curve and must be reliably determined. Project RLs are client specified reporting levels which may be higher than the QL. Results reported below the QL must be qualified as estimated values. Also see Section 19.6.1.3, Relationship of Limit of Detection (LOD) to Quantitation Limit (QL).
- The client request is documented and the lab informs the client of its procedure for working with unusual compounds. The final report must be footnoted: *Reporting Limit based on the low standard of the calibration curve.*

19.4.3 Initial Demonstration of Capability (IDOC) Procedures

Initial Demonstration and Capability (IDOC) procedure is described in laboratory SOP No. PT-QA-001.

A certification statement (Figure 19-1) shall be used to document the completion of each initial and continuing demonstration of capability. A copy of the certification is archived in the analyst's training file.

19.5 Laboratory Developed Methods And Non-Standard Methods

Any new method developed by the laboratory must be fully defined in an SOP and validated by qualified personnel with adequate resources to perform the method. Method specifications and the relation to client requirements must be clearly conveyed to the client if the method is a non-standard method (not a published or routinely accepted method). The client must also be in agreement to the use of the non-standard method.

19.6 Validation Of Methods

Validation is the confirmation by examination and the provision of objective evidence that the particular requirements for a specific intended use are fulfilled. Validation of a method is a planned activity. A coordinator is designated for the process, who's responsibility it is to communicate the process and progress to all involved personnel.

All non-standard methods, laboratory designed/developed methods, standard methods used outside of their scope, and major modifications to published methods must be validated to confirm they are fit for their intended use. The validation will be as extensive as necessary to meet the needs of the given application. The results are documented with the validation procedure used and contain a statement as to the fitness for use.

19.6.1 Method Validation and Verification Activities for All New Methods

While method validation can take various courses, the following activities can be required as part of method validation. Method validation records are designated QC records and are archived accordingly.

19.6.1.1 Determination of Method Selectivity

Method selectivity is the demonstrated ability to discriminate the analyte(s) of interest from other compounds in the specific matrix or matrices from other analytes or interference. In some cases to achieve the required selectivity for an analyte, a confirmation analysis is required as part of the method.

19.6.1.2 Determination of Method Sensitivity

Sensitivity can be both estimated and demonstrated. Whether a study is required to estimate sensitivity depends on the level of method development required when applying a particular measurement system to a specific set of samples. Where estimations and/or demonstrations of sensitivity are required by regulation or client agreement, such as the procedure in 40 CFR Part 136 Appendix B, under the Clean Water Act, these shall be followed.

19.6.1.3 Relationship of Limit of Detection (LOD) to the Quantitation Limit (QL)

An important characteristic of expression of sensitivity is the difference in the LOD and the QL. The LOD is the minimum level at which the presence of an analyte can be reliably concluded. The QL is the minimum concentration of analyte that can be quantitatively determined with acceptable precision and bias. For most instrumental measurement systems, there is a region where semi-quantitative data is generated around the LOD (both above and below the estimated MDL or LOD) and below the QL. In this region, detection of an analyte may be confirmed but quantification of the analyte is unreliable within the accuracy and precision guidelines of the measurement system. When an analyte is detected below the QL, and the presence of the analyte is confirmed by meeting the qualitative identification criteria for the analyte, the analyte can be reliably reported, but the amount of the analyte can only be estimated. If data is to be reported in this region, it must be done so with a qualification that denotes the semi-quantitative nature of the result.

19.6.1.4 Determination of Interferences

A determination that the method is free from interferences in a blank matrix is performed.

19.6.1.5 Determination of Range

Where appropriate to the method, the quantitation range is determined by comparison of the response of an analyte in a curve to established or targeted criteria. Generally the upper quantitation limit is defined by highest acceptable calibration concentration. The lower quantitation limit or QL cannot be lower than the lowest non-zero calibration level, and can be constrained by required levels of bias and precision.

19.6.1.6 Determination of Accuracy and Precision

Accuracy and precision studies are generally performed using replicate analyses, with a resulting percent recovery and measure of reproducibility (standard deviation, relative standard deviation) calculated and measured against a set of target criteria.

19.6.1.7 Documentation of Method

The method is formally documented in an SOP. If the method is a minor modification of a standard laboratory method that is already documented in an SOP, an SOP Attachment describing the specific differences in the new method is acceptable in place of a separate SOP.

19.6.1.8 Continued Demonstration of Method Performance

Continued demonstration of Method Performance is addressed in the SOP. Continued demonstration of method performance is generally accomplished by batch specific QC samples such as LCS, method blanks or PT samples.

19.7 Method Detection Limits (MDL)/ Limits Of Detection (LOD)

Method detection limits (MDL) are initially determined in accordance with 40 CFR Part 136, Appendix B or alternatively by other technically acceptable practices that have been accepted by regulators. MDL is also sometimes referred to as Limit of Detection (LOD). The MDL theoretically represents the concentration level for each analyte within a method at which the analyst is 99% confident that the true value can be differentiated from blanks. The MDL is determined for each analyte initially during the method validation process and updated as required in the analytical methods, whenever there is a significant change in the procedure or equipment, or based on project specific requirements. Generally, the analyst prepares at least seven replicates of solution spiked at one to five times the estimated method detection limit (most often at the lowest standard in the calibration curve) into the applicable matrix with all the analytes of interest. Each of these aliquots is extracted (including any applicable clean-up procedures) and analyzed in the same manner as the samples. All instruments used for analysis of client samples are included in the MDL study and verification. Where possible, the seven replicates should be analyzed over 2-4 days to provide a more realistic MDL. [To allow for some flexibility, this low level standard may be analyzed every batch or every week or some other frequency rather than doing the study all at once. In addition, a larger number of data points may be used if the appropriate t-value multiplier is used]

Refer to the Corporate SOP No. CA-Q-S-006 or laboratory SOP No. PT-QA-007, *Detection Limits*, for details on the laboratory's MDL process.

19.8 Instrument Detection Limits (IDL)

The IDL is sometimes used to assess the reasonableness of the MDLs or in some cases required by the analytical method or program requirements. IDLs are most used in metals analyses but may be useful in demonstration of instrument performance in other areas.

IDLs are calculated to determine an instrument's sensitivity independent of any preparation method. IDLs are calculated either using 7 replicate spike analyses, like MDL but without sample preparation, or by the analysis of 10 instrument blanks and calculating 3 x the absolute value of the standard deviation.

If IDL is > than the MDL, it may be used as the reported MDL.

19.9 Verification Of Detection And Reporting Limits

Once the MDL is determined, it must be verified on each by analyzing a quality control sample (prepared as a sample) at no more than 3 times the calculated MDL for single analyte analyses (e.g. most wet chemistry methods) and no more than 4 times the calculated MDL for multiple analyte methods (e.g. GC, GCMS, ICP, etc.). The analytes must be qualitatively identified. This verification does not apply to methods that are not readily spiked (e.g. pH, turbidity, etc.) or where the lab does not report to the MDL. If the MDL does not verify, then the lab will not report to the MDL, or redevelop their MDL or use the level where qualitative identification is established. MDLs must be verified at least annually. Refer to the laboratory SOP PT-QA-007 for further details.

When the laboratory establishes a quantitation limit, it must be initially verified by the analysis of a low level standard or QC sample at 1-2 times the reporting limit and annually thereafter. The annual requirement is waived for methods that have an annually verified MDL. The laboratory will comply with any regulatory requirements.

The laboratory quantitation limit is equivalent to the Limit of Quantitation (LOQ), which is at a concentration equal to or greater than the lowest non-zero calibration standard. The RL is a level at or above the LOQ that is used for specific project reporting purposes, as agreed to between the laboratory and the client. The RL cannot be lower than the LOQ concentration, but may be higher. The LOQ is at a concentration equal to, or greater than, the MDL.

19.10 Retention Time Windows

Most organic analyses and some inorganic analyses use chromatography techniques for qualitative and quantitative determinations. For every chromatography analysis or as specific in the reference method, each analyte will have a specific time of elution from the column to the detector. This is known as the analyte's retention time. The variance in the expected time of elution is defined as the retention time window. As the key to analyte identification in chromatography, retention time windows must be established on every column for every analyte used for that method. These records are kept with the files associated with an instrument for later quantitation of the analytes. Complete details are available in the laboratory SOPs.

19.11 Evaluation Of Selectivity

The laboratory evaluates selectivity by following the checks within the applicable analytical methods, which include mass spectral tuning, second column confirmation, ICP interelement interference checks, chromatography retention time windows, sample blanks, spectrochemical, atomic absorption or fluorescence profiles, co-precipitation evaluations and specific electrode response factors.

19.12 Estimation Of Uncertainty Of Measurement

19.12.1 Uncertainty is "a parameter associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand" (as defined by the International Vocabulary of Basic and General Terms in Metrology, ISO Geneva, 1993, ISBN 92-67-10175-1). Knowledge of the uncertainty of a measurement provides additional confidence in a result's validity. Its value accounts for all the factors which could possibly affect the result, such as adequacy of analyte definition, sampling, matrix effects and interferences, climatic conditions, variances in weights, volumes, and standards, analytical

procedure, and random variation. Some national accreditation organizations require the use of an "expanded uncertainty": the range within which the value of the measurand is believed to lie within at least a 95% confidence level with the coverage factor k=2.

19.12.2 Uncertainty is not error. Error is a single value, the difference between the true result and the measured result. On environmental samples, the true result is never known. The measurement is the sum of the unknown true value and the unknown error. Unknown error is a combination of systematic error, or bias, and random error. Bias varies predictably, constantly, and independently from the number of measurements. Random error is unpredictable, assumed to be Gaussian in distribution, and reducible by increasing the number of measurements.

19.12.3 The minimum uncertainty associated with results generated by the laboratory can be determined by using the Laboratory Control Sample (LCS) accuracy range for a given analyte. The LCS limits are used to assess the performance of the measurement system since they take into consideration all of the laboratory variables associated with a given test over time (except for variability associated with the sampling and the variability due to matrix effects). The percent recovery of the LCS is compared either to the method-required LCS accuracy limits or to the statistical, historical, in-house LCS accuracy limits.

19.12.4 To calculate the uncertainty for the specific result reported, multiply the result by the decimal of the lower end of the LCS range percent value for the lower end of the uncertainty range, and multiply the result by the decimal of the upper end of the LCS range percent value for the upper end of the uncertainty range. These calculated values represent uncertainties at approximately the 99% confidence level with a coverage factor of k =3. As an example, for a reported result of 1.0 mg/L with an LCS recovery range of 50 to 150%, the estimated uncertainty in the result would be 1.0 +/- 0.5 mg/L. Uncertainty determination is further described in Pittsburgh Laboratory SOP No. PT-QA-005, *Measurement Uncertainty*.

19.12.5 In the case where a well recognized test method specifies limits to the values of major sources of uncertainty of measurement and specifies the form of presentation of calculated results, no further discussion of uncertainty is required.

19.13 Sample Reanalysis Guidelines

Because there is a certain level of uncertainty with any analytical measurement, a sample re-preparation (where appropriate) and subsequent analysis (hereafter referred to as 'reanalysis') may result in either a higher or lower value from an initial sample analysis. There are also variables that may be present (e.g., sample homogeneity, analyte precipitation over time, etc.) that may affect the results of a reanalysis. Based on the above comments, the laboratory will reanalyze samples at a client's request with the following caveats. **Client specific Contractual Terms & Conditions for reanalysis protocols may supercede the following items.**

- Homogenous samples: If a reanalysis agrees with the original result to within the RPD limits for MS/MSD or Duplicate analyses, or within $\pm$ 1 reporting limit for samples $\leq$ 5x the reporting limit, the original analysis will be reported. At the client's request, both results may be reported.
- If the reanalysis does not agree (as defined above) with the original result, then the laboratory will investigate the discrepancy and reanalyze the sample a third time for confirmation if sufficient sample is available.

- Any potential charges related to reanalysis are discussed in the contract terms and conditions or discussed at the time of the request. The client will typically be charged for reanalysis unless it is determined that the lab was in error.
- Due to the potential for increased variability, reanalysis may not be applicable to Non-homogenous, Encore, and Sodium Bisulfate preserved samples. See the Area Technical Manager/Supervisor or Laboratory Director if unsure.

19.14 Control Of Data

The laboratory has policies and procedures in place to ensure the authenticity, integrity, and accuracy of the analytical data generated by the laboratory.

19.14.1 Computer and Electronic Data Related Requirements

The three basic objectives of our computer security procedures and policies are shown below. The laboratory is currently running the TALs LIMS which is a custom in-house developed LIMS system that has been highly customized to meet the needs of the laboratory. It is referred to as LIMS for the remainder of this section. The LIMS utilizes Microsoft SQL Server, which is an industry standard relational database platform. It is referred to as Database for the remainder of this section.

19.14.1.1 Maintain the Database Integrity: Assurance that data is reliable and accurate through data verification (review) procedures, password-protecting access, anti-virus protection, data change requirements, as well as an internal LIMS permissions procedure.

- LIMS Database Integrity is achieved through data input validation, internal user controls, and data change requirements.
- Spreadsheets and other software developed in-house must be verified with documentation through hand calculations prior to use. Cells containing calculations must be lock-protected and controlled.
- Instrument hardware and software adjustments are safeguarded through maintenance logs, audit trails and controlled access.

19.14.1.2 Ensure Information Availability: Protection against loss of information or service is ensured through scheduled back-ups, stable file server network architecture, secure storage of media, line filter, Uninterruptible Power Supply (UPS), and maintaining older versions of software as revisions are implemented.

19.14.1.3 Maintain Confidentiality: Ensure data confidentiality through physical access controls such as password protection or website access approval, when electronically transmitting data.

19.14.2 Data Reduction

The complexity of the data reduction depends on the analytical method and the number of discrete operations involved (e.g., extractions, dilutions, instrument readings and concentrations). The analyst calculates the final results from the raw data or uses appropriate computer programs to assist in the calculation of final reportable values.

For manual data entry, e.g., Wet Chemistry, the data is reduced by the analyst and then verified by the Department Manager or alternate analyst prior to updating the data in LIMS. The spreadsheets, or any other type of applicable documents, are signed by both the analyst and alternate reviewer to

confirm the accuracy of the manual entry(s). The applicable data/spreadsheet is scanned in LIMS with the batch.

Manual integration of peaks will be documented and reviewed and the raw data will be flagged in accordance with the TestAmerica Corporate SOP No. CA-Q-S-002, *Acceptable Manual Integration Practices*.

Analytical results are reduced to appropriate concentration units specified by the analytical method, taking into account factors such as dilution, sample weight or volume, etc. Blank correction will be applied only when required by the method or per manufacturer's indication; otherwise, it should not be performed. Calculations are independently verified by appropriate laboratory staff. Calculations and data reduction steps for various methods are summarized in the respective analytical SOPs or program requirements.

19.14.2.1 All raw data must be retained, including computer file (if appropriate), and/or run log. All criteria pertinent to the method must be recorded. The documentation is recorded at the time observations or calculations are made and must be signed or initialed/dated (month/day/year). It must be easily identifiable who performed which tasks if multiple people were involved.

19.14.2.2 In general, concentration results are reported in milligrams per liter (mg/l) or micrograms per liter (µg/l) for liquids and milligrams per kilogram (mg/kg) or micrograms per kilogram (µg/kg) for solids. For values greater than 10,000 mg/l, results can be reported in percent, i.e., 10,000 mg/l = 1**%.** Units are defined in each lab SOP.

19.14.2.3 In reporting, the analyst or the instrument output records the raw data result using values of known certainty plus one uncertain digit. If final calculations are performed external to LIMS, the results should be entered in LIMS with at least three significant figures. In general, results are reported to 2 significant figures on the final report.

19.14.2.4 For those methods that do not have an instrument printout or an instrumental output compatible with the LIMS System, the raw results and dilution factors are entered directly into LIMS by the analyst, and the software calculates the final result for the analytical report. LIMS has a defined significant figure criterion for each analyte.

19.14.2.5 The laboratory strives to import data directly from instruments or calculation spreadsheets to ensure that the reported data are free from transcription and calculation errors. For those analyses with an instrumental output compatible with the LIMS, the raw results and dilution factors are transferred into LIMS electronically after reviewing the quantitation report, and removing unrequested or poor spectrally-matched compounds. The analyst prints a copy of what has been entered to check for errors. This printout and the instrument's printout of calibrations, concentrations, retention times, chromatograms, and mass spectra, if applicable, are retained with the data file. The data file is stored on the server and every night backed up to a tape file.

19.14.3 Logbook / Worksheet Use Guidelines

Logbooks and worksheets are filled out 'real time' and have enough information on them to trace the events of the applicable analysis/task. (e.g. calibrations, standards, analyst, sample ID, date, time on short holding time tests, temperatures when applicable, calculations are traceable, etc.)

- Corrections are made following the procedures outlined in Section 12.
- Logbooks are controlled by the QA department. A record is maintained of all logbooks in the lab.
- Unused portions of pages must be "Z"'d out, signed and dated.
- Worksheets are created with the approval of the Technical Manager and QA Manager at the facility.
  - Any cells that perform calculations must have the calculation verified and the cell locked so that the formula cannot be changed.
  - The QA Manager controls all worksheets following the procedures in Section 6.

19.14.4 Review / Verification Procedures

Data review procedures comprise a set of computerized and manual checks applied at appropriate levels of the measurement process. See Pittsburgh Laboratory SOPs PT-QA-013, *Independent QA Data Review*; PT-QA-018, *Technical Data Review*; and PT-SR-001, *Sample Receipt and Login*; for details.

19.14.4.1 Log-In Review - The data review process starts at the sample receipt stage. Sample control personnel review chain-of-custody forms and project instructions from the project management group. This is the basis of the sample information and analytical instructions entered into the LIMS. The log-in instructions are reviewed by the personnel entering the information, and a second level review is conducted by the project management staff.

19.14.4.2 First Level Data Review - The next level of data review occurs with the analysts. As data are generated, analysts review their work to ensure that the results meet project and SOP requirements. First level reviews include inspection of all raw data (e.g., instrument output for continuous analyzers, chromatograms, spectra, and manual integrations), evaluation of calibration/calibration verification data in the day's analytical run, evaluation of QC data, documentation of standards and reagents, and reliability of sample results. The analyst transfers data into LIMS, data qualifiers are added as needed. All first level reviews are documented.

19.14.4.3 Second Level Data Review – All analytical data are subject to review by a second qualified analyst or supervisor. Second level reviews include inspection of all raw data (e.g., instrument output, chromatograms, and spectra) including 100% of data associated with any changes made by the primary analyst, such as manual integrations or reassignment of peaks to different analytes, or elimination of false negative analytes. The second review also includes evaluation of initial calibration/calibration verification data in the day's analytical run, evaluation of QC data, documentation of standards and reagents, reliability of sample results, qualifiers and NCM narratives. Manual calculations are checked in second level review. All second level reviews are documented.

Issues that deem further review include the following:

- QC data are outside the specified control limits for accuracy and precision
- Reviewed sample data does not match with reported results
- Unusual detection limit changes are observed
- Samples having unusually high results
- Samples exceeding a known regulatory limit
- Raw data indicating some type of contamination or poor technique
- Inconsistent peak integration
- Transcription errors
- Results outside of calibration range

19.14.4.4 Unacceptable analytical results may require reanalysis of the samples. Any problems are brought to the attention of the Laboratory Director, Project Manager, Quality Assurance Manager, Technical Director, Department Manager or section Supervisor for further investigation. Corrective action is initiated whenever necessary.

19.14.4.5 The results are then entered or directly transferred into the computer database and a hard copy (or .pdf) is printed for the client.

19.14.4.6 As a final review prior to the release of the report, the Project Manager (or designee) reviews the results for appropriateness and completeness. This review and approval ensures that client requirements have been met and that the final report has been properly completed. The process includes, but is not limited to, verifying that chemical relationships are evaluated, COC is followed, cover letters/ narratives are present, flags are appropriate, and project specific requirements are met.

19.14.4.7 Any project that requires a data package is subject to a tertiary data review for transcription errors and acceptable quality control requirements. The Project Manager (or designee) then signs the final report. They also check the report for any clerical or invoicing errors. When complete, the report is sent out to the client.

19.14.4.8 As a further check of the system, the QA department reviews both selected and random analytical batches and final reports.

19.14.4.9 A visual summary of the flow of samples and information through the laboratory, as well as data review and validation, is presented in Figure 19-2.

19.14.5 Manual Integrations

Computerized data systems provide the analyst with the ability to re-integrate raw instrument data in order to optimize the interpretation of the data. Though manual integration of data is an invaluable tool for resolving variations in instrument performance and some sample matrix problems, when used improperly, this technique would make unacceptable data appear to meet quality control acceptance limits. Improper re-integrations lead to legally indefensible data, a poor reputation, or possible laboratory decertification. Because guidelines for re-integration of data are not provided in the methods and most methods were written prior to widespread implementation of computerized data systems, the laboratory trains all analytical staff on proper manual integration techniques using Corporate SOP No. CA-Q-S-002.

19.14.5.1 The analyst must adjust baseline or the area of a peak in some situations, for example when two compounds are not adequately resolved or when a peak shoulder needs to be separated from the peak of interest. The analyst must use professional judgment and common sense to determine when manual integrating is required. Analysts are encouraged to ask for assistance from a senior analyst or manager when in doubt.

19.14.5.2 Analysts shall not increase or decrease peak areas for the sole purpose of achieving acceptable QC recoveries that would have otherwise been unacceptable. The intentional recording or reporting of incorrect information (or the intentional omission of correct information) is against company principles and policy and is grounds for immediate termination.

19.14.5.3 Client samples, performance evaluation samples, and quality control samples are all treated equally when determining whether or not a peak area or baseline should be manually adjusted.

19.14.5.4 All manual integrations receive a second level review. Manual integrations must be indicated on an expanded scale “after” chromatograms such that the integration performed can be easily evaluated during data review. Expanded scale “before” chromatograms are also required for all manual integrations on QC parameters (calibrations, calibration verifications, laboratory control samples, internal standards, surrogates, etc.) unless the laboratory has another documented Corporate approved procedure in place that can demonstrate an active process for detection and deterrence of improper integration practices.

Figure 19-1

Example - Demonstration of Capability Documentation

DEMONSTRATION OF CAPABILITIY (DOC)

Laboratory Name:_____
Laboratory Address:_____
Method:_____ Matrix:_____
Date:_____ Analyst(s):_____
Source of Analyte(s):_____

Analytical Results

Analyst	Conc. (Units)	Rep 1	Rep 2	Rep 3	Rep 4	Avg. % Recovery	% RSD
_____	_____	_____	_____	_____	_____	_____	_____

% RSD = Percent relative standard deviation = standard deviation divided by average % Recovery

Raw data reference: _____

Certification Statement:

We, the undersigned, certify that:

1. The analyst identified above, using the cited test method with the specifications in the cited SOP, which is in use at this facility for the analysis of samples under the laboratory's Quality Assurance Plan, has completed the Demonstration of Capability (DOC).
2. The test method(s) was performed by the analyst identified on this certificate.
3. A copy of the test method and the laboratory-specific SOPs are available for all personnel on site. These documents have been reviewed by the analyst as part of this DOC.
4. The data associated with the demonstration of capability are true, accurate, complete, and self-explanatory.
5. All raw data necessary to reconstruct and validate these analyses have been retained at the facility, and the associated information is well organized and available for review.

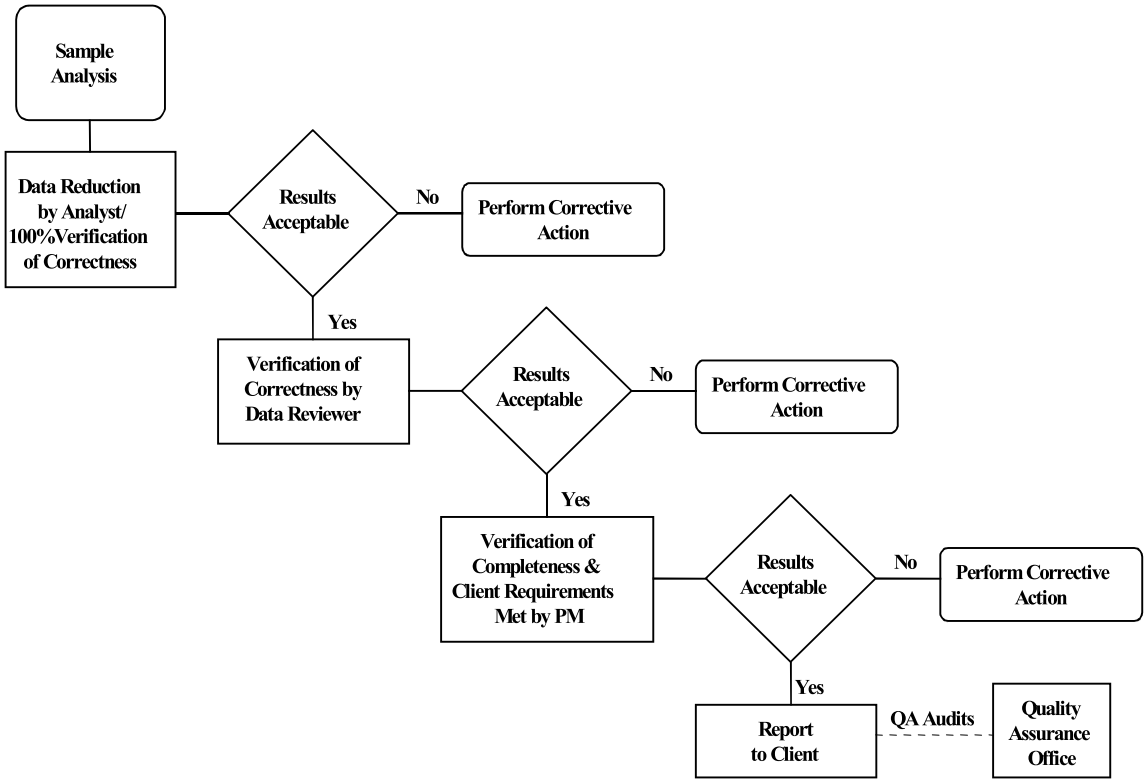
_____ _____
Analyst Signature Date

_____ _____
Technical Manager Signature Date

_____ _____
Quality Assurance Coordinator Signature Date

Figure 19-2

Work Flow



SECTION 20

EQUIPMENT AND CALIBRATIONS

20.1 Overview

The laboratory purchases the most technically advanced analytical instrumentation for sample analyses. Instrumentation is purchased on the basis of accuracy, dependability, efficiency and sensitivity. Each laboratory is furnished with all items of sampling, preparation, analytical testing and measurement equipment necessary to correctly perform the tests for which the laboratory has capabilities. Each piece of equipment is capable of achieving the required accuracy and complies with specifications relevant to the method being performed. Before being placed into use, the equipment (including sampling equipment) is calibrated and checked to establish that it meets its intended specification. The calibration routines for analytical instruments establish the range of quantitation. Calibration procedures are specified laboratory analytical SOPs. Also see Corporate Policy No. CA-Q-P-003, *Calibration Curves and Selection of Calibration Points*.

A list of laboratory instrumentation types is presented in Table 20-1.

Equipment is only operated by authorized and trained personnel. Manufacturer's instructions for equipment use are readily accessible to all appropriate laboratory personnel.

20.2 Preventive Maintenance

The laboratory follows a well-defined maintenance program to ensure proper equipment operation and to prevent the failure of laboratory equipment or instrumentation during use. This program of preventive maintenance helps to avoid delays due to instrument failure.

Routine preventive maintenance procedures and frequency, such as cleaning and replacements, should be performed according to the procedures outlined in the manufacturer's manual. Qualified personnel must also perform maintenance when there is evidence of degradation of peak resolution, a shift in the calibration curve, loss of sensitivity, or failure to continually meet one of the quality control criteria.

Table 20-2 lists examples of scheduled routine maintenance. It is the responsibility of each Technical Manager to ensure that instrument maintenance logs are kept for all equipment in his/her department. Preventative maintenance procedures may also be outlined in analytical SOPs or instrument manuals. Further detail for equipment maintenance is included in SOP No. PT-QA-022 and individual analytical SOPs. (Note: for some equipment, the log used to monitor performance is also the maintenance log. Multiple pieces of equipment may share the same log as long as it is clear as to which instrument is associated with an entry.)

Instrument maintenance logs are controlled and are used to document instrument problems, instrument repair and maintenance activities. Maintenance logs shall be kept for all major pieces of equipment. Instrument maintenance logs may also be used to specify instrument parameters.

- Documentation must include all major maintenance activities such as contracted preventive maintenance and service and in-house activities such as the replacement of electrical components, lamps, tubing, valves, columns, detectors, cleaning and adjustments.

- Each entry in the instrument log includes the Analyst's initials, the date, a detailed description of the problem (or maintenance needed/scheduled), a detailed explanation of the solution or maintenance performed, and a verification that the equipment is functioning properly (state what was used to determine a return to control. e.g. CCV run on *'date'* was acceptable, or instrument recalibrated on 'date' with acceptable verification, etc.) must also be documented in the instrument records.

- When maintenance or repair is performed by an outside agency, service receipts detailing the service performed can be affixed into the logbooks adjacent to pages describing the maintenance performed. This attached document must be signed across the page entered and the logbook so that it is clear that a page is missing if only half a signature is found in the logbook.

If an instrument requires repair (subjected to overloading or mishandling, gives suspect results, or otherwise has shown to be defective or outside of specified limits) it shall be taken out of operation and tagged as out-of-service or otherwise isolated until such a time as the repairs have been made and the instrument can be demonstrated as operational by calibration and/or verification or other test to demonstrate acceptable performance. The laboratory shall examine the effect of this defect on previous analyses.

In the event of equipment malfunction that cannot be resolved, service shall be obtained from the instrument vendor manufacturer, or qualified service technician, if such a service can be tendered. If on-site service is unavailable, arrangements shall be made to have the instrument shipped back to the manufacturer for repair. Back-up instruments, which have been approved, for the analysis shall perform the analysis normally carried out by the malfunctioning instrument. If the back-up is not available and the analysis cannot be carried out within the needed timeframe, the samples shall be subcontracted.

If an instrument is sent out for service or transferred to another facility, it must be recalibrated and the laboratory MDL verified (using an MDLV) prior to return to lab operations.

20.3 Support Equipment

This section applies to all devices that may not be the actual test instrument, but are necessary to support laboratory operations. These include but are not limited to: balances, ovens, refrigerators, freezers, incubators, water baths, field sampling devices, temperature measuring devices, thermal/pressure sample preparation devices and volumetric dispensing devices if quantitative results are dependent on their accuracy, as in standard preparation and dispensing or dilution into a specified volume. All raw data records associated with the support equipment are retained to document instrument performance.

Support equipment that provides quantitative results are calibrated or calibration verified to a recognized national metrology standard, such as NIST, where available, over the expected range of use. The acceptability for use shall be according to the needs of the analysis or application for which the equipment is being used.

Calibration and calibration verification scheduling and documentation for support equipment is maintained by the QA department. All equipment is labeled with the most recent calibration information and the next verification due date.

20.3.1 Weights and Balances

The accuracy of the balances used in the laboratory is checked every working day, before use. All balances are placed on stable counter tops.

Each balance is checked prior to initial serviceable use with at least two certified ASTM type 1 weights spanning its range of use (weights that have been calibrated to ASTM type 1 weights may also be used for daily verification). ASTM type 1 weights used only for calibration of other weights (and no other purpose) are inspected for corrosion, damage or nicks at least annually and if no damage is observed, they are calibrated at least every 5 years by an outside calibration laboratory. Any weights (including ASTM Type 1) used for daily balance checks or other purposes are recalibrated/recertified annually to NIST standards (this may be done internally if laboratory maintains “calibration only” ASTM type 1 weights).

All balances are serviced annually by a qualified service representative, who supplies the laboratory with a certificate that identifies traceability of the calibration to the NIST standards.

All of this information is recorded in logs, and the recalibration/recertification certificates are kept on file. Refer to Pittsburgh Laboratory SOP No. PT-QA-012, *Selection and Calibration of Balances and Weights*, for details.

20.3.2 pH, Conductivity, and Turbidity Meters

The pH meters used in the laboratory are accurate to ± 0.1 pH units, and have a scale readability of at least 0.05 pH units. The meters automatically compensate for the temperature, and are calibrated with at least two working range buffer solutions before each use.

Conductivity meters are also calibrated before each use with a known standard to demonstrate the meters do not exceed an error of 1% or one umhos/cm.

Turbidity meters are also calibrated before each use. All of this information is documented in logs.

Consult pH and Conductivity, and Turbidity laboratory analytical SOPs for further information.

20.3.3 Thermometers

All thermometers are calibrated on an annual basis with a NIST-traceable thermometer. IR thermometers, digital probes and thermocouples are calibrated quarterly. IR thermometers are checked daily for calibration accuracy against an NIST thermometer daily before use.

- If the temperature measuring device is used over a range of 10℃ or less, then a single point verification within the range of use is acceptable;
- If the temperature measuring device is used over a range of greater than 10℃, then the verification must bracket the range of use.

IR thermometers, digital probes and thermocouples are calibrated quarterly.

Mercury or digital NIST thermometers are recalibrated every five years (unless thermometer has been exposed to temperature extremes or apparent separation of internal liquid) by an approved outside service and the provided certificate of traceability is kept on file. The NIST thermometer(s) have increments of at least 1 degree (0.5 degree or less increments are required for drinking water microbiological laboratories), and have ranges applicable to method

and certification requirements. The NIST traceable thermometers are used for no other purpose than to calibrate other thermometers.

All of this information is documented in logbooks. Monitoring method-specific temperatures, including incubators, heating blocks, water baths, and ovens, is documented in method or device-specific logbooks. More information on this subject can be found in Pittsburgh Laboratory SOP No. PT-QA-008, *Thermometer and Barometer Verification and Temperature Monitoring*.

20.3.4 Refrigerators/Freezer Units, Waterbaths, Ovens and Incubators

The temperatures of all refrigerator units and freezers used for sample and standard storage are monitored each working day. Sample storage temperatures are monitored continuously (24/7).

Ovens, waterbaths and incubators are monitored on days of use.

All of this equipment has a unique identification number, and is assigned a unique thermometer for monitoring.

Sample storage refrigerator temperatures are kept between > 0ºC and ≤ 6 ºC.

Specific temperature settings/ranges for other refrigerators, ovens waterbaths, and incubators can be found in method specific SOPs.

All of this information is documented in Daily Temperature Logbooks or electronically. Refer to laboratory SOP No. PT-QA-008.

20.3.5 Autopipettors, Dilutors, and Syringes

Mechanical volumetric dispensing devices, including burettes, (except Class A Glassware and glass microliter syringes) are given unique identification numbers and the delivery volumes are verified gravimetrically, at a minimum, on a quarterly basis. Glass micro-syringes are considered the same as Class A glassware.

For those dispensers that are not used for analytical measurements, a label is applied to the device stating that it is not calibrated. Any device not regularly verified cannot be used for any quantitative measurements. Pipette calibration is described in Pittsburgh Laboratory SOP No. PT-QA-017, *Aqueous Pipette Calibration*.

Micro-syringes are purchased from Hamilton Company. Each syringe is traceable to NIST. The laboratory keeps on file an “Accuracy and Precision Statement of Conformance” from Hamilton attesting established accuracy.

20.3.6 Autoclaves

Autoclave performance is verified prior to initial use and at least annually by a third party vendor, including verification of both temperature and pressure. The timer function is verified quarterly. Sterilization temperatures are recorded on a maximum temperature thermometer for each cycle. Records are maintained for each use including date, contents, maximum temperature reached, pressure, time in sterilization mode, total run time, and analyst’s initials. See Pittsburgh Laboratory SOP No. PT-MI-001 for details.

20.3.7 Field Sampling Devices (Isco Auto Samplers)

Each Auto Sampler (ISCO) is assigned a unique identification number in order to keep track of the calibration. This number is also recorded on the sampling documentation.

The Auto Sampler is calibrated semiannually by setting the sample volume to 100ml and recording the volume received. The results are filed in a logbook/binder. The Auto Sampler is programmed to run three (3) cycles and each of the three cycles is measured into a graduated cylinder to verify 100ml are received.

If the RSD (Relative Standard Deviation) between the 3 cycles is greater than 10%, the procedure is repeated and if the result is still greater than 10%, then the Auto Sampler is taken out of service until it is repaired and calibration verification criteria can be met. The results of this check are kept in a logbook/binder.

20.4 Instrument Calibrations

Calibration of analytical instrumentation is essential to the production of quality data. Strict calibration procedures are followed for each method. These procedures are designed to determine and document the method detection limits, the working range of the analytical instrumentation and any fluctuations that may occur from day to day.

Sufficient raw data records are retained to allow an outside party to reconstruct all facets of the initial calibration. Records contain, but are not limited to, the following: calibration date, method, instrument, analyst(s) initials or signatures, analysis date, analytes, concentration, response, type of calibration (Avg RF, curve, or other calculations that may be used to reduce instrument responses to concentration.)

Sample results must be quantitated from the initial calibration and may not be quantitated from any continuing instrument calibration verification unless otherwise required by regulation, method or program.

If the initial calibration results are outside of the acceptance criteria, corrective action is performed and any affected samples are reanalyzed if possible. If the reanalysis is not possible, any data associated with an unacceptable initial calibration will be reported with appropriate data qualifiers (refer to Section 12).

Note: Instruments are calibrated initially and as needed after that and at least annually.

20.4.1 Calibration Standards

Calibration standards are prepared using the procedures indicated in the Reagents and Standards section of the determinative method SOP. If a reference method does not specify the number of calibration standards, a minimum of 3 calibration points (exception being ICP and ICP/MS methods) will be used.

Standards for instrument calibration are obtained from a variety of sources. All standards are traceable to national or international standards of measurement, or to national or international standard reference materials.

The lowest concentration calibration standard that is analyzed during an initial calibration must be at or below the stated reporting limit for the method based on the final volume of extract (or sample).

The other concentrations define the working range of the instrument/method or correspond to the expected range of concentrations found in actual samples that are also within the working range of the instrument/method. Results of samples not bracketed by initial instrument calibration standards (within calibration range to at least the same number of significant figures used to report the data) must be reported as having less certainty, e.g., defined qualifiers or flags (additional information may be included in the case narrative). The exception to these rules is ICP and ICP-MS methods or other methods which define the working range with periodic linear dynamic range studies, rather than through the range of concentrations of daily calibration standards.

All initial calibrations are verified with a standard obtained from a second source and traceable to a national standard, when available (or vendor certified different lot if a second source is not available). For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst at a different time or by a different preparation would be considered a second source. This verification occurs immediately after the calibration curve has been analyzed, and before the analysis of any samples.

20.4.1.1 Calibration Verification

The calibration relationship established during the initial calibration must be verified at least daily as specified in the laboratory method SOPs in accordance with the referenced analytical methods and in the 2009 TNI standard. The process of calibration verification applies to both external standard and internal standard calibration techniques, as well as to linear and non-linear calibration models. Initial calibration verification is with a standard source secondary (second source standard) to the calibration standards, but continuing calibration verifications may use the same source standards as the calibration curve.

Note: The process of calibration verification referred to is fundamentally different from the approach called "calibration" in some methods. As described in those methods, the calibration factors or response factors calculated during calibration are used to update the calibration factors or response factors used for sample quantitation. This approach, while employed in other EPA programs, amounts to a daily single-point calibration.

All target analytes and surrogates, including those reported as non-detects, must be included in periodic calibration verifications for purposes of retention time confirmation and to demonstrate that calibration verification criteria are being met, i. e., RPD, per 2009 TNI Std. EL-V1M4 Sec. 1.7.2.

All samples must be bracketed by periodic analyses of standards that meet the QC acceptance criteria (e.g., calibration and retention time). The frequency is found in the determinative methods or SOPs.

Generally, the initial calibrations must be verified at the beginning of each 12-hour analytical shift during which samples are analyzed. (Some methods may specify more or less frequent verifications). The 12-hour analytical shift begins with the injection of the calibration verification standard (or the MS tuning standard in MS methods). The shift ends after the completion of the

analysis of the last sample, QC, or standard that can be injected within 12 hours of the beginning of the shift.

A continuing instrument calibration verification (CCV) must be repeated at the beginning and, for methods that have quantitation by external calibration models, at the end of each analytical batch. Some methods have more frequent CCV requirements see specific SOPs. Most Inorganic methods require the CCV to be analyzed after every 10 samples or injections, including matrix or batch QC samples.

Note: If an internal standard calibration is being used (GCMS methods, for example) then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

If the results of a CCV are outside the established acceptance criteria and analysis of a second consecutive (and immediate) CCV fails to produce results within acceptance criteria, corrective action shall be performed. Once corrective actions have been completed & documented, the laboratory shall demonstrate acceptable instrument / method performance by analyzing two consecutive CCVs, or a new initial instrument calibration shall be performed.

Sample analyses and reporting of data may not occur or continue until the analytical system is calibrated or calibration verified. However, data associated with an unacceptable calibration verification may be fully useable and may be reported, based upon discussion and approval of the client, under the following special conditions:

a) When the acceptance criteria for the CCV are exceeded high (i.e., high bias) and the associated samples within the batch are non-detects, then those non-detects may be reported with a footnote or case narrative explaining the high bias. Otherwise the samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted; or

b) When the acceptance criteria for the CCV are exceeded low (i.e., low bias), samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted.

Samples reported under one of the conditions identified above will be appropriately flagged.

20.4.1.2 Verification of Linear and Non-Linear Calibrations

Calibration verification for calibrations involves the calculation of the percent drift or the percent difference of the instrument response between the initial calibration and each subsequent analysis of the verification standard. These calculations are available in the laboratory method SOPs. Verification standards are evaluated based on the % Difference from the average CF or RF of the initial calibration or based on %Drift or %Recovery if a linear or quadratic curve is used.

Regardless of whether a linear or non-linear calibration model is used, if initial verification criterion is not met, then no sample analyses may take place until the calibration has been verified or a new initial calibration is performed that meets the specifications listed in the method SOPs. If the calibration cannot be verified after the analysis of a single verification standard, then adjust the instrument operating conditions and/or perform instrument maintenance, and

analyze another aliquot of the verification standard. If the calibration cannot be verified with the second standard, then a new initial calibration is performed.

- When the acceptance criteria for the calibration verification are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported. Otherwise, the samples affected by the unacceptable calibration verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted.

- When the acceptance criteria for the calibration verification are exceeded low, i.e., low bias, those samples affected by the unacceptable verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted. Alternatively, a reporting limit standard may be analyzed to demonstrate that the laboratory can still support non-detects at their reporting limit.

Note: Some programs require additional verification steps for linear and quadratic calibration – i.e. reading the lowest, or all, initial calibration level standard against the curve, or verification at a low and a high concentration. See analytical SOPs and project notes for details.

20.5 Tentatively Identified Compounds (TICs) – GC/MS Analysis

For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by the purpose of the analyses being conducted. Data system library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other.

Note: If the TIC compound is not part of the client target analyte list but is calibrated by the laboratory and is both qualitatively and/or quantitatively identifiable, it should not be reported as a TIC. If the compound is reported on the same form as true TICs, it should be qualified and/or narrated that the reported compound is qualitatively and quantitatively (if verification in control) reported compared to a known standard that is in control (where applicable).

For example, the RCRA permit or waste delisting requirements may require the reporting of non-target analytes. Only after visual comparison of sample spectra with the nearest library searches may the analyst assign a tentative identification.

20.6 GC/MS TUNING

Prior to any GCMS analytical sequence, including calibration, the instrument parameters for the tune and subsequent sample analyses within that sequence must be set.

Prior to tuning/auto-tuning the mass spec, the parameters may be adjusted within the specifications set by the manufacturer or the analytical method. These generally don't need any adjustment but it may be required based on the current instrument performance. If the tune verification does not pass it may be necessary to clean the source or perform additional maintenance. Any maintenance is documented in the maintenance log.

Table 20-1

TestAmerica Pittsburgh Instrumentation Type List
(see PT-QA-WI-045 for the most current full listing of instrumentation and equipment)

GC	GC/MS	ICP	ICP/MS	IC	Carbon Analyzer	Auto-Analyzer	Variable Spectro-photometer	Electrode Meter
√	√	√	√	√	√	√	√	√

Tables 20-2

Example - Schedule of Routine Maintenance
(See SOP No. PT-QA-022 for more instrument specific information)

Daily	Weekly	Monthly	Quarterly	Annually	As Needed
Check sample waste container level.	Check peristaltic pump: proper roller pressure, sample introduction tubing, correct pump rotation, and condition of drain tubing.	Clean all filters and fans.	Replace oil in roughing pumps.	Replace oil in turbo-molecular pump.	Check electronic settings for optimum sensitivity: resolution, mass calibration, ion optics, CEM, deflector voltage.
Check quartz torch condition.	Check condition of sampler and skimmer cones.	Check recirculator water level.			
Measure quartz torch for proper alignment.	Check and drain oil mist eliminator on roughing pumps.				
Clean spray chamber and nebulizer.					
Check oil level of roughing pumps.					

SECTION 21

MEASUREMENT TRACEABILITY

21.1 Overview

Traceability of measurements shall be assured using a system of documentation, calibration, and analysis of reference standards. Laboratory equipment that are peripheral to analysis and whose calibration is not necessarily documented in a test method analysis or by analysis of a reference standard shall be subject to ongoing certifications of accuracy. At a minimum, these must include procedures for checking specifications of ancillary equipment: balances, thermometers, temperature, Deionized (DI) and Reverse Osmosis (RO) water systems, automatic pipettes and other volumetric measuring devices. (Refer to Section 20.3). With the exception of Class A Glassware and Glass microliter syringes, quarterly accuracy checks are performed for all mechanical volumetric devices. Microsyringes can be verified at least semi-annually or disposed of after 6 months of use. Wherever possible, subsidiary or peripheral equipment is checked against standard equipment or standards that are traceable to national or international standards. Class A Glassware and Glass microliter syringes should be routinely inspected for chips, acid etching or deformity (e.g., bent needle). If the Class A glassware or syringe is suspect, the accuracy of the glassware will be assessed prior to use.

21.2 NIST-Traceable Weights And Thermometers

Reference standards of measurement shall be used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

For NIST-traceable weights and thermometers, the laboratory requires that all calibrations be conducted by a calibration laboratory accredited by A2LA, NVLAP (National Voluntary Laboratory Accreditation Program) or another accreditation organization that is a signatory to a MRA (Mutual Recognition Arrangement) of one or more of the following cooperations – ILAC (International Laboratory Accreditation Cooperation) or APLAC (Asia – Pacific Laboratory Accreditation Cooperation). A certificate and scope of accreditation is kept on file at the laboratory.

Additional details can be found in laboratory SOP No's. PT-QA-008 and PT-QA-012.

21.3 Reference Standards / Materials

Reference standards/materials, where commercially available, are traceable to certified reference materials. Commercially prepared reference standards, to the extent available, are purchased from vendors accredited by A2LA, NVLAP, ISO 9001:2000, ISO 17025. All reference standards from commercial vendors shall be accompanied by a certificate that includes at least the following information:

- Manufacturer
- Analytes or parameters calibrated
- Identification or lot number
- Calibration method

- Concentration with associated uncertainties
- Purity

If a standard cannot be purchased from a vendor that supplies a Certificate of Analysis, the purity of the standard is documented by analysis. The receipt of all reference standards must be documented in the LIMS. Reference standards are labeled with a unique Standard Identification Number and expiration date. All documentation received with the reference standard is retained as a QC record and references the Standard Identification Number.

All reference, primary and working standards/materials, whether commercially purchased or laboratory prepared, must be checked regularly to ensure that the variability of the standard or material from the 'true' value does not exceed method requirements. The accuracy of calibration standards is checked by comparison with a standard from a second source. In cases where a second standard manufacturer is not available, a vendor certified different lot is acceptable for use as a second source. For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst would be considered a second source. The appropriate Quality Control (QC) criteria for specific standards are defined in laboratory SOPs. In most cases, the analysis of an Initial Calibration Verification (ICV) or LCS (where there is no sample preparation) is used as the second source confirmation. These checks are generally performed as an integral part of the analysis method (e.g. calibration checks, laboratory control samples).

All standards and materials must be stored and handled according to method or manufacturer's requirements in order to prevent contamination or deterioration. Refer to the Corporate Environmental Health & Safety Manual or laboratory SOPs. For safety requirements, please refer to method SOPs and the laboratory Environmental Health and Safety Manual.

Standards and reference materials shall not be used after their expiration dates unless their reliability is verified by the laboratory and their use is approved by the Quality Assurance Manager. The laboratory has contingency procedures for re-verifying expired standards. See Pittsburgh Laboratory SOP No. PT-QA-006, *Procurement of Standards and Materials, Labeling and Traceability*.

21.4 Documentation And Labeling Of Standards, Reagents, And Reference Materials

Reagents must be at a minimum the purity required in the test method. The date of reagent receipt and the expiration date are documented. The lots for most of the common solvents and acids are tested for acceptability prior to company-wide purchase. (Refer to TestAmerica's Corporate SOP No. CA-Q-S-001, *Acid & Solvent Lot Testing and Approval*.)

All manufacturer or vendor supplied Certificate of Analysis or Purity must be retained, stored appropriately, and readily available for use and inspection. These records are maintained in the QA public drive and in the LIMS, scanned into Reagent log. Records must be kept of the date of receipt and date of expiration of standards, reagents and reference materials. In addition, records of preparation of laboratory standards, reagents, and reference materials must be retained, stored appropriately, and be readily available for use and inspection. For detailed information on documentation and labeling, please refer to laboratory analytical SOPs and SOP No. PT-QA-006.

Commercial materials purchased for preparation of calibration solutions, spike solutions, etc., are usually accompanied with an assay certificate or the purity is noted on the label. If the assay purity is 96% or better, the weight provided by the vendor may be used without correction. If the assay purity is less than 96% a correction will be made to concentrations applied to solutions prepared from the stock commercial material.

21.4.1 All standards, reagents, and reference materials that may affect quality must be labeled in an unambiguous manner. Standards are logged into the laboratory's LIMS system, and are assigned a unique identification number. The following information is typically recorded within LIMS.

- Standard ID
- Description of Standard
- Department
- Preparer's name
- Final volume and number of vials prepared
- Solvent type and lot number
- Preparation Date
- Expiration Date
- Standard source type (stock or daughter)
- Standard type (spike, surrogate, other)
- Parent standard ID (if applicable)
- Parent Standard Analyte Concentration (if applicable)
- Parent Standard Amount used (if applicable)
- Component Analytes
- Final concentration of each analyte
- Comment box (text field)

Records are maintained electronically for standard and reference material preparation. These records show the traceability to purchased stocks or neat compounds. These records also include method of preparation, date of preparation, expiration date and preparer's name or initials. Preparation procedures are provided in the laboratory analytical SOPs.

21.4.2 All standards, reagents, and reference materials must be clearly labeled with a minimum of the following information:

- Expiration Date (include prep date for reagents)
- Standard ID (from electronic standard log in LIMS)
- Special Health/Safety warnings if applicable

Records must also be maintained of the date of receipt for commercially purchased items or date of preparation for laboratory prepared items. Special Health/Safety warnings must also be available to the analyst. This information is maintained in standard/reagent log. Health and safety warning are in the SDS (Safety Data Sheets) which is accessed through the company intranet site.

21.4.3 In addition, the following information may be included:

- Date of receipt for commercially purchased items or date of preparation for laboratory prepared items
- Date opened (for multi-use containers, if applicable)
- Description of standard (if different from manufacturer's label or if standard was prepared in the laboratory)
- Recommended Storage Conditions
- Concentration (if applicable)
- Initials of analyst preparing standard or opening container

All containers of prepared reagents must include, expiration date and an ID number to trace back to preparation.

Procedures for preparation of reagents can be found in the Method SOPs.

Standard ID numbers must be traceable through associated logbooks, worksheets and raw data.

All reagents and standards must be stored in accordance to the following priority: 1) with the manufacturer's recommendations; 2) with requirements in the specific analytical methods as specified in the laboratory SOP.

SECTION 22

SAMPLING

22.1 Overview

The laboratory provides sampling services for the following matrices:

- Groundwater
- Wastewater
- Potable Water
- Wastes
- Soil and Sediment

The laboratory also offers the following services:

- Flow Monitoring
- Field Parameter Analysis

Field Analyses are address in TestAmerica Pittsburgh SOP No.'s:

- PT-FS-001 – Field Measurement of Dissolved Oxygen (DO)
- PT-FS-002 – Field Measurement of Total Residual Chlorine
- PT-FS-003 – Field Measurement of pH

22.2 Sampling Containers

The laboratory offers clean sampling containers for use by clients. These containers are obtained from reputable container manufacturers and meet EPA specifications as required. Certificates of cleanliness for bottles and preservatives are provided by the supplier and are maintained at the laboratory. Alternatively, the certificates may be maintained by the supplier and available to the laboratory on-line.
For detailed information regarding container/bottle order, refer to laboratory SOP No. PT-SR-002, *Bottle Order Preparation and Shipping*.

22.2.1 Preservatives

Upon request, preservatives are provided to the client in pre-cleaned sampling containers. In general, containers are purchased pre-preserved from the container supplier. Whether prepared by the laboratory or bought pre-preserved, the grades of the preservatives are at a minimum:

- Hydrochloric Acid – AR Select (ACS) or equivalent
- Methanol – Purge and Trap grade
- Nitric Acid – AR Select (ACS), Trace-Metals Grade or equivalent
- Sodium Hydroxide – AR Select (ACS) or equivalent
- Sulfuric Acid – AR Select (ACS) or equivalent
- Sodium Thiosulfate – ACS Grade or equivalent
- Sodium Bisulfate – ACS Grade or equivalent

22.3 Definition Of Holding Time

The date and time of sampling documented on the COC form establishes the day and time zero. As a general rule, when the maximum allowable holding time is expressed in “days” (e.g., 14 days, 28 days), the holding time is based on calendar day measured. Holding times expressed in “hours” (e.g., 6 hours, 24 hours, etc.) are measured from date and time zero. However, there are some programs that determine holding time compliance based on the date and specific time of analysis compared to the time of sampling regardless of how long the holding time is. Holding times for analysis include any necessary reanalysis.

22.4 Sampling Containers, Preservation Requirements, Holding Times

The container type, preservation, and holding time criteria specified in the SOPs are derived from the source documents for the methods. If method required holding times as specified in the SOPs or preservation requirements are not met, the reports will be qualified using a flag, footnote or case narrative. As soon as possible, or “ASAP”, is an EPA designation for tests for which rapid analysis is advised, but for which neither EPA nor the laboratory have a basis for a holding time.

22.5 Sample Aliquots / Subsampling

Taking a representative sub-sample from a container is necessary to ensure that the analytical results are representative of the sample collected in the field. The size of the sample container,

the quantity of sample fitted within the container, and the homogeneity of the sample need consideration when sub-sampling for sample preparation. It is the laboratory's responsibility to take a representative subsample or aliquot of the sample provided for analysis.

Analysts should handle each sample as if it is potentially dangerous. At a minimum, safety glasses, gloves, and lab coats must be worn when preparing aliquots for analysis.

Guidelines for subsampling are located in laboratory SOP No. PT-QA-024.

SECTION 23

HANDLING OF SAMPLES

Sample management procedures at the laboratory ensure that sample integrity and custody are maintained and documented from sampling/receipt through disposal. Details can be found in laboratory SOP No. PT-SR-001, *Sample Receipt and Login*, and PT-HS-001, *Pittsburgh Facility Addendum EH&S Manual*.

23.1 Chain Of Custody (COC)

The COC form is the written documented history of any sample and is initiated when bottles are sent to the field, or at the time of sampling. This form is completed by the sampling personnel and accompanies the samples to the laboratory where it is received and stored under the laboratory's custody. The purpose of the COC form is to provide a legal written record of the handling of samples from the time of collection until they are received at the laboratory. It also serves as the primary written request for analyses from the client to the laboratory. The COC form acts as a purchase order for analytical services when no other contractual agreement is in effect. An example of a COC form may be found in Figure 23-1.

23.1.1 Field Documentation

The information the sampler needs to provide at the time of sampling on the container label is:

- Sample identification
- Date and time
- Preservative

During the sampling process, the COC form is completed and must be legible (see Figure 23-1). This form includes information such as:

- Client name, address, phone number and fax number (if available)
- Project name and/or number
- The sample identification
- Date, time and location of sampling
- Sample collectors name
- The matrix description
- The container description
- The total number of each type of container

- Preservatives used
- Analysis requested
- Requested turnaround time (TAT)
- Any special instructions
- Purchase Order number or billing information (e.g. quote number) if available
- The date and time that each person received or relinquished the sample(s), including their signed name.

When the sampling personnel deliver the samples directly to TestAmerica personnel, the samples are stored in a cooler with ice, as applicable, and remain solely in the possession of the client's field technician until the samples are delivered to the laboratory personnel. The sample collector must assure that each container is in his/her physical possession or in his/her view at all times, or stored in such a place and manner to preclude tampering. The field technician relinquishes the samples in writing on the COC form to the sample control personnel at the laboratory or to a TestAmerica courier. When sampling personnel deliver the samples through a common carrier (Fed-Ex, UPS), the CoC relinquished date/time is completed by the field personnel and samples are released to the carrier. Samples are only considered to be received by lab when personnel at the fixed laboratory facility have physical contact with the samples.

Note: Independent couriers are not required to sign the COC form. The COC is usually kept in the sealed sample cooler. The receipt from the courier is stored in the LIMS login along with the CoC.

23.1.2 Legal / Evidentiary Chain-of-Custody

If samples are identified for legal/evidentiary purposes on the COC, login will complete the custody seal retain the shipping record with the COC, and initiate an internal COC for laboratory use by analysts and a sample disposal record.

23.2 Sample Receipt

Samples are received at the laboratory by designated sample receiving personnel and a unique laboratory project identification number is assigned. Each sample container shall be assigned a unique sample identification number that is cross-referenced to the client identification number such that traceability of test samples is unambiguous and documented. Each sample container is affixed with a durable sample identification label. Sample acceptance, receipt, tracking and storage procedures are summarized in the following sections.

23.2.1 Laboratory Receipt

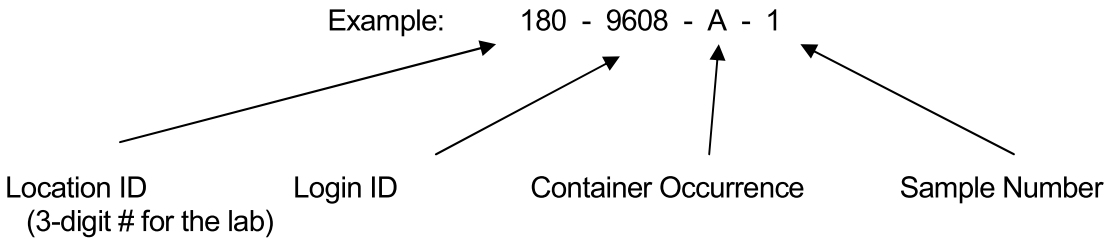
When samples arrive at the laboratory, sample receiving personnel inspect the coolers and samples. The integrity of each sample must be determined by comparing sample labels or tags with the COC and by visual checks of the container for possible damage. Samples and COC must meet the laboratory Sample Acceptance Policy (Figure 23-2). Any non-conformance, irregularity, or compromised sample receipt must be documented in LIMS on the Sample Receipt checklist (Figure 23-3), and must be brought to the immediate attention of the client. The COC, shipping documents, documentation of any non-conformance, irregularity, or

compromised sample receipt, record of client contact, and resulting instructions become part of the project record. This procedure is further described in laboratory SOP No. PT-SR-001.

23.2.1.1 Unique Sample Identification

All samples that are processed through the laboratory receive a unique sample identification to ensure that there can be no confusion regarding the identity of such samples at anytime. This system includes identification for all samples, subsamples and subsequent extracts and/or digestates.

The laboratory assigns a unique identification (e.g., Sample ID) code to each sample container received at the laboratory. This Primary ID is made up of the following information (consisting of 4 components):



The above example states that TestAmerica Pittsburgh Laboratory (Location 180). Login ID is 9608 (unique to a particular client/job occurrence). The container code indicates it is the first container ("A") of Sample #1.

If the primary container goes through a prep step that creates a "new" container, then the new container is considered secondary and gets another ID. An example of this being a client sample in a 1-Liter amber bottle is sent through a Liquid/Liquid Extraction and an extraction vial is created from this step. The vial would be a SECONDARY container. The secondary ID has 5 components.

Example: 180 - 9608 - A - 1 - **A** ←——**Secondary Container Occurrence**

Example: 180-9608-A-1-A, would indicate the PRIMARY container listed above that went through a step that created the 1st occurrence of a Secondary container.

With this system, a client sample can literally be tracked throughout the laboratory in every step from receipt to disposal.

23.3 Sample Acceptance Policy

The laboratory has a written sample acceptance policy (Figure 23-2) that clearly outlines the circumstances under which samples shall be accepted or rejected. These include:

- a COC must filled out completely
- samples must be properly labeled
- proper sample containers with adequate volume for the analysis and necessary QC

- samples must be preserved according to the requirements of the requested analytical method
- sample holding times must be adhered to
- Samples that require chilling must be received proper temperature
- the project manager will be notified if any sample is received in damaged condition

Data from samples which do not meet these criteria are flagged and the nature of the variation from policy is defined.

23.3.1.1 After inspecting the samples, the sample receiving personnel sign and date the COC form, make any necessary notes of the samples' conditions and store them in appropriate refrigerators or storage locations.

23.3.1.2 Any deviations from these checks that question the suitability of the sample for analysis, or incomplete documentation on the chain-of-custody will be resolved by consultation with the client. If the sample acceptance policy criteria are not met, the laboratory shall either:

- Retain all correspondence and/or records of communications with the client regarding the disposition of rejected samples, or

- Fully document any decision to proceed with sample analysis that does not meet sample acceptance criteria.

- If the conditions listed on the Acceptance Policy are not satisfactory and when lacking direction or agreement with the client, the sample may be rejected by the laboratory.

Note: North Carolina requires that they be notified when samples are processed that do not meet sample acceptance criteria.

Once sample acceptance is verified, the samples are logged into the LIMS according to laboratory SOP No. PT-SR-001.

23.4 Sample Storage

In order to avoid deterioration, contamination or damage to a sample during storage and handling, from the time of receipt until all analyses are complete, samples are stored in refrigerators, freezers, or protected locations suitable for the sample matrix. In addition, samples to be analyzed for volatile organic parameters are stored in separate refrigerators designated for volatile organic parameters only. Samples are never to be stored with reagents, standards or materials that may create contamination.

To ensure the integrity of the samples during storage, refrigerator blanks are maintained in the volatile sample refrigerators and analyzed at least every two weeks. See laboratory SOP PT-MS-005, *Volatile Holding Blanks*.

Analysts and technicians retrieve the sample container allocated to their analysis from the designated storage location and place them on carts, analyze the sample, and return the remaining sample or empty container to the storage location from which it originally came. All

unused portions of samples, including empty sample containers, are returned to the secure sample control area. Raw samples requiring cold storage are kept in the cold room for approximately 30 days after reported. Volatile samples are stored in the VOA refrigerator. All sample extracts are kept in the refrigerators for approximately two to four weeks after analysis, which meets or exceeds most sample holding times. After the cold storage time, the sample are moved to dry room-temperature sample archive area, where they are stored for an additional four weeks before they are disposed of. This holding period allows samples to be checked if a discrepancy or question arises. Special arrangements may be made to store samples for longer periods of time. This extended holding period allows additional metal analyses to be performed on the archived sample and assists clients in dealing with legal matters or regulatory issues.

Access to the laboratory is controlled such that sample storage need not be locked at all times unless a project specifically demands it. Samples are accessible to laboratory personnel only. Visitors to the laboratory are prohibited from entering the refrigerator and laboratory areas unless accompanied by an employee of TestAmerica.

23.5 Hazardous Samples And Foreign Soils

To minimize exposure to personnel and to avoid potential accidents, hazardous, for any sample that is known to be hazardous at the time of receipt a cautionary email communication should be sent to all applicable laboratory personnel by the project manager or designee. All hazardous samples are disposed of appropriately through a hazardous waste disposal process. Foreign soil samples are sent out for incineration by an USDA-approved waste disposal facility. Analysts will notify Sample Control of any sample determined to be hazardous after completion of analysis by sending an email. All hazardous samples are either returned to the client or disposed of appropriately through a hazardous waste disposal firm that lab-packs all hazardous samples and removes them from the laboratory. Foreign soil samples are sent out for incineration by a USDA-approved waste disposal facility.

23.6 Sample Shipping

In the event that the laboratory needs to ship samples, the samples are placed in a cooler with enough ice to ensure the samples remain just above freezing and at or below 6.0°C during transit. The samples are carefully surrounded by packing material to avoid breakage (yet maintain appropriate temperature). A trip blank is enclosed for those samples requiring water/solid volatile organic analyses. The chain-of-custody form is signed by the sample control technician and attached to the shipping paperwork. Samples are generally shipped overnight express or hand-delivered by a TestAmerica courier to maintain sample integrity. All personnel involved with shipping and receiving samples must be trained to maintain the proper chain-of-custody documentation and to keep the samples intact and on ice. The Environmental, Health and Safety Manual contains additional shipping requirements.

Note: If a client does not request trip blank analysis on the COC or other paperwork, the laboratory will not analyze the trip blanks that were supplied. However, in the interest of good client service, the laboratory will advise the client at the time of sample receipt that it was noted that they did not request analysis of the trip blank; and that the laboratory is providing the notification to verify that they are not inadvertently omitting a key part of regulatory compliance testing.

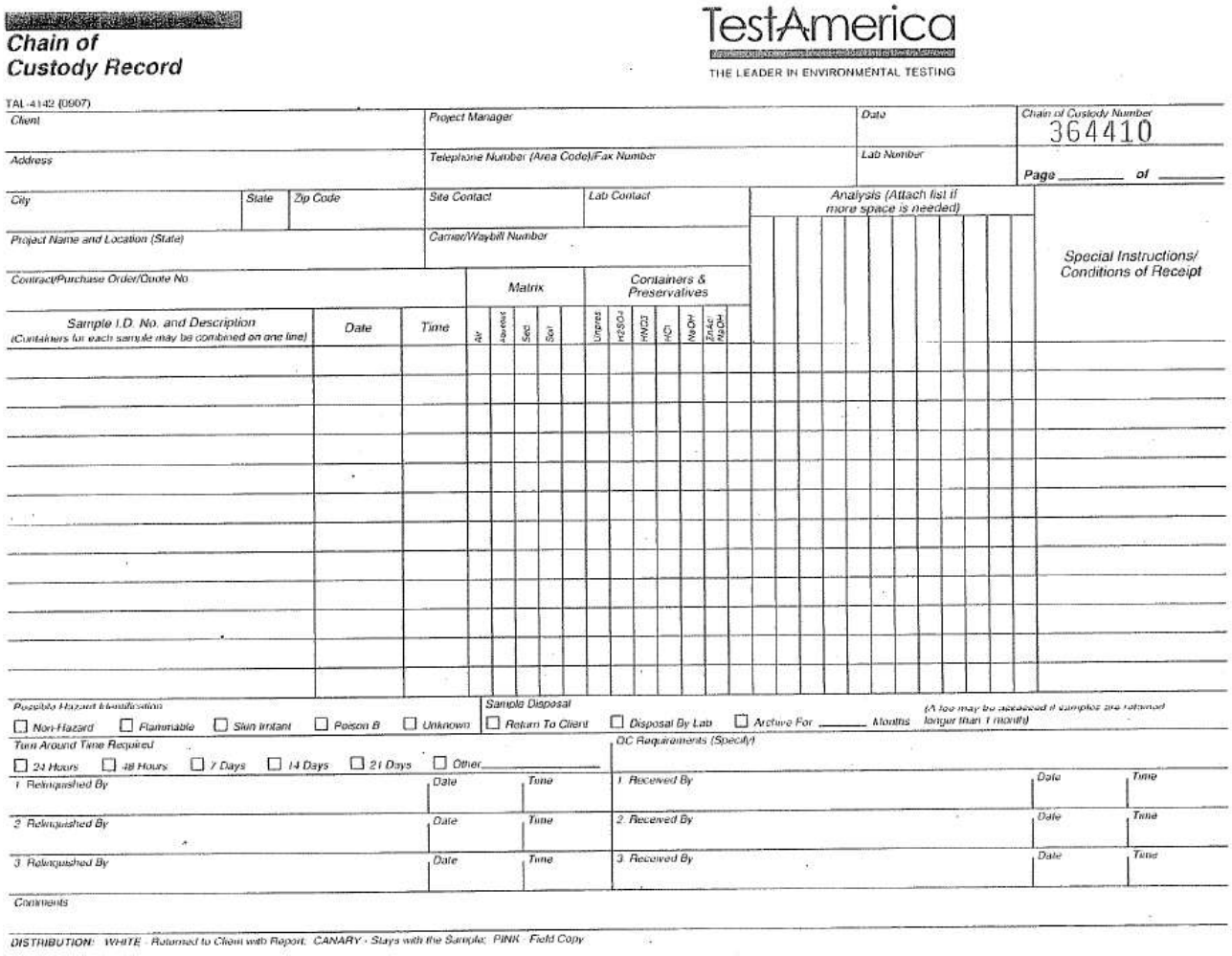
23.7 Sample Disposal

Samples should be retained for a minimum of 30 days after the project report is sent, however, provisions may be made for earlier disposal of samples once the holding time is exceeded. Some samples are required to be held for longer periods based on regulatory or client requirements (e.g., 60 days after project report is sent). The laboratory must follow the longer sample retention requirements where required by regulation or client agreement. Several possibilities for sample disposal exist: the sample may be consumed completely during analysis, the sample may be returned to the customer or location of sampling for disposal, or the sample may be disposed of in accordance with the laboratory's waste disposal procedures (SOP No. PT-HS-001). All procedures in the laboratory Environmental, Health and Safety Manual are followed during disposal. Samples are normally maintained in the laboratory no longer than two months from receipt unless otherwise requested. Unused portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work.

If a sample is part of a known litigation, the affected legal authority, sample data user, and/or submitter of the sample must participate in the decision about the sample's disposal. All documentation and correspondence concerning the disposal decision process must be kept on file. Pertinent information includes the date of disposal, nature of disposal (such as sample depletion, hazardous waste facility disposal, return to client), names of individuals who conducted the arrangements and physically completed the task. The laboratory will remove or deface sample labels prior to disposal unless this is accomplished through the disposal method (e.g., samples are incinerated). A Waste Disposal Record should be completed.

Figure 23-1

Example: Chain of Custody (COC)



Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TAL-4142 (0907)

Client	Project Manager	Date	Chain of Custody Number 364410
Address	Telephone Number (Area Code)/Fax Number	Lab Number	Page _____ of _____
City / State / Zip Code	Site Contact	Lab Contact	Analysis (Attach list if more space is needed)
Project Name and Location (State)	Carrier/Waybill Number		Special Instructions/ Conditions of Receipt
Contract/Purchase Order/Quote No.	Matrix / Containers & Preservatives		

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Air	Aqueous	Sed.	Soil	Unpres.	H_2SO_4	HNO_3	HCl	NaOH	ZnAc/ NaOH

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal
☐ Return To Client ☐ Disposal By Lab ☐ Archive For _____ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required
☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☐ Other _____

QC Requirements (Specify)

1. Relinquished By	Date	Time	1. Received By	Date	Time
2. Relinquished By	Date	Time	2. Received By	Date	Time
3. Relinquished By	Date	Time	3. Received By	Date	Time

Comments

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

Figure 23-2

Sample Acceptance Policy

All incoming work will be evaluated against the criteria listed below. Where applicable, data from any samples that do not meet the criteria listed below will be noted on the laboratory report defining the nature and substance of the variation. In addition the client will be notified either by telephone, fax or e-mail ASAP after the receipt of the samples.

1) Samples must arrive with labels intact with a Chain of Custody filled out completely. The following information must be recorded.
   - *Client name, address, phone number and fax number (if available)*
   - *Project name and/or number*
   - *Unique sample identification*
   - *Date, time and location of sampling*
   - *The collectors name*
   - *The matrix description*
   - *The container description*
   - *The total number of each type of container*
   - *Preservatives used*
   - *Analysis requested*
   - *Requested turnaround time (TAT)*
   - *Any special instructions*
   - *Purchase Order number or billing information (e.g. quote number) if available*
   - *The date and time that each person received or relinquished the sample(s), including their signed name.*
   - **Information must be legible**

2) Samples must be properly labeled.
   - Use durable labels (labels provided by TestAmerica are preferred)
   - Include a unique identification number
   - Include sampling date and time & sampler ID
   - Include preservative used.
   - Use indelible ink
   - **Information must be legible**

3) Proper sample containers with adequate volume for the analysis and necessary QC are required for each analysis requested.

4) Samples must be preserved according to the requirements of the requested analytical method. (See Sampling Guide)

5) Most analytical methods require chilling samples to 4° C (other than water samples for metals analysis). For these methods, the criteria are met if the samples are chilled to below 6° C and above freezing (0°C). For methods with other temperature criteria (e.g. some bacteriological methods require $\leq$ 10 ^{o}C), the samples must arrive within $\pm$ 2° C of the required temperature or within the method specified range. **Note:** Samples that are hand delivered to the laboratory immediately after

collection may not have had time to cool sufficiently. In this case the samples will be considered acceptable as long as there is evidence that the chilling process has begun (arrival on ice).

5i.) Samples that are delivered to the laboratory on the same day they are collected may not meet the requirements of Section 5. In these cases, the samples shall be considered acceptable if the samples were received on ice.

5ii.) If sample analysis is begun within fifteen (15) minutes of collection, thermal preservation is not required.

5iii.)Thermal preservation is not required in the field if the laboratory receives and refrigerates the sample within fifteen (15) minutes of collection.

- Chemical preservation (pH) will be verified prior to analysis and documented, either in sample control or at the analyst's level. The project manager will be notified immediately if there is a discrepancy. If analyses will still be performed, all affected results will be flagged to indicate improper preservation.

- **FOR WATER SAMPLES TESTED FOR CYANIDE (Method OIA-1677)**
  - In the Field: Samples are to be tested for Sulfide using lead acetate paper prior to the addition of Sodium Hydroxide (NaOH). If sulfide is present, the sample is treated in the field with lead carbonate or if the client requests the sample to be treated at the lab it will be filtered and treated at the lab with Cadmium Chloride.

  - If the sulfide test and treatment is not performed in the field, the lab will test the samples for sulfide using lead acetate paper at the time of receipt and if sulfide is present in the sample, the client will be notified and given the option of retaking the sample and treating in the field per the method requirements or the laboratory can analyze the samples as delivered and qualify the results in the final report.

- It is the responsibility of the client to notify the laboratory if thiosulfate, sulfite, or thiocyanate are known or suspected to be present in the sample. This notification may be on the chain of custody. The samples may need to be subcontracted to a laboratory that performs a UV digestion. If the lab does not perform the UV digestion on samples that contain these compounds, the results must be qualified in the final report.

- The laboratory must test the sample for oxidizing agents (e.g. Chlorine) prior to analysis and treat according to the methods prior to distillation. (ascorbic acid or sodium arsenite are the preferred choice).

- Water samples that require ortho-phosphorus must be filtered in the field within 15 minutes of sampling. Samples received without indication of filtration in the field will have results flagged for improper preservation.

- Samples for coliform analysis must be in sterile containers and must be free of residual chlorine. The bottle must be filled to <u>above</u> the 100mL mark.

6) *Matrix Spikes* are required for your project, separate sample volumes must be available for the requested analyses.

7) For Volatile Organic analyses: Efforts should be made to minimize any air bubbles in aqueous volatile samples. Air bubbles also the escape of volatile organics. This is especially important because air bubbles tend to form in iced samples. Volatile vials containing air bubbles larger than a pea will be treated as non-conformances.

8) All samples submitted for Volatile Organic analyses must have a Trip Blank submitted at the same time. TestAmerica will supply a blank with the bottle order.

9) Sample Holding Times

- TestAmerica will make every effort to analyze samples within the regulatory holding time. Samples must be received in the laboratory with enough time to perform the sample analysis. Except for short holding time samples (< 48hr HT) sample must be received with at least 48 hrs (working days) remaining on the holding time for us to ensure analysis.

- Analyses that are designated as "field" analyses (Odor, pH, Dissolved Oxygen, Disinfectant Residual; a.k.a. Residual Chlorine, and Redox Potential) should be analyzed ASAP by the field sampler prior to delivering to the lab (within 15 minutes). However, if the analyses are to be performed in the laboratory, TestAmerica will make every effort to analyze the samples within 24 hours from receipt of the samples in the testing laboratory. Samples for "field" analyses received after 4:00 pm on Friday or on the weekend will be analyzed no later than the next business day after receipt (Monday unless a holiday). Samples will remain refrigerated and sealed until the time of analysis. Samples analyzed in the laboratory will be qualified on the final report to indicate holding time exceedance.

10) The project manager will be notified if any sample is received in damaged condition. TestAmerica will request that a sample be resubmitted for analysis. The laboratory will notify the client upon sample receipt if the samples exhibit obvious signs of damage, contamination or inadequate preservation.

11) Recommendations for packing samples for shipment.

- Pack samples in Ice rather than "Blue" ice packs.

- Soil samples should be placed in plastic zip-lock bags. The containers often have dirt around the top and do not seal very well and are prone to intrusion from the water from melted ice.

- Water samples would be best if wrapped with bubble-wrap or paper (newspaper, or paper towels work) and then placed in plastic zip-lock bags.

- Fill extra cooler space with bubble wrap.

12) If the conditions listed on the Acceptance Policy are not satisfactory and when lacking direction or agreement with the client, the sample will be rejected by the laboratory.

Figure 23-3

Example: Sample Receipt Checklist

Login Sample Receipt Checklist

Client: Cardno ENTRIX

Job Number: 180-264-1

Login Number: 264
List Number: 1
Creator: Gamber, Tom

List Source: TestAmerica Pittsburgh

Question	Answer	Comment
Radioactivity either was not measured or, if measured, is at or below background	True	
The cooler's custody seal, if present, is intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the sample IDs on the containers and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
VOA sample vials do not have headspace or bubble is <6mm (1/4") in diameter.	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

SECTION 24

ASSURING THE QUALITY OF TEST RESULTS

24.1 Overview

In order to assure our clients of the validity of their data, the laboratory continuously evaluates the quality of the analytical process. The analytical process is controlled not only by instrument calibration as discussed in Section 20, but also by routine process quality control measurements (e.g. Blanks, Laboratory Control Samples (LCS), Matrix Spikes (MS), duplicates (DUP), surrogates, Internal Standards (IS)). These quality control checks are performed as required by the method or regulations to assess precision and accuracy. Quality control samples are to be treated in the exact same manner as the associated field samples being tested. In addition to the routine process quality control samples, Proficiency Testing (PT) Samples (concentrations unknown to laboratory) are analyzed to help ensure laboratory performance.

24.2 Controls

Sample preparation or pre-treatment is commonly required before analysis. Typical preparation steps include homogenization, solvent extraction, sonication, acid digestion, filtration, distillation, reflux, evaporation, drying and ashing. During these pre-treatment steps, samples are arranged into discreet manageable groups referred to as preparation (prep) batches. Prep batches provide a means to control variability in sample treatment. Control samples are added to each prep batch to monitor method performance and are processed through the entire analytical procedure with investigative/field samples.

24.3 Negative Controls

Table 24-1. Negative Controls

Control Type	Details
Method Blank (MB)	are used to assess preparation and analysis for possible contamination during the preparation and processing steps.
	The specific frequency of use for method blanks during the analytical sequence is defined in the specific standard operating procedure for each analysis. Generally it is 1 for each batch of samples; not to exceed 20 environmental samples.
	The method blank is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (e.g., Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The method blank goes through all of the steps of the process (including as necessary: filtration, clean-ups, etc.).
	Reanalyze or qualify associated sample results when the concentration of a targeted analyte in the blank is at or above the reporting limit as established by the method or by regulation, AND is greater than 1/10 of the amount measured in the sample.
Calibration Blanks	are prepared and analyzed along with calibration standards where applicable. They are prepared using the same reagents that are used to prepare the standards. In some analyses the calibration blank may be included in the calibration curve.

Table 24-1. Negative Controls

Control Type	Details
Instrument Blanks	are blank reagents or reagent water that may be processed during an analytical sequence in order to assess contamination in the analytical system. In general, instrument blanks are used to differentiate between contamination caused by the analytical system and that caused by the sample handling or sample prep process. Instrument blanks may also be inserted throughout the analytical sequence to minimize the effect of carryover from samples with high analyte content.
Trip Blank [1]	are required to be submitted by the client with each shipment of samples requiring aqueous and solid volatiles analyses (or as specified in the client's project plan). Additionally, trip blanks may be prepared and analyzed for volatile analysis of air samples, when required by the client. A trip blank may be purchased (certified clean) or is prepared by the laboratory by filling a clean container with pure deionized water that has been purged to remove any volatile compounds. Appropriate preservatives are also added to the container. The trip blank is sent with the bottle order and is intended to reflect the environment that the containers are subjected to throughout shipping and handling and help identify possible sources if contamination is found. The field sampler returns the trip blank in the cooler with the field samples.
Field Blanks [1]	are sometimes used for specific projects by the field samplers. A field blank prepared in the field by filling a clean container with pure reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken. (EPA OSWER)
Equipment Blanks [1]	are also sometimes created in the field for specific projects. An equipment blank is a sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (TNI)
Holding Blanks	also referred to as refrigerator or freezer blanks, are used to monitor the sample storage units for volatile organic compounds during the storage of VOA samples in the laboratory

[1] When known, these field QC samples should not be selected for matrix QC as it does not provide information on the behavior of the target compounds in the field samples. Usually, the client sample ID will provide information to identify the field blanks with labels such as "FB", "EB", or "TB."

Evaluation criteria and corrective action for these controls are defined in the specific standard operating procedure for each analysis. Also further detail is provided in SOP No. PT-QA-021.

24.3.1 Negative Controls for Microbiological Methods – Microbiological Methods utilize a variety of negative controls throughout the process to ensure that false positive results are not obtained. These controls are critical to the validity of the microbiological analyses. Some of these negative controls are:

Table 24-2. Negative Controls for Microbiology

Control Type	Details
Sterility Checks (Media)	are analyzed for each lot of pre-prepared media, ready-to-use media and for each batch of medium prepared by the laboratory.
Filtration Blanks	blanks are run at the beginning and end for each sterilized filtration unit used in a filtration series. For pre-sterilized single use funnels a sterility check is performed on at least one funnel per lot.
Sterility checks (Sample Containers)	are performed on at least one container per lot of purchased, pre-sterilized containers. If containers are prepared and sterilized by the laboratory, one container per sterilization batch is checked. Container sterility checks are performed using non-selective growth media.

Sterility Checks (Dilution Water)	are performed on each batch of dilution water prepared by the laboratory and on each batch of pre-prepared dilution water. All checks are performed using non-selective growth media.
Sterility Checks (Filters)	are also performed on at least one filter from each new lot of membrane filters using non-selective growth media.

Negative culture controls demonstrate that a media does not support the growth of non-target organisms and ensures that there is not an atypical positive reaction from the target organisms. Prior to the first use of the media, each lot of pre-prepared selective media or batch of laboratory prepared selective media is analyzed with at least one known negative culture control as appropriate to the method.

24.4 Positive Controls

Control samples (e.g., QC indicators) are analyzed with each batch of samples to evaluate data based upon (1) Method Performance (Laboratory Control Sample (LCS) or Blank Spike (BS)), which entails both the preparation and measurement steps; and (2) Matrix Effects (Matrix Spike (MS) or Sample Duplicate (MD, DUP), which evaluates field sampling accuracy, precision, representativeness, interferences, and the effect of the matrix on the method performed. Each regulatory program and each method within those programs specify the control samples that are prepared and/or analyzed with a specific batch

Note that frequency of control samples vary with specific regulatory, methodology and project specific criteria. Complete details on method control samples are as listed in each analytical SOP.

24.4.1 Method Performance Control - Laboratory Control Sample (LCS)

The LCS measures the accuracy of the method in a blank matrix and assesses method performance independent of potential field sample matrix affects in a laboratory batch.

The LCS is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (for example: Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The LCS is spiked with verified known amounts of analytes or is made of a material containing known and verified amounts of analytes, taken through all preparation and analysis steps along with the field samples. Where there is no preparation taken for an analysis (such as in aqueous volatiles), or when all samples and standards undergo the same preparation and analysis process (such as Phosphorus), a calibration verification standard may be reported as the LCS. In some instances where there is no practical clean solid matrix available, aqueous LCS's may be processed for solid matrices; final results may be calculated as mg/kg or ug/kg, assuming 100% solids and a weight equivalent to the aliquot used for the corresponding field samples, to facilitate comparison with the field samples.

Certified pre-made reference material purchased from a NIST/A2LA accredited vendor may also be used for the LCS when the material represents the sample matrix or the analyte is not easily spiked (e.g. solid matrix LCS for metals, TDS, etc.).

The specific frequency of use for LCS during the analytical sequence is defined in the specific standard operating procedure for each analysis. It is generally 1 for each batch of samples; not to exceed 20 environmental samples.

If the mandated or requested test method, or project requirements, do not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample (and Matrix Spike) where applicable (e.g. no spike of pH). However, in cases where the components interfere with accurate assessment (such as simultaneously spiking chlordane, toxaphene and PCBs in Method 608), the test method has an extremely long list of components or components are incompatible, at a minimum, a representative number of the listed components (see below) shall be used to control the test method. The selected components of each spiking mix shall represent all chemistries, elution patterns and masses, permit specified analytes and other client requested components. However, the laboratory shall ensure that all reported components are used in the spike mixture within a two-year time period.

- For methods that have 1-10 target analytes, spike all components.
- For methods that include 11-20 target analytes, spike at least 10 or 80%, whichever is greater.
- For methods with more than 20 target analytes, spike at least 16 components.
- Exception: Due to analyte incompatibility in pesticides, Toxaphene and Chlordane are only spiked at client request based on specific project needs.
- Exception: Due to analyte incompatibility between the various PCB aroclors, aroclors 1016 and 1260 are used for spiking as they cover the range of all of the aroclors. Specific aroclors may be used by request on a project specific basis.

24.4.2 Positive Controls for Microbiological Methods

- Each lot of pre-prepared media (including chromofluorogenic reagent) and each batch of laboratory prepared media is tested with a pure culture of known positive reaction.

- In addition, every analytical batch also contains a pure culture of known positive reaction.

  A pure culture of known negative reaction is also tested with each analytical batch to ensure specificity of the procedure.

24.5 Sample Matrix Controls

Table 24-3 Sample Matrix Control

Control Type	Details	
Matrix Spikes (MS)	Use	used to assess the effect sample matrix of the spiked sample has on the precision and accuracy of the results generated by the method used;
	Typical Frequency [1]	At a minimum, with each matrix-specific batch of samples processed, an MS is carried through the complete analytical procedure. Unless specified by the client, samples used for spiking are randomly selected and rotated between different client projects. If the mandated or requested test method does not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample and Matrix Spike. Refer to the method SOP for complete details
	Description	essentially a sample fortified with a known amount of the test analyte(s).
Surrogate	Use	Measures method performance to sample matrix (organics only).
	Typical Frequency [1]	Are added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. The recovery of the surrogates is compared to the acceptance limits for the specific method. Poor surrogate recovery may indicate a problem with sample composition and shall be reported, with data qualifiers, to the client whose sample produced poor recovery.
	Description	Are similar to matrix spikes except the analytes are compounds with properties that mimic the analyte of interest and are unlikely to be found in environment samples.
Duplicates[2]	Use	For a measure of analytical precision, with each matrix-specific batch of samples processed, a matrix duplicate (MD or DUP) sample, matrix spike duplicate (MSD), or LCS duplicate (LCSD) is carried through the complete analytical procedure.
	Typical Frequency [1]	Duplicate samples are usually analyzed with methods that do not require matrix spike analysis.
	Description	Performed by analyzing two aliquots of the same field sample independently or an additional LCS.
Internal Standards	Use	Are spiked into all environmental and quality control samples (including the initial calibration standards) to monitor the qualitative aspect of organic and some inorganic analytical measurements.
	Typical Frequency [1]	All organic and ICP methods as required by the analytical method.
	Description	Used to correct for matrix effects and to help troubleshoot variability in analytical response and are assessed after data acquisition. Possible sources of poor internal standard response are sample matrix, poor analytical technique or instrument performance.

[1] See the specific analytical SOP for type and frequency of sample matrix control samples.

[2] LCSD's are normally not performed except when regulatory agencies or client specifications require them. The recoveries for the spiked duplicate samples must meet the same laboratory established recovery limits as the accuracy QC samples. If an LCSD is analyzed both the LCS and LCSD must meet the same recovery criteria and be included in the final report. The precision measurement is reported as "Relative Percent Difference" (RPD). Poor precision between duplicates (except LCS/LCSD) may indicate non-homogeneous matrix or sampling.

24.6 Acceptance Criteria (Control Limits)

As mandated by the test method and regulation, each individual analyte in the LCS, MS, or Surrogate Spike is evaluated against the control limits published in the test method. Where there are no established acceptance criteria, the laboratory calculates in-house control limits

with the use of control charts or, in some cases, utilizes client project specific control limits. When this occurs, the regulatory or project limits will supersede the laboratory's in-house limits.

Note: For methods, analytes and matrices with very limited data (e.g., unusual matrices not analyzed often), interim limits are established using available data or by analogy to similar methods or matrices.

Once control limits have been established, they are verified, reviewed, and updated if necessary on an annual basis unless the method requires more frequent updating. Control limits are established per method (as opposed to per instrument) regardless of the number of instruments utilized.

Laboratory generated % Recovery acceptance (control) limits are generally established by taking $\pm$ 3 Standard Deviations (99% confidence level) from the average recovery of a minimum of 20-30 data points (more points are preferred).

- Regardless of the calculated limit, the limit should be no tighter than the Calibration Verification (ICV/CCV) (Unless the analytical method specifies a tighter limit).

- In-house limits cannot be any wider than those mandated in a regulated analytical method. Client or contract required control limits are evaluated against the laboratory's statistically derived control limits to determine if the data quality objectives (DQOs) can be achieved. If laboratory control limits are not consistent with DQOs, then alternatives must be considered, such as method improvements or use of an alternate analytical method.

- The lowest acceptable recovery limit will be 10% (the analyte must be detectable and identifiable). Exception: The lowest acceptable recovery limit for Benzidine will be 5% and the analyte must be detectable and identifiable.

- The maximum acceptable recovery limit will be 150%.

- The maximum acceptable RPD limit will be 35% for waters and 40% for soils. The minimum RPD limit is 10%.

- If either the high or low end of the control limit changes by $\leq$ 5% from previous, the control chart is visually inspected and, using professional judgment, they may be left unchanged if there is no effect on laboratory ability to meet the existing limits.

24.6.1 The lab must be able to generate a current listing of their control limits and track when the updates are performed. Current and historical limits are maintained in the LIMS, along with the effective dates. In addition, the laboratory must be able to recreate historical control limits. Refer to laboratory SOP No. PT-QA-021, *Quality Control Program*, for details on the creation, evaluation and application of statistical control limits.

24.6.2 A LCS that is within the acceptance criteria establishes that the analytical system is in control and is used to validate the process. Samples that are analyzed with an LCS with recoveries outside of the acceptance limits may be determined as out of control and should be reanalyzed if possible. If reanalysis is not possible, then the results for all affected analytes for samples within the same batch must be qualified when reported. The internal corrective action

process (see Section 12) is also initiated if an LCS exceeds the acceptance limits. Sample results may be qualified and reported without reanalysis if:

- The analyte results are below the reporting limit and the LCS is above the upper control limit.

- If the analytical results are above the relevant regulatory limit and the LCS is below the lower control limit. For further detail refer to laboratory SOP PT-QA-021 and method specific SOPs.

- For TNI work, there are an allowable number of Marginal Exceedances (ME):

<11 analytes	0 marginal exceedances are allowed
11 – 30 Analytes	1 marginal exceedance is allowed
31-50 Analytes	2 marginal exceedances are allowed
51-70 Analytes	3 marginal exceedances are allowed
71-90 Analytes	4 marginal exceedances are allowed
> 90 Analytes	5 marginal exceedances are allowed

  - Marginal exceedances are recovery exceedances between 3 SD and 4 SD from the mean recovery limit (TNI).

  - Marginal exceedances must be random. If the same analyte exceeds the LCS control limit repeatedly, it is an indication of a systematic problem. The source of the error must be located and corrective action taken. The laboratory has a system to monitor marginal exceedances to ensure that they are random.

  - Though marginal exceedances may be allowed, the data must still be qualified to indicate it is outside of the normal limits.

24.6.3 If the MS/MSDs do not meet acceptance limits, the MS/MSD and the associated parent sample are reported with a qualifier for those analytes that do not meet limits. If obvious preparation errors are suspected, or if requested by the client, unacceptable MS/MSDs are reprocessed and reanalyzed to prove matrix interference. A more detailed discussion of acceptance criteria and corrective action can be found in SOP No. PT-QA-021 – Laboratory Quality Control Program, analytical method SOPs and in Section 12 of this document.

24.6.4 If a surrogate standard falls outside the acceptance limits, if there is not obvious chromatographic matrix interference, reanalyze the sample to confirm a possible matrix effect. If the recoveries confirm or there was obvious chromatographic interference, results are reported from the original analysis and a qualifier is added. If the reanalysis meets surrogate recovery criteria, the second run is reported (or both are reported if requested by the client). Under certain circumstances, where all of the samples are from the same location and share similar chromatography, the reanalysis may be performed on a single sample rather than all of the samples and if the surrogate meets the recovery criteria in the reanalysis, all of the affected samples would require reanalysis.

24.7 Additional Procedures to Assure Quality Control

The laboratory has written and approved method SOPs to assure the accuracy of the test method including calibration (see Section 20), use of certified reference materials (see Section 21) and use of PT samples (see Section 15).

A discussion regarding MDLs, Limit of Detection (LOD) and Limit of Quantitation (LOQ) can be found in Section 19.

Use of formulae to reduce data is discussed in the method SOPs and in Section 20.

Selection of appropriate reagents and standards is included in Section 9 and 21.

A discussion on selectivity of the test is included in Section 5.

Constant and consistent test conditions are discussed in Section 18.

The laboratories sample acceptance policy is included in Section 23.

SECTION 25

REPORTING RESULTS

25.1 Overview

The results of each test are reported accurately, clearly, unambiguously, and objectively in accordance with State and Federal regulations as well as client requirements. Analytical results are issued in a format that is intended to satisfy customer and laboratory accreditation requirements as well as provide the end user with the information needed to properly evaluate the results. Where there is conflict between client requests and laboratory ethics or regulatory requirements, the laboratory's ethical and legal requirements are paramount, and the laboratory will work with the client during project set up to develop an acceptable solution. Refer to Section 7.

A variety of report formats are available to meet specific needs.

In cases where a client asks for simplified reports, there must be a written request from the client. There still must be enough information that would show any analyses that were out of conformance (QC out of limits) and there should be a reference to a full report that is made available to the client. Review of reported data is included in Section 19.

25.2 Test Reports

Analytical results are reported in a format that is satisfactory to the client and meets all requirements of applicable accrediting authorities and agencies. A variety of report formats are available to meet specific needs. The report is printed on laboratory letterhead, reviewed, and signed by the appropriate project manager. At a minimum, the standard laboratory report shall contain the following information:

25.2.1 A report title (e.g. Analytical Report) on the cover page with a "Result" column header on the sample result page

25.2.2 Each report cover page printed on company letterhead, which includes the laboratory name, address and telephone number

25.2.3 A unique identification of the report (e.g. job Number) and on each page an identification in order to ensure the page is recognized as part of the report and a clear identification of the end

Note: Page numbers of report are represented as page # of ## at the bottom of the page. Where the first number is the page number and the second is the total number of pages

25.2.4 A copy of the chain of custody (COC)

- Any COCs involved with Subcontracting are included

25.2.5 The name and address of client and a project name/number, if applicable

25.2.6 Client project manager or other contact

25.2.7 Description and unambiguous identification of the tested sample(s) including the client identification code

25.2.8 Date of receipt of sample, date and time of collection, and date(s) and time of test preparation and performance, and time of preparation or analysis if the required holding time for either activity is less than or equal to 72 hours

25.2.9 Date reported or date of revision, if applicable

25.2.10 Method of analysis including method code (EPA, Standard Methods, etc)

25.2.11 Reporting Limit.

25.2.12 Method detection limits (if requested)

25.2.13 Definition of Data qualifiers and reporting acronyms (e.g. ND)

25.2.14 Sample results

25.2.15 QC data consisting of method blank, surrogate, LCS, and MS/MSD recoveries and control limits are included unless the client specifies they do not require reporting the QC

25.2.16 Condition of samples at receipt including temperature. This may be accomplished in the case narrative or by attaching sample login sheets. The temperature is documented on the sample receipt checklist and noted in the report case narrative.

25.2.17 A statement expressing the validity of the results, that the source methodology was followed and all results were reviewed for error

25.2.18 A statement to the effect that the results relate only to the items tested and the sample as received by the laboratory

25.2.19 A statement that the report shall not be reproduced except in full, without prior express written approval by the laboratory coordinator

25.2.20 A signature and title of the person(s) accepting responsibility for the content of the report and date of issue (Signatories are appointed by the Lab Director)

25.2.21 When TNI accreditation is required, the lab shall certify that the test results meet all requirements of TNI or provide reasons and/or justification if they do not

25.2.22 If applicable, the laboratory includes a cover letter

25.2.23 Where applicable, a narrative to the report that explains the issue(s) and corrective action(s) taken in the event that a specific accreditation or certification requirement was not met

25.2.24 When soil samples are analyzed, a specific identification as to whether soils are reported on a “wet weight” or “dry weight” basis

25.2.25 Appropriate laboratory certification number for the state of origin of the sample, if applicable

25.2.26 If only part of the report is provided to the client (client requests some results before all of it is complete), it must be clearly indicated on the report (e.g., preliminary report). A complete report must be sent once all of the work has been completed.

25.2.27 Any non-TestAmerica subcontracted analysis results are provided as a separate report on the official letterhead of the subcontractor. All TestAmerica subcontracting is clearly identified on the report as to which laboratory performed a specific analysis.

25.2.28 A clear statement notifying the client that non-accredited tests were performed and directing the client to the laboratory’s accreditation certificates of approval shall be provided when non-accredited tests are included in the report

Note: It is required by the PA DEP that non-accredited parameters be clearly identified on the sample results.

Note: Refer to the Corporate SOP on Electronic Reporting and Signature Policy (No. CA-I-P-002) for details on internally applying electronic signatures of approval.

25.3 Reporting Level Or Report Type

The laboratory offers four levels of quality control reporting. Each level, in addition to its own specific requirements, contains all the information provided in the preceding level. The packages provide the following information in addition to the information described above:

- Level I is a report with the features described in Section 25.2 above.
- Level II is a Level I report plus summary information, including results for the method blank reported to the laboratory MDL, percent recovery for laboratory control samples and matrix spike samples, and the RPD values for all MSD and sample duplicate analyses.
- Level III contains all the information supplied in Level II, but presented on the CLP-like summary forms, and relevant calibration information. A Level II report is not included, unless specifically requested. No raw data is provided.
- Level IV is the same as Level III with the addition of all raw supporting data.

In addition to the various levels of QC packaging, the laboratory also provides reports in diskette deliverable form. Initial reports may be provided to clients by facsimile. Procedures used to ensure client confidentiality are outlined in Section 25.6.

25.3.1 Electronic Data Deliverables (EDDs)

EDDs are routinely offered as part of TestAmerica's services in addition to the test report as described in section 25.2. When NELAP accreditation is required and both a test report and EDD are provided to the client, the official version of the test report will be the combined information of the report and the EDD. Data qualifiers appearing on the test report must be included in the EDD.

Pittsburgh offers a variety of EDD formats including Environmental Restoration Information Management System (ERPIMS), Staged Electronic Data Deliverable (SEDD) Environmental Quality Information System (EQuIS), Electronic Deliverable Format (EDF), Excel and custom files as requested by the client.

EDD specifications are submitted to the IT department by the PM for review and undergo the contract review process. Once the facility has committed to providing data in a specific electronic format, the coding of the format may need to be performed. This coding is documented and validated. The validation of the code is retained by the IT staff coding the EDD.

EDDs shall be subject to a review to ensure their accuracy and completeness. If EDD generation is automated, review may be reduced to periodic screening if the laboratory can demonstrate that it can routinely generate that EDD without errors. Any revisions to the EDD format must be reviewed until it is demonstrated that it can routinely be generated without errors. If the EDD can be reproduced accurately and if all subsequent EDDs can be produced error-free, each EDD does not necessarily require a review.

25.4 Supplemental Information For Test

The lab identifies any unacceptable QC analyses or any other unusual circumstances or observations such as environmental conditions and any non-standard conditions that may have

affected the quality of a result. This is typically in the form of a footnote or a qualifier and/or a narrative explaining the discrepancy in the front of the report.

Numeric results with values outside of the calibration range, either high or low are qualified as 'estimated'.

Where quality system requirements are not met, a statement of compliance/non-compliance with requirements and/or specifications is required, including identification of test results derived from any sample that did not meet TNI sample acceptance requirements such as improper container, holding time, or temperature.

Where applicable, a statement on the estimated uncertainty of measurements; information on uncertainty is needed when a client's instructions so require.

Opinions and Interpretations - The test report contains objective information, and generally does not contain subjective information such as opinions and interpretations. If such information is required by the client, the Laboratory Director will determine if a response can be prepared. If so, the Laboratory Director will designate the appropriate member of the management team to prepare a response. The response will be fully documented, and reviewed by the Laboratory Director, before release to the client. There may be additional fees charged to the client at this time, as this is a non-routine function of the laboratory.

Note: Review of data deliverable packages for submittal to regulatory authorities requires responses to non-conforming data concerning potential impact on data quality. This necessitates a limited scope of interpretation, and this work is performed by the Manager(s)/Team Leaders or as assigned by the lab Director. This is the only form of "interpretation" of data that is routinely performed by the laboratory.

When opinions or interpretations are included in the report, the laboratory provides an explanation as to the basis upon which the opinions and interpretations have been made. Opinions and interpretations are clearly noted as such and where applicable, a comment should be added suggesting that the client verify the opinion or interpretation with their regulator.

25.5 Environmental Testing Obtained From Subcontractors

If the laboratory is not able to provide the client the requested analysis, the samples would be subcontracted following the procedures outlined in the Corporate SOP on Subcontracting (SOP # CA-L-S-002).

Data reported from analyses performed by a subcontractor laboratory are clearly identified as such on the analytical report provided to the client. Results from a subcontract laboratory outside of TestAmerica are reported to the client on the subcontract laboratory's original report stationary and the report includes any accompanying documentation.

25.6 Client Confidentiality

In situations involving the transmission of environmental test results by telephone, facsimile or other electronic means, client confidentiality must be maintained.

TestAmerica will not intentionally divulge to any person (other than the Client or any other person designated by the Client in writing) any information regarding the services provided by TestAmerica or any information disclosed to TestAmerica by the Client. Furthermore, information known to be potentially endangering to national security or an entity's proprietary rights will not be released.

Note: This shall not apply to the extent that the information is required to be disclosed by TestAmerica under the compulsion of legal process. TestAmerica will, to the extent feasible, provide reasonable notice to the client before disclosing the information.

Note: Authorized representatives of an accrediting authority are permitted to make copies of any analyses or records relevant to the accreditation process, and copies may be removed from the laboratory for purposes of assessment.

25.6.1 Report deliverable formats are discussed with each new client. If a client requests that reports be faxed or e-mailed, the reports are to meet all requirements of this document, including a cover letter.

25.7 Format Of Reports

The format of reports is designed to accommodate each type of environmental test carried out and to minimize the possibility of misunderstanding or misuse.

25.8 Amendments To Test Reports

Corrections, additions, or deletions to reports are only made when justification arises through supplemental documentation. Justification is documented using the laboratory's corrective action system (refer to Section 12).

The revised report is retained on the data server, as is the original report. The revised report is stored in the data server under the job number followed by "Rev (n)" where 'n' is the revision number. The revised report will have the words "Revision (n)" on the report cover page beneath the report date.

When the report is re-issued, a notation of "report re-issue" is placed on the cover/signature page of the report or at the top of the narrative page with a brief explanation of reason for the re-issue and a reference back to the last final report generated.

25.9 Policies On Client Requests For Amendments

25.9.1 Policy on Data Omissions or Reporting Limit Increases

Fundamentally, our policy is simply to not omit previously reported results (including data qualifiers) or to not raise reporting limits and report sample results as ND. This policy has few exceptions. Exceptions are:

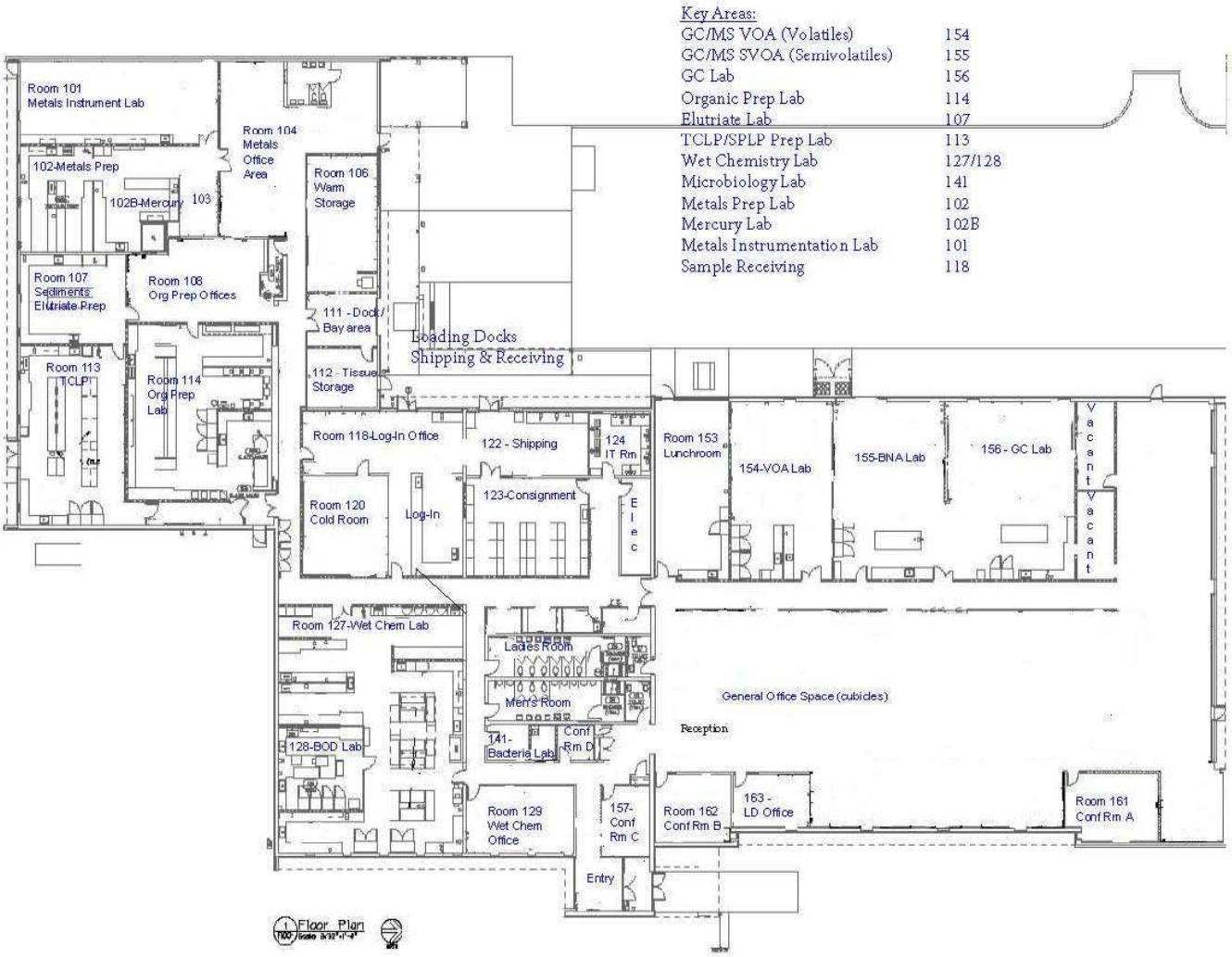
- Laboratory error
- Sample identification is indeterminate (confusion between COC and sample labels)

- An incorrect analysis (not analyte) was requested (e.g., COC lists 8315 but client wanted 8310). A written request for the change is required.
- Incorrect limits reported based on regulatory requirements
- The requested change has absolutely *no possible* impact on the interpretation of the analytical results and there is *no possibility* of the change being interpreted as misrepresentation by anyone inside or outside of our company.

25.9.2 Multiple Reports

TestAmerica does not issue multiple reports for the same job number where there is different information on each report (this does not refer to copies of the same report) unless required to meet regulatory needs and approved by QA.

Appendix 1
Laboratory Floor Plan



Appendix 2
Glossary/Acronyms

Glossary:

Acceptance Criteria: Specified limits placed on characteristics of an item, process, or service defined in requirement documents. (ASQC)

Accreditation: The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory.

Accuracy: The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (QAMS)

Analyst: The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality. (TNI)

Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis. (TNI)

Anomaly: A condition or event, other than a deficiency, that may affect the quality of the data, whether in the laboratory's control or not.

Assessment: The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of laboratory accreditation). (TNI)

Audit: A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives. (TNI)

Batch: Environmental samples which are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one to 20 environmental samples of the same matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An **analytical batch** is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various quality system matrices and can exceed twenty (20) samples. (TNI)

Bias: The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value). (TNI)

Blank: A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. (ASQC)

Calibration: A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. (TNI)

1) In calibration of support equipment the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI).

2) In calibration according to methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications.

Calibration Curve: The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (TNI)

Calibration Standard: A substance or reference material used to calibrate an instrument (QAMS)

Certified Reference Material (CRM): A reference material, accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute. (TNI)

Chain of Custody (COC) Form: Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; the collector; time of collection; preservation; and requested analyses. (TNI)

Compromised Samples: Those samples which are improperly sampled, insufficiently documented (chain of custody and other sample records and/or labels), improperly preserved, collected in improper containers, or exceeding holding times when delivered to a laboratory. Under normal conditions, compromised samples are not analyzed. If emergency situation require analysis, the results must be appropriately qualified.

Confidential Business Information (CBI): Information that an organization designates as having the potential of providing a competitor with inappropriate insight into its management, operation or products. TNI and its representatives agree to safeguarding identified CBI and to maintain all information identified as such in full confidentiality.

Confirmation: Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to Second Column Confirmation; Alternate wavelength; Derivatization; Mass spectral interpretation; Alternative detectors or Additional Cleanup procedures. (TNI)

Conformance: An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements. (ANSI/ASQC E4-1994)

Correction: Actions necessary to correct or repair analysis specific non-conformances. The acceptance criteria for method specific QC and protocols as well as the associated corrective actions. The analyst will most frequently be the one to identify the need for this action as a result of calibration checks and QC sample analysis. No significant action is taken to change behavior, process or procedure.

Corrective Action: The action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO 8402)

Data Audit: A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data re of acceptable quality (i.e., that they meet specified acceptance criteria). (TNI)

Data Reduction: The process of transforming the number of data items by arithmetic or statistical calculations, standard curves, and concentration factors, and collation into a more useable form. (TNI)

Data Review Checker: Automated data review feature in TALS that compares data entered to list of control and preventative review requirements and presents all findings to the first level data reviewer for response or correction.

Deficiency: An unauthorized deviation from acceptable procedures or practices, or a defect in an item. (ASQC), whether in the laboratory's control or not.

Demonstration of Capability: A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision. (TNI)

Document Control: The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly, and controlled to ensure use of the correct version at the location where the prescribed activity if performed. (ASQC)

Duplicate Analyses: The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. (EPA-QAD)

Equipment Blank: Sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures.

External Standard Calibration: Calibrations for methods that do not utilize internal standards to compensate for changes in instrument conditions.

Field Blank: Blank prepared in the field by filing a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken (EPA OSWER)

Field of Accreditation: Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.

Holding Times : The maximum times that samples may be held prior to analyses and still be considered valid or not compromised. (40 CFR Part 136)

Internal Standard: A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical test method. (TNI)

Internal Standard Calibration: Calibrations for methods that utilize internal standards to compensate for changes in instrument conditions.

Instrument Blank: A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. (EPA-QAD)

Instrument Detection Limit (IDL): The minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific instrument. The IDL is associated with the instrumental portion of a specific method only, and sample preparation steps are not considered in its derivation. The IDL is a statistical estimation at a specified confidence interval of the concentration at which the relative uncertainty is ± 100%. The IDL represents a range where qualitative detection occurs on a specific instrument. Quantitative results are not produced in this range.

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes, taken through all preparation

and analysis steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

An LCS shall be prepared at a minimum of 1 per batch of 20 or less samples per matrix type per sample extraction or preparation method, or more frequently if so required by the reference method, except for analytes for which spiking solutions are not available such as, total volatile solids, odor, temperature, or dissolved oxygen. The results of these samples shall be used to determine batch acceptance.

Least Squares Regression (1st Order Curve): The least squares regression is a mathematical calculation of a straight line over two axes. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The regression calculation will generate a correlation coefficient (r) that is a measure of the "goodness of fit" of the regression line to the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r must be greater than or equal to 0.99 for organics and 0.995 for inorganics.

Limit of Detection (LOD): [a.k.a., Method Detection Limit (MDL]: A laboratory's estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect in their facility. (TNI)

LOD Verification [a.k.a., MDL Verification]: A processed QC sample in the matrix of interest, spiked with the analyte at no more than 3X the LOD for single analyte tests and 4X the LOD for multiple analyte tests and processed through the entire analytical procedure.

Limit(s) of Quantitation (LOQ) [a.k.a., Reporting Limit]: The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. (TNI)

(QS) Matrix: The component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions shall be used:

Aqueous: Any aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine. Includes surface water, groundwater, effluents, and TCLP or other extracts.

Drinking Water: any aqueous sample that has been designated as a potable or potential potable water source.

Saline/Estuarine: any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.

Non-aqueous Liquid: any organic liquid with <15% settleable solids.

Biological Tissue: any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Solids: includes soils, sediments, sludges, and other matrices with >15% settleable solids.

Chemical Waste: a product or by-product of an industrial process that results in a matrix not previously defined.

Air *& Emissions*: whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device. (TNI)

Matrix Spike (spiked sample or fortified sample): A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by

adding a known amount of target analyte to a specified amount of sample for which an independent test result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Matrix Spike Duplicate (spiked sample or fortified sample duplicate): A replicate matrix spike prepared and analyzed to obtain a measure of the precision of the recovery for each analyte.
Method Blank: A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.

Method Detection Limit: The minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40 CFR Part 136, Appendix B)

Negative Control: Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results.

Non-conformance**:** An indication, judgment, or state of not having met the requirements of the relevant specifications, contract, or regulation.

Observation: A record of phenomena that (1) may assist in evaluation of the sample data; (2) may be of importance to the project manager and/or the client, and yet not at the time of the observation have any known effect on quality.

Performance Audit: The routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory.

Positive Control: Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects.

Precision: The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms.

Preservation: Any conditions under which a sample must be kept in order to maintain chemical and/or biological integrity prior to analysis. (TNI)

Proficiency Testing: A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (TNI)

Proficiency Testing Program: The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories. (TNI)

Proficiency Test Sample (PT): A sample, the composition of which is unknown to the laboratory and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria. (TNIS)

Quality Assurance: An integrated system of management activities involving planning, implementation, assessment,~~,~~ reporting and quality improvement to ensure that a process, item, ~~product~~ or service is of the type of quality needed and expected by the client. (TNI)

Quality Assurance [Project] Plan (QAPP): A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. (EAP-QAD)

Quality Control: The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality. (TNI)

Quality Control Sample: A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control. (TNI)

Quality Manual: A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. (TNI)

Quality System: A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC activities. (TNI)

Raw Data: The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records. (TNI)

Record Retention: The systematic collection, indexing and storing of documented information under secure conditions.

Reference Material: Material or substance one or more properties of which are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (ISO Guide 30-2.1)

Reference Standard: Standard used for the calibration of working measurement standards in a given organization or a given location. (TNI)

Sampling: Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.

Second Order Polynomial Curve (Quadratic): The 2nd order curves are a mathematical calculation of a slightly curved line over two axis. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The 2nd order regression will generate a coefficient of determination (COD or r^2) that is a measure of the "goodness of fit" of the quadratic curvature the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r^2 must be greater than or equal to 0.99.

Selectivity: The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system. (TNI)

Sensitivity: The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (TNI)

Spike: A known mass of target analyte added to a blank, sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.

Standard: The document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of standard setting NELAC and meets the approval requirements of standard adoption organizations procedures and policies. (TNI)

Standard Operating Procedures (SOPs): A written document which details the method for an operation, analysis, or action, with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks. (TNI)

Storage Blank: A blank matrix stored with field samples of a similar matrix (volatiles only) that measures storage contribution to any source of contamination.

Surrogate: A substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes.

Surrogate compounds must be added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. Poor surrogate recovery may indicate a problem with sample composition and shall be reported to the client whose sample produced poor recovery. (QAMS)

Systems Audit (also Technical Systems Audit): A thorough, systematic, qualitative on-site assessment of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system. (EPA-QAD)

Technical Manager: A member of the staff of an environmental laboratory who exercises actual day-to-day supervision of laboratory operations for the appropriate fields of accreditation and reporting of results

Technology: A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.

Traceability: The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project. (TNI)

Trip Blank:
A blank matrix placed in a sealed container at the laboratory that is shipped, held unopened in the field, and returned to the laboratory in the shipping container with the field samples.

Uncertainty:
A parameter associated with the result of a measurement that characterizes the dispersion of the value that could reasonably be attributed to the measured value.

Acronyms:

CAR – Corrective Action Report
CCV – Continuing Calibration Verification
CF – Calibration Factor
CFR – Code of Federal Regulations
COC – Chain of Custody
DOC – Demonstration of Capability
DQO – Data Quality Objectives
DUP - Duplicate
EHS – Environment, Health and Safety
EPA – Environmental Protection Agency
GC - Gas Chromatography
GC/MS - Gas Chromatography/Mass Spectrometry
HPLC - High Performance Liquid Chromatography
ICP - Inductively Coupled Plasma Atomic Emission Spectroscopy
ICP/MS – ICP/Mass Spectrometry
ICV – Initial Calibration Verification
IDL – Instrument Detection Limit
IH – Industrial Hygiene
IS – Internal Standard
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
LIMS – Laboratory Information Management System
LOD – Limit of Detection
LOQ – Limit of Quantitation
MDL – Method Detection Limit
MDLCK – MDL Check Standard
MDLV – MDL Verification Check Standard
MRL – Method Reporting Limit Check Standard
MS – Matrix Spike
MSD – Matrix Spike Duplicate
MSDS - Material Safety Data Sheet
NELAP - National Environmental Laboratory Accreditation Program
PT – Performance Testing
TNI – The NELAC Institute
QAM – Quality Assurance Manual
QA/QC – Quality Assurance / Quality Control
QAPP – Quality Assurance Project Plan
RF – Response Factor
RPD – Relative Percent Difference
RSD – Relative Standard Deviation
SD – Standard Deviation
SOP: Standard Operating Procedure
TAT – Turn-Around-Time
VOA – Volatiles
VOC – Volatile Organic Compound

Appendix 3

Laboratory Certifications, Accreditations, Validations

Pittsburgh maintains certifications, accreditations, certifications, and validations with numerous state and national entities. Programs vary but may include on-site audits, reciprocal agreements with another entity, performance testing evaluations, review of the QA Manual, Standard Operating Procedures, Method Detection Limits, training records, etc. At the time of this QA Manual revision, the laboratory has accreditation / certification / licensing with the following organizations:

Organization	Certificate Number Or Laboratory ID Number
Arkansas	88-0690
California ELAP	2891
Connecticut	PH-0688
Florida	E871008
Illinois	002602
Kansas	E-10350
Louisiana	04041
New Hampshire	203010
New Jersey	PA005
New York	11182
North Carolina	434
Pennsylvania	02-00416
South Carolina	89014002
Texas	T104704528
Utah	STLP
USDA	P330-10-00139
USDA	P-Soil -01
Virginia VELAP	460189
West Virginia	142
Wisconsin	998027800

The certificates and parameter lists (which may differ) are available, upon request, from a laboratory representative. They may be found on the Corporate web site, the laboratory's public server and in the QA web page.

Appendix 4

Pittsburgh Laboratory SOP List

Document No.	Title
PT-FS-001	Field Measurement of Dissolved Oxygen (DO) Method: SM 4500-O G
PT-FS-002	Field Measurement of Total Residual Chlorine Method: SM 4500-Cl G
PT-FS-003	Field Measurement of pH Method: SM 4500 H+B
PT-GC-001	Gas Chromatographic Analysis of Herbicides, SW-846 Method 8151A
PT-GC-002	Analysis of Organochlorine Pesticides and PCBs by Method 608
PT-GC-004	1,2-Dibromoethane(EDB) and 1,2-Dibromo-3-Chloropropane(DBCP) in Water by Microextraction and Gas Chromatography, Method 8011
PT-GC-005	Polychlorinated Biphenyls (PCBs) and PCBs as Congeners by GC/ECD - Method: SW-846 8082 and 8082A
PT-GC-006	Chlorinated Pesticides - Method: SW-846 8081A/B
PT-GC-007	Organophosphorus Pesticides by Gas Chromatography - Method: SW-846 8141A and 8141B
PT-GC-009	Determination of Inorganic Anions by Ion Chromatography EPA Method 300 SW-846 Method 9056A
PT-GC-010	TOC Analysis for Solids by Lloyd Kahn Method
PT-GC-013	Determination of Particulate Organic Carbon in Sediment and Estuarine / Coastal Water Matrices
PT-GC-014	Halogenated Organic Compounds by Direct Injection GC/ECD
PT-HS-001	Pittsburgh Facility Addendum to TestAmerica Corporate Environmental Health & Safety Manual (CW-E-M-001)
PT-HS-002	Bloodborne Pathogen Exposure Control Path
PT-IP-002	Acid Digestion of Soils, SW-846 Method 3050B
PT-IP-003	Acid Digestion of Aqueous Samples by SW-846 Methods 3005A, 3010A and EPA Methods 200.7 and 200.8
PT-IT-001	Data Backup Procedures
PT-MI-001	Total Coliforms and E. coli – Presence/Absence Test Using Colilert
PT-MS-001	Semivolatile Organic Anaysis by GC/MS, Method 625
PT-MS-002	Volatile Organics by GC/MS Based on Method 624
PT-MS-005	VOA Holding Blanks
PT-MS-008	GC/MS Analysis for Semivolatile Organics, Methods: SW-846 8270C & D
PT-MS-010	Determination of Volatile Organics by GC/MS Methods: SW-846 8260B & C

Document No.	Title
PT-MT-001	Inductively Coupled Plasma-Atomic Emission Spectroscopy, Spectrometric Method for Trace Element Analyses, SW-846 Method 6010B, 6010C, 6010D and EPA Method 200.7
PT-MT-002	Analysis of Metals by Inductively Coupled Plasma/Mass Spectrometry (ICPMS) for Methods 200.8, 6020, 6020A
PT-MT-005	Preparation and Analysis of Mercury in Aqueous Samples by Cold Vapor Atomic Absorption, SW-846 7470A and MCAWW 245.1
PT-MT-007	Preparation and Analysis of Mercury in Solid Samples by Cold Vapor Atomic Absorption Spectroscopy, SW846 7471A & 7471B
PT-OP-001	Extraction and Cleanup of Organic Compounds from Waters and Solids, Based on SW-846 3500 and 600 Series Methods
PT-OP-002	Simplified Laboratory Runoff Procedure (SLRP)
PT-OP-003	Standard Elutriate Test (SET)
PT-OP-004	Toxicity Characteristic Leaching Procedure and Synthetic Precipitation Leaching Procedure
PT-OP-005	Modified and Effluent Elutriate Tests (MET and EET)
PT-OP-006	Long Tube Column Settling Test
PT-OP-007	Illinois Re-suspension Tests
PT-OP-008	Dredging Elutriate Test (DRET)
PT-OP-009	Sequential Batch Leach Test (SBLT) for Freshwater Sediments
PT-OP-011	Extractable Residue (Lipids) from Animal Tissue
PT-OP-015	Modified Multiple Extraction Procedure Method: SW-846 1320
PT-OP-016	Porewater Generation
PT-OP-017	Liquid-Solid Partitioning as a Function of Extract pH in Solid Materials using a Parallel Batch Procedure SW-846 Method 1313
PT-OP-018	Liquid-Solid Partitioning as a Function of Liquid-to-Solid Ratio in Solid Materials using a Parallel Batch Procedure SW-846 Method 1316
PT-OP-019	Mass Transfer Rates of Constituents in Monolithic or Compacted Granular Materials using a Semi-Dynamic Tank Leaching Procedure SW-846 Method 1315
PT-OP-020	Standard Test Method for 24-h Batch-Type Measurement of Contaminant Sorption by Soils and Sediments ASTM D4646-03
PT-OP-021	Liquid-Solid Partitioning as a Function of Liquid-to-Solid Ratio for Constituents in Solid Materials using an Up-Flow Percolation Column Procedure SW-846 Method 1314
PT-OP-022	Low Volume Extraction and Cleanup of Organic Compounds from Waters Method: SW846 3500 Series
PT-OP-023	Measurement of the Leachability of Solidified Wastes by a Short Term Test Procedure Modified ANSI/ANS-16.1-2003
PT-OP-025	Soil/Sediment Amendment Procedure
PT-OP-026	Extraction of Organic Compounds from Solids, Sediments, Tissues, and Wipes Based on SW-846 3500 Series Methods

Document No.	Title
PT-OP-027	Extraction of Herbicides by SW846 Method 8151A
PT-OP-028	Clean-up of Organic Extracts by SW-846 3600 Series Methods
PT-OP-030	Handling and Preparation of Biota and Tissue Samples
PT-OP-031	Australian Standard Leaching Procedure - AS 4439.3-1997
PT-QA-001	Employee Orientation & Training
PT-QA-002	Internal Auditing
PT-QA-003	Glassware Clean-up for Organic/Inorganic Procedures
PT-QA-004	Quarantine Soil Procedure
PT-QA-005	Measurement Uncertainty
PT-QA-006	Procurement of Standards and Materials; Labeling and Traceability
PT-QA-007	Detection Limits
PT-QA-008	Thermometer and Barometer Calibration and Temperature Monitoring
PT-QA-009	Rounding and Significant Figures
PT-QA-010	Document Development and Control
PT-QA-012	Selection and Calibration of Balances and Weights
PT-QA-013	Independent QA Data Review
PT-QA-014	Reporting Limits
PT-QA-016	Nonconformance & Corrective Action System
PT-QA-017	Aqueous Pipette Calibration – Gravimetric Method
PT-QA-018	Technical Data Review Requirements
PT-QA-019	Records Information Management
PT-QA-021	Laboratory Quality Control Program
PT-QA-022	Equipment Maintenance
PT-QA-024	Subsampling
PT-QA-026	Container Accuracy Verification – Gravimetric
PT-QA-031	Internal Chain of Custody

Document No.	Title
PT-SR-001	Sample Receipt & Login
PT-SR-002	Bottle Order Preparation and Shipping
PT-WC-001	Determination of Total and Total Volatile Solids in Waters and Wastes (Methods EPA160.4 and SM 2540B & 2540E)
PT-WC-002	Color, Method 110.2
PT-WC-003	Alkalinity, SM Method 2320B
PT-WC-004	Total Hardness (mg/L as CaCO3) by Method SM 2340C; and Hardness by Calculation SM 2340B
PT-WC-005	Turbidity by Method 180.1
PT-WC-007	Nitrate/Nitrite-N EPA Method 353.2
PT-WC-008	Acid Volatile Sulfides (AVS) and Simultaneously Extracted Metals (SEM) in Sediment
PT-WC-009	Performance Checks on Spectronic 21 and Model 1001 Spectro-Photometers
PT-WC-010	Total Sulfide as Acid Soluble Sulfide, Method 9030B/9034, Standard Method 20th Ed. 4500S-2-F
PT-WC-013	Specific Conductance by 120.1, 2510B, and 9050A
PT-WC-014	Nitrogen, Ammonia (Automated), Method 350.1
PT-WC-015	Chromium, Hexavalent (Colorimetric) by SM3500-Cr-B, SW846 3060A/7196
PT-WC-016	Biochemical Oxygen Demand (BOD) and Carbonaceous Biochemical Oxygen Demand (CBOD) by Dissolved Oxygen Probe - SM5210B
PT-WC-017	Total Organic Carbon (TOC) and Total Inorganic Carbon (TIC), Methods SM 5310C and SW-846 9060/9060A
PT-WC-018	Cyanide – Semi-Automated, Pyridine-Barbituric Acid For Total and Amenable, Cyanide in Water (Methods 335.4) and Soil Analyses (Method 9012A/9012B)
PT-WC-020	Percent Moisture, Ash, Organic Matter and Total Solids in Soil Samples - SM 2540G and ASTM D297-84
PT-WC-021	Flash Point by Pensky-Martens Closed Tester, SW-846 Method 1010A and ASTM D93-08
PT-WC-022	Ignitability of Solids for Waste Characterization EPA SW-846 Chapter 7, Section 7.1
PT-WC-023	Chemical Oxygen Demand, Low Level, Method 410.4
PT-WC-025	n-hexane extractable material (HEM) in Sludge, Sediment and Soil samples - 9071B
PT-WC-026	PH Electrometric by SM 4500 H+B and SW-846 Methods: 9045C/D and 9040B/C
PT-WC-027	Salinity by Calculation, Electrical Conductivity Method SM 2520B
PT-WC-028	Hexane Extractable Material (HEM; Oil and Grease) and Silica Gel Treated Hexane Extractable Material (SGT-HEM; TPH), Method 1664A/1664B and 9070A
PT-WC-029	Available Cyanide by Ligand Exchange and Flow Injection Analysis (FIA) Method 1677

Document No.	Title
PT-WC-031	Cyanide Extraction Procedure for Solids and Oils, SW-846 Method 9013
PT-WC-032	Total Organic Carbon Analysis for Solid Matrices by Walkley Black
PT-WC-033	DI-Leachate Procedure for Solids (1 Hour Routine DI Leachate Procedure)
PT-WC-034	Paint Filter Liquids Test, SW-846 Method 9095B
PT-WC-035	Acidity of Water and Waste Water, SM Method 2310B
PT-WC-036	Flash Point of Liquids by Setaflash (Small Scale) Closed-Cup Apparatus, SW-846 Method 1020B and ASTM Standard D 3278-96
PT-WC-037	Oxidation Reduction Potential, SM 2580B (20th Ed)
PT-WC-038	Phenolics (Automated), Method 420.1/420.2, SW-846 9065/9066
PT-WC-039	Screening Apparent Specific Gravity and Bulk Density of Waste - Method: ASTM D 5057-90
PT-WC-040	Anion Surfactants as MBAS, Standard Methods 5540C
PT-WC-041	Compatibility of Screening Analysis of Waste, Method: ASTM D5058 Test Method C – Water Compatibility
PT-WC-042	Acid Titration of Samples for Bechtel Bettis (NaOH Solution for Caustic and Na2CO3 Concentration), Bechtel-Bettis SOP - WAPD-MT(CAC)-2141, Revision 0
PT-WC-043	Determination of Total and Volatile Suspended Solids in Waters and Wastes - EPA 160.4 and SM 2540D & 2540E
PT-WC-044	Determination of Settleable Solids in Water SM 2540F
PT-WC-045	Determination of Total Dissolved and Volatile Dissolved Solids in Water and Wastes, SM 2540C & 2540E
PT-WC-046	ASTM 18-Hour Leaching Procedure

Note: The SOPs are subject to change, refer to PT-QA-WI-002 for current list of SOPs and revision numbers.

Quality Assurance Manual

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Title Page:

Quality Assurance Manual
Approval Signatures



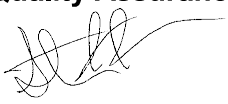
6/27/2017

Laboratory Director - Deborah L. Lowe — Date



5/29/2017

Quality Assurance Manager – Virginia Zusman — Date



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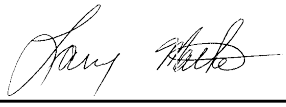


6/15/2017

Technical Director - Larry Matko — Date



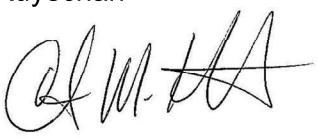
6/1/2017

Department/Technical Manager (Organics) - Sharon Bacha — Date



6/14/2017

Department/Technical Manager (Inorganics) - Roseann Ruyechan — Date



6/27/2017

Department Manager (Sample Management) - Chris Kovitch — Date

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REFERENCED CORPORATE SOPS AND POLICIES

SOP / Policy Reference	Title
CA-C-S-001	Worksharing Program
CA-I-P-002	Electronic Reporting and Signature Policy
CA-L-P-002	Contract Compliance Policy
CA-L-S-004	Subcontracting
CA-Q-M-002	Corporate Quality Management Plan
CA-Q-P-003	Calibration Curves and Selection of Calibration Points
CA-Q-S-001	Acid & Solvent Lot Testing and Approval
CA-Q-S-002	Acceptable Manual Integration Practices
CA-Q-S-006	Detection Limits
CA-Q-S-009	Root Cause Analysis
CA-T-P-001	Qualified Products List
CW-E-M-001	Corporate Environmental Health & Safety Manual
CW-F-P-002	Company-Wide Authorization Matrix
CW-F-P-004	Procurement and Contracts Policy
CW-F-S-007	Fixed Asset Acquisition, Retention and Safeguarding
CW-L-P-001	Records Retention Policy
CW-L-P-004	Ethics Policy
CW-L-S-002	Internal Investigation
CW-Q-S-001	Corporate Document Control and Archiving
CW-Q-S-002	Writing a Standard Operating Procedure (SOPs)
CW-Q-S-003	Internal Auditing
CW-Q-S-004	Management Systems Review
CW-Q-S-005	Data Recall Process

REFERENCED LABORATORY DOCUMENTS

SOP Reference	Title
PT-QA-001	Employee Orientation and Training (DOCs)
PT-QA-002	Internal Auditing
PT-QA-005	Measurement Uncertainty
PT-QA-006	Procurement of Standards and Materials; Labeling and Traceability
PT-QA-007	Detection Limits
PT-QA-008	Thermometer and Barometer Verification and Temperature Monitoring
PT-QA-010	Document and Spreadsheet Development & Control
PT-QA-012	Selection and Calibration of Balances and Weights
PT-QA-013	Independent QA Data Review
PT-QA-016	Nonconformance and Corrective Action System
PT-QA-017	Aqueous Pipette / Dispenser Calibration – Gravimetric Method
PT-QA-018	Technical Data Review Requirements
PT-QA-019	Records Management, Retention and Archive
PT-QA-021	Laboratory Quality Control Program
PT-QA-022	Equipment Maintenance
PT-QA-024	Subsampling
PT-QA-WI-002	Master Document List

SECTION 3
INTRODUCTION, SCOPE AND APPLICABILITY

3.1 INTRODUCTION AND COMPLIANCE REFERENCES

TestAmerica Pittsburgh's Quality Assurance Manual (QAM) is a document prepared to define the overall policies, organization objectives and functional responsibilities for achieving TestAmerica's data quality goals. The laboratory maintains a local perspective in its scope of services and client relations and maintains a national perspective in terms of quality.

The QAM has been prepared to assure compliance with The NELAC Institute (TNI) Standard, dated 2009, Volume 1 Modules 2 and 4, and ISO/IEC Guide 17025:2005(E) (TNI). In addition, the policies and procedures outlined in this manual are compliant with TestAmerica's Corporate Quality Management Plan (CQMP) CA-Q-M-002, and the various accreditation and certification programs listed in Appendix 3. The CQMP provides a summary of TestAmerica's quality and data integrity system. It contains requirements and general guidelines under which all TestAmerica facilities shall conduct their operations.

This QAM has been prepared to be consistent with requirements of the following documents:

- EPA *Requirements for Quality Management Programs* (QA/R-2), EPA/240/B-01/002, May 31, 2006
- EPA 600/4-88/039, *Methods for the Determination of Organic Compounds in Drinking Water,* EPA, Revised July 1991
- EPA 600/R-95/131, *Methods for the Determination of Organic Compounds in Drinking Water,* Supplement III, EPA, August 1995
- EPA 600/4-79-019, *Handbook for Analytical Quality Control in Water and Wastewater Laboratories,* EPA, March 1979
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008, Final Update V, August 2015*
- *Federal Register, 40 CFR Parts 136, 141, 172, 173, 178, 179 and 261*
- *Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration*
- APHA, *Standard Methods for the Examination of Water and Wastewater,* 18th Edition, 19th, 20th, 21st, 22nd and on-line Editions
- *U.S. Department of Energy* Order 414.1D, *Quality Assurance*, April 25, 2011
- Nuclear Regulatory Commission (NRC) quality assurance requirements
- Marine Protection, Research, and Sanctuaries Act (MPRSA)
- Toxic Substances Control Act (TSCA)

3.2 TERMS AND DEFINITIONS

A Quality Assurance Program is a company-wide system designed to ensure that data produced by the laboratory conforms to the standards set by state and/or federal regulations. The program functions at the management level through company goals and management policies, and at the analytical level through Standard Operating Procedures (SOPs) and quality control. The TestAmerica program is designed to minimize systematic error, encourage constructive, documented problem solving, and provide a framework for continuous improvement within the organization.

Refer to Appendix 2 for the Glossary/Acronyms.

3.3 SCOPE / FIELDS OF TESTING

The laboratory analyzes a broad range of environmental and industrial samples every month. Sample matrices vary among effluent water, surface water, groundwater, hazardous waste, sludge, soils, sediments, and tissue. The Quality Assurance Program contains specific procedures and methods to test samples of differing matrices for chemical, physical and biological parameters. The Program also contains guidelines on maintaining documentation of analytical processes, reviewing results, servicing clients and tracking samples through the laboratory. The technical and service requirements of all analytical requests are thoroughly evaluated before commitments are made to accept the work. Measurements are made using published reference methods or methods developed and validated by the laboratory.

The methods covered by this manual include the most frequently requested methodologies needed to provide analytical services in the United States and its territories. The specific list of test methods used by the laboratory can be found in the Statement of Qualifications (SOQ). The current list of accredited methods is maintained in Total Access. The approach of this manual is to define the minimum level of quality assurance and quality control necessary to meet these requirements. All methods performed by the laboratory shall meet these criteria as appropriate. In some instances, quality assurance project plans (QAPPs), project specific data quality objectives (DQOs) or local regulations may require criteria other than those contained in this manual. In these cases, the laboratory will abide by the requested criteria following review and acceptance of the requirements by the Laboratory Director and the Quality Assurance (QA) Manager. In some cases, QAPPs and DQOs may specify less stringent requirements. The Laboratory Director and the QA Manager must determine if it is in the lab's best interest to follow the less stringent requirements.

3.3.1 Specialty Analyses

3.3.1.1 Dredged Material Evaluations

TestAmerica Pittsburgh offers trace level testing of waters (site-waters and elutriates), sediments, and tissues in support of Dredged Material Evaluations for in-water (ocean and inland waters) and upland (Confined Disposal Facilities (CDFs), beneficial use, etc.) disposal options. In-house capabilities for commonly requested sediment program parameters include:

- Organochlorine Pesticides
- Organophosphorus Pesticides
- PCBs (as Aroclors and Congeners)
- Volatile Organics
- Semivolatile Organics
- Metals
- Cyanide
- Total Sulfides
- Acid Volatile Sulfide (AVS) and Simultaneously Extracted Metals (SEM)
- Nitrogen, Ammonia
- Nitrogen, Nitrate + Nitrite
- Biochemical Oxygen Demand (BOD)
- Chemical Oxygen Demand (COD)
- Total Organic Carbon (combustion procedure for sediments)

- Total Solids/Moisture Content
- Total Volatile Solids
- Lipids
  - With teaming arrangements with other TestAmerica facilities, additional sediment program capabilities include:
    - Polychlorinated Dibenzo-Dioxins and Furans (PCDDs/PCDFs)
    - Butyl Tins (mono – tetra)
    - Total Kjeldahl Nitrogen
    - Total Phosphorus
    - Grain Size
    - Specific Gravity
    - Atterberg Limits

TestAmerica Pittsburgh also generates elutriate samples following appropriate U.S. Army Corps of Engineers procedures. These include:

- Standard Elutriate Test (SET) for in-water disposal evaluations, and
- Modified Elutriate Test (MET) or Effluent Elutriate Test (EET) for CDF disposal evaluations.
- Illinois Resuspension Tests (Supernatant and Elutriate Tests).
- Dredge Elutriate Test (DRET)

TestAmerica Pittsburgh currently supports dredge material evaluation projects following several state specific programs, as well as, under the following guidance documents:

- Ocean Testing Manual or OTM (USACE, 1991).
- New Jersey's Tidal Waters Technical Manual (NJDEP, 1997).
- Inland Testing Manual or ITM (USACE, 1998).
- Upland Testing Manual or UTM (USACE, 2003).

3.3.1.2 Tissue Analyses

TestAmerica Pittsburgh has extensive experience in supporting projects requiring tissue analyses. These include analyses of laboratory cultured reference species from bioaccumulation tests associated with dredged material evaluations to a variety of field collected species (aquatic and terrestrial). TestAmerica Pittsburgh has developed modifications to the standard solid methodologies (where possible) to allow for the use of smaller sample weights and achieve lower quantitation limits. In-house capabilities for commonly requested tissue parameters include:

- Organochlorine Pesticides
- PCBs (as Aroclors and Congeners)
- Semivolatile Organics
- Metals
- Lipids
- Moisture Content

- With teaming arrangements with other TestAmerica facilities, additional tissue capabilities include:
  - Polychlorinated Dibenzo-Dioxins and Furans (PCDDs/PCDFs)
  - Butyl Tins (mono – tetra)

3.4 MANAGEMENT OF THE MANUAL

3.4.1 Review Process

The template on which this manual is based is reviewed annually by Corporate Quality Management Personnel to assure that it remains in compliance with Section 3.1. This manual itself is reviewed every two years by senior laboratory management to assure that it reflects current practices and meets the requirements of the laboratory's clients and regulators as well as the CQMP. Occasionally, the manual may need changes in order to meet new or changing regulations and operations. The QA Manager will review the changes in the normal course of business and incorporate changes into revised sections of the document. All updates will be reviewed by the senior laboratory management staff. The laboratory updates and approves such changes according to Pittsburgh laboratory SOP No. PT-QA-010, *Document Development and Control*.

SECTION 4

MANAGEMENT REQUIREMENTS

4.1 Overview

TestAmerica Pittsburgh is a local operating unit of TestAmerica Laboratories, Inc.. The organizational structure, responsibilities and authorities of the Corporate staff of TestAmerica Laboratories, Inc. are presented in the CQMP. The laboratory has day-to-day independent operational authority overseen by Corporate officers (e.g., President and Chief Executive Officer (CEO), Chief Operating Officer (COO), Executive Vice President (VP) Operations, Corporate Quality etc.). The laboratory operational and support staff work under the direction of the Laboratory Director. The organizational structure for both Corporate & TestAmerica Pittsburgh is presented in Figure 4-1.

4.2 Roles And Responsibilities

In order for the Quality Assurance Program to function properly, all members of the staff must clearly understand and meet their individual responsibilities as they relate to the quality program. The following descriptions briefly define each role in its relationship to the Quality Assurance Program.

4.2.1 Additional Requirements for Laboratories

The responsibility for quality resides with every employee of the laboratory. All employees have access to the QAM, are trained to this manual, and are responsible for upholding the standards therein. Each person carries out his/her daily tasks in a manner consistent with the goals and in accordance with the procedures in this manual and the laboratory's SOPs. Role descriptions for Corporate personnel are defined in the CQMP. This manual is specific to the operations of TestAmerica's Pittsburgh laboratory.

4.2.2 President and Chief Executive Officer (CEO)

The President and CEO is a member of the Board of Directors and is ultimately responsible for the quality and performance of all TestAmerica facilities. The President and CEO establishes the overall quality standard and data integrity program for the Analytical Business, providing the necessary leadership and resources to assure that the standard and integrity program are met.

~~4.2.3~~ Chief Operation Officer (COO)

The COO reports directly to the President and CEO of TestAmerica. The COO~~VPO~~ oversees the operations of all TestAmerica laboratories and the EMLab P&K business unit. The VP's of Operations report directly to COO

4.2.4 Vice President of Operations

Each VP of Operations reports directly to the Executive VP of Operations and is a part of the Executive Committee. Each VP of Operations is responsible for the overall administrative and operational management of their respective laboratories. The VP's responsibilities include allocation of personnel and resources, long-term planning, goal setting, and achieving the financial, business, and quality objectives of TestAmerica. The VP's ensure timely compliance with Corporate Management directives, policies, and management systems reviews. The VP's are also responsible for restricting any laboratory from performing analyses that cannot be consistently and successfully performed to meet the standards set forth in this manual.

4.2.5 Vice President of Quality and Environmental Health and Safety (VP-QA/EHS)

The Vice President (VP) of QA/EHS reports directly to the President and CEO. With the aid of the Executive Committee, Laboratory Directors, Quality Directors, Safety Manager, EH&S Coordinators and QA Managers, the VP-QA/EHS has the responsibility for the establishment, general overview and Corporate maintenance of the Quality Assurance and EH&S Programs within TestAmerica. Additional responsibilities include:

- Review of QA/QC and EHS aspects of Corporate SOPs & Policies, national projects and expansions or changes in services.
- Work with various organizations outside of TestAmerica to further the development of quality standards and represent TestAmerica at various trade meetings.
- Preparation of a monthly report that includes quality metrics across the analytical laboratories and a summary of any quality related initiatives and issues.
- Preparation of a monthly report that includes EH&S metrics across the analytical laboratories and a summary of any EH&S related initiatives and issues.
- Work with various organizations outside of TestAmerica to further the development of quality standards and represent TestAmerica at various trade meetings.
- With the assistance of the Corporate Senior Management Teams and the EHS Director~~s~~, development and implementation of the TestAmerica Environmental, Health and Safety Program

4.2.6 Vice President of Client Service

The VP of Client Services leads the Client Service Organization (CSO) and is responsible for client satisfaction, driving operational excellence and improving client responsiveness. The VP provides direction to the Client Service Directors, Programs Managers and Project Managers.

4.2.7 Quality Assessment Director

The Quality Assessment Director reports to the VP-QA/EHS. The Quality Assessment Director has QA oversight of laboratories; responsible for the internal audit system, schedule and procedure; monitors laboratory internal audit findings; identifies common laboratory weaknesses; and monitors corrective action closures. Together with the Quality Compliance Director, the Quality Systems Director, and the VP-QA/EHS, the Quality Assessment Director has the responsibility for the establishment, general overview and maintenance of the Analytical Quality Assurance Program within TestAmerica.

4.2.8 Quality Compliance Director

The Quality Compliance Director reports to the VP-QA/EHS. The Quality Compliance Director has QA oversight of laboratories; monitors and communicates DoD / DoE requirements; develops Corporate tools for ensuring and improving compliance; develops Corporate assessment tools; identifies common laboratory weaknesses; and monitors corrective action closures. Together with the Quality Assessment Director, Quality Systems Director and the VP-QA/EHS, the Quality Compliance Director has the responsibility for the establishment, general overview and maintenance of the Analytical Quality Assurance Program within TestAmerica.

4.2.9 Quality Systems Director

The Quality Systems Director reports to the VP-QA/EHS. The Quality Systems Director has QA oversight of laboratories; develops quality policies, procedures and management tools; monitors and communicates regulatory and certification requirements; identifies common laboratory weaknesses; and monitors corrective action closures. Together with the Quality Assessment Director, Quality Compliance Director and the VP-QA/EHS, the Quality Systems Director has the responsibility for the establishment, general overview and maintenance of the Analytical Quality Assurance Program within TestAmerica.

4.2.10 Quality Information Manager

The Quality Information Manager is responsible for managing all company official documents (e.g., Policies, Procedures, Work Instructions), the company's accreditation database, intranet websites, external laboratory subcontracting, regulatory limits for clients on the company's TotalAccess website; internal and external client support for various company groups (e.g., Client Services, EH&S, Legal, IT, Sales) for both quality and operational functions. The Quality Information Manager reports to the VP-QA/EHS; and works alongside the Quality Assessment, Quality Compliance and Quality System Directors and EHS Managers to support both the Analytical Quality Assurance and EHS Programs within TestAmerica.

4.2.11 Technical Services Director

The Technical Services Director is responsible for establishing, implementing and communicating TestAmerica's Analytical Business's Technical Policies, SOPs, and Manuals. Other responsibilities include conducting technical assessments as required, acting as a technical resource in national contracts review, coordinating new technologies, establishing best practices, advising staff on technology advances, innovations, and applications.

4.2.12 Ethics and Compliance Officers (ECOs)

TestAmerica has designated two senior members of the Corporate staff to fulfill the role of Ethics and Compliance Officer (ECO) – Corporate Counsel & VP of Human Resources and the VP-QA/EHS. Each ECO acts as a back-up to the other ECO and both are involved when data investigations occur. Each ECO has a direct line of communication to the entire senior Corporate and lab management staff.

The ECOs ensure that the organization distributes the data integrity and ethical practices policies to all employees and ensures annual trainings and orientation of new hires to the ethics program and its policies. The ECO is responsible for establishing a mechanism to foster employee reporting of incidents of illegal, unethical, or improper practices in a safe and confidential environment.

The ECOs monitor and audit procedures to determine compliance with policies and to make recommendations for policy enhancements to the President and CEO, VPOs, Laboratory Director or other appropriate individuals within the laboratory. The ECO will assist the laboratory QA Manager in the coordination of internal auditing of ethical policy related activities and processes within the laboratory, in conjunction with the laboratories regular internal auditing function.

The ECOs will also participate in investigations of alleged violations of policies and work with the appropriate internal departments to investigate misconduct, remedy the situation, and prevent recurrence of any such activity.

4.2.13 Chief Information Officer (CIO)

The CIO is responsible for establishing, implementing and communicating TestAmerica's Information Technology (IT) Policies, SOPs and Manuals. Other responsibilities include coordinating new technologies, development of electronic communication tools such as TestAmerica's intranet and internet sites, ensuring data security and documentation of software, ensuring compliance with the NELAC standard, and assistance in establishing, updating, and maintaining Laboratory Information Management Systems (LIMS) at the various TestAmerica facilities.

4.2.14 Environmental Health and Safety Managers (Corporate)

The EHS Managers report directly to the VP-QA/EHS. The EHS Managers are responsible for the development and implementation of the TestAmerica Environmental, Health and Safety program. Responsibilities include:

- Consolidation and tracking all safety and health-related information and reports for the company, and managing compliance activities for TestAmerica locations
- Coordination/preparation of the Corporate Environmental, Health and Safety Manual Template that is used by each laboratory to prepare its own laboratory-specific Safety Manual/ CHP
- Preparation of information and training materials for laboratory EHS Coordinators
- Assistance in the internal and external coordination of employee exposure and medical monitoring programs to insure compliance with applicable safety and health regulations

- Serving as Department of Transportation (D.O.T.) focal point and providing technical assistance to location management
- Serving as Hazardous Waste Management main contact and providing technical assistance to location management

4.2.15 Laboratory Director

Pittsburgh's Laboratory Director is responsible for the overall quality, safety, financial, technical, human resource and service performance of the whole laboratory and reports to their respective GM. The Laboratory Director provides the resources necessary to implement and maintain an effective and comprehensive Quality Assurance and Data Integrity Program. The Laboratory Director can also serve as the Technical Manager.

Specific responsibilities include, but are not limited to:

- Providing one or more technical managers for the appropriate fields of testing. If the Technical Manager is absent for a period of time exceeding 15 consecutive calendar days, the Laboratory Director must designate another full time staff member meeting the qualifications of the Technical Manager to temporarily perform this function. If the absence exceeds 35 consecutive calendar days, the primary accrediting authority must be notified in writing.
- Ensuring that all analysts and supervisors have the appropriate education and training to properly carry out the duties assigned to them and ensures that this training has been documented.
- Ensuring that personnel are free from any commercial, financial and other undue pressures which might adversely affect the quality of their work.
- Ensuring TestAmerica's human resource policies are adhered to and maintained.
- Ensuring that sufficient numbers of qualified personnel are employed to supervise and perform the work of the laboratory.
- Ensuring that appropriate corrective actions are taken to address analyses identified as requiring such actions by internal and external performance or procedural audits. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs may be temporarily suspended by the Laboratory Director.
- Reviewing and approving all SOPs prior to their implementation and ensures all approved SOPs are implemented and adhered to.
- Pursuing and maintaining appropriate laboratory certification and contract approvals. Supports ISO 17025 requirements.
- Ensuring client specific reporting and quality control requirements are met.
- Captaining the management team, consisting of the QA Manager, the Technical Managers and the Department Managers.
- Monitoring the validity of the analyses performed and data generated in the laboratory.
- Providing training and development programs to applicable laboratory staff as new hires and, on a scheduled basis. Training includes instruction on calculations, instrumentation management to include troubleshooting and preventive maintenance.
- The Technical Manager meets the requirements specified in the Section 5.2.6.1 of the TNI standards.

4.2.16 Quality Assurance (QA) Manager or Designee

The QA Manager has responsibility and authority to ensure the continuous implementation of the quality system. The QA Manager reports directly to the Laboratory Director and their Corporate Quality Director. This position is able to evaluate data objectively and perform assessments without outside (e.g., managerial) influence. Corporate QA may be used as a resource in dealing with regulatory requirements, certifications and other quality assurance related items. The QA Manager directs the activities of the QA Specialists to accomplish specific responsibilities, which include, but are not limited to:

- Serving as the focal point for QA/QC in the laboratory.
- Having functions independent from laboratory operations for which he/she has quality assurance oversight.
- Maintaining and updating the QAM.
- Monitoring and evaluating laboratory certifications; scheduling proficiency testing samples.
- Monitoring and communicating regulatory changes that may affect the laboratory to management.
- Training and advising the laboratory staff on quality assurance/quality control procedures that are pertinent to their daily activities.
- Having documented training and/or experience in QA/QC procedures and the laboratory's Quality System.
- Having a general knowledge of the analytical test methods for which data audit/review is performed (and/or having the means of getting this information when needed).
- Arranging for or conducting internal audits on quality systems and the technical operation.
- Maintaining records of all ethics-related training, including the type and proof of attendance.
- Maintaining, improving, and evaluating the corrective action database and the corrective and preventive action systems.
- Notifying laboratory management of deficiencies in the quality system and ensuring corrective action is taken. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs shall be investigated following procedures outlined in Section 12 and if deemed necessary may be temporarily suspended during the investigation.
- Objectively monitoring standards of performance in quality control and quality assurance without outside (e.g., managerial) influence.
- Having the responsibility and final authority to accept or reject data and to stop work in progress in the event that procedures and practices compromise the validity and integrity of analytical data.
- Coordinating of document control of SOPs, MDLs, control limits, and miscellaneous forms and information. Controlling distribution of controlled documents.
- Reviewing a percentage of all final data reports for internal consistency, including Chain of Custody (COC), correspondence with the analytical request, batch QC status, completeness of any corrective action statements, 5% of calculations, format, holding time, sensibility and completeness of the project file contents.
- Reviewing of external audit reports and data validation requests.

- Following-up with audits to ensure client QAPP requirements are met.
- Establishing reporting schedule and preparation of various quality reports for the Laboratory Director, clients and/or Corporate QA.
- Approving quality control reference data in TALS.
- Developing suggestions and recommendations to improve quality systems.
- Researching current state and federal requirements and guidelines.
- Captaining the QA team to enable communication and to distribute duties and responsibilities.
- Ensuring Communication & monitoring standards of performance to ensure that systems are in place to produce the level of quality as defined in this document.
- Evaluating the thoroughness and effectiveness of training.
- Ensuring Compliance with ISO 17025, and other national and state programs

4.2.17 Technical Director

The Technical Director serves as a technical resource for TestAmerica's personnel and clients in their field of expertise. The Technical Director reports directly to the Laboratory Director. Specific responsibilities include, but are not limited to:

- Managing technical projects and evaluating technologies, reviewing technical data
- Solving technical problems in the laboratory including troubleshooting instruments and developing or modifying methods as needed to meet customer requirements.
- Maintaining and repairing analytical instruments to reduce downtime.
- Consulting with clients, regulators, and others regarding technical aspects of analyses.
- Suggesting and implementing process improvements to maximize productivity, save costs, and decrease turn-around time.
- Participating in TestAmerica's best practice process to spread best technical practices and developing TestAmerica Standard Operating Procedures (SOPs). Leads the implementation and follow-up of the best practices and SOPs in the laboratory.
- Evaluating and adapting new technologies and methodologies. Performs non-routine analysis as required to meet the needs of current long-term clients or as a means to capture new clients in support of business development efforts.
- Training analysts and technicians in area of expertise.
- Assisting with the development of health and safety protocols.
- Consulting with Project Managers and sales staff regarding analytical techniques and capabilities.
- Investigating issues raised by clients, QA, sales, and other departments to find root cause and implement corrective action and proper response.
- Contributing technical information and evaluation for deciding major new equipment purchases and capital expenditures.
- Ensuring compliance with ISO 17025, and other national and state programs

4.2.18 Quality Assurance Specialist

The QA Specialist is responsible for QA documentation and involvement in the following activities:

- Assisting the QA Manager in performing the annual internal laboratory audits, compiling the evaluation, and coordinating the development of an action plan to address any deficiency identified.
- Facilitating external audits, coordinating with the QA Manager and Laboratory Staff to address any deficiencies noted at the time of the audit and subsequently presented in the final audit report.
- Assisting the QA Manager in the preparation of new SOPs and in the maintenance of existing SOPs, coordinating annual reviews and updates.
- Managing the performance testing (PT) studies, coordinates follow up studies for failed analytes and works with QA Manager and Laboratory Staff to complete needed corrective action reports.
- Assisting with review and maintenance of training records.
- Assisting the Quality Manager and Project Management Group in the review of program plans for consistency with organizational and contractual requirements. Summarize and convey to appropriate personnel anomalies or inconsistencies observed in the review process.
- Assisting with management of and applications for certifications and accreditations.
- Monitoring for compliance the following QA Metrics: temperature monitoring of refrigeration units and incubators; thermometer calibrations; balance calibrations; Eppendorf/pipette calibrations; and proper standard/reagent storage.
- Performing Technical Data Audits and the Audit Miner data file review process for organic instrumentation. Maintain tracking of reviews.
- Assisting with technical review of data packages which require QA review.

4.2.19 Technical Manager / Department Manager

The Technical Manager reports directly to the Laboratory Director. The scope of responsibility ranges from the new-hire training and existing technology through the ongoing training and development programs for existing analysts and new instrumentation and for compliance with the ISO 17025 Standard. Specific responsibilities include, but are not limited to:

- Exercising day-to-day supervision of laboratory operations for the appropriate field of accreditation and reporting of results. Coordinating, writing, and reviewing preparation of all test methods, i. e., SOPs, with regard to quality, integrity, regulatory and optimum and efficient production techniques, and subsequent analyst training and interpretation of the SOPs for implementation and unusual project samples. He/she insures that the SOPs are properly managed and adhered to at the bench. He/she develops standard costing of SOPs to include supplies, labor, overhead, and capacity (design vs. demonstrated versus first-run yield) utilization.
- Reviewing and approving, with input from the QA Manager, proposals from marketing, in accordance with an established procedure for the review of requests and contracts. This procedure addresses the adequate definition of methods to be used for analysis and any limitations, the laboratory's capability and resources, the client's expectations. Differences are resolved before the contract is signed and work begins. A system documenting any significant changes is maintained, as well as pertinent discussions with the client regarding their requirements or the results of the analyses during the performance of the contract. All

work subcontracted by the laboratory must be approved by the client. Any deviations from the contract must be disclosed to the client. Once the work has begun, any amendments to the contract must be discussed with the client and so documented.

- Monitoring the validity of the analyses performed and data generated in the laboratory. This activity begins with reviewing and supporting all new business contracts, insuring data quality, analyzing internal and external non-conformances to identify root cause issues and implementing the resulting corrective and preventive actions, facilitating the data review process (training, development, and accountability at the bench), and providing technical and troubleshooting expertise on routine and unusual or complex problems.
- Providing training and development programs to applicable laboratory staff as new hires and, subsequently, on a scheduled basis. Training includes instruction on calculations, instrumentation management to include troubleshooting and preventive maintenance.
- Enhancing efficiency and improving quality through technical advances and improved LIMS utilization. Capital forecasting and instrument life cycle planning for second generation methods and instruments as well as asset inventory management.
- Coordinating sample management from “cradle to grave,” insuring that no time is lost in locating samples.
- Scheduling all QA/QC-related requirements for compliance, e.g., MDLs, etc..
- Captaining department personnel to communicate quality, technical, personnel, and instrumental issues for a consistent team approach.
- Coordinating audit responses with the QA Manager.
- Ensuring compliance with ISO 17025, and other national and state programs

4.2.20 Manger of Project Management

The Manager of Project Management reports directly to the Client Services Director with dotted line reporting to the Laboratory Director. There is an entire staff of Project Managers that makes up the Project Management team. With the overall goal of total client satisfaction. In addition to the responsibilities of the Project Manager, listed in section 4.2.10, the MPM’s responsibilities include, but are not limited to:

- Training project managers in technical procedures and promoting the growth of the Project Management Team
- Acting as liaison between laboratory management and the Project Management Team
- Managing human resources for the Project Management Team

4.2.21 Project Manager

The PM reports to the Manager of Project Management and serves as the interface between the laboratory’s technical departments and the laboratory’s clients. The responsibilities of this position include, but are not limited to:

- Ensuring that clients receive the proper sampling supplies
- Responding to client inquiries concerning sample status
- Assisting clients with the resolution of problems concerning COC

- Ensuring that client specifications, when known, are met by communicating project and quality assurance requirements to the laboratory
- Notifying the supervisors of incoming projects and sample delivery schedules
- Maintaining communication with clients on sample progress from daily status meeting with agreed-upon due dates
- Discussing with client any project-related problems, resolving service issues, and coordinating technical details with the laboratory staff
- Familiarizing laboratory staff with specific quotes, sample log-in review, and final report completeness
- Informing QA Manager of special client requests that are outside of standard operating procedure
- Monitoring the status of all data package projects in-house to ensure timely and accurate delivery of reports
- Informing clients of data package-related problems and resolve service issues
- Coordinating requests for sample containers and other services

4.2.22 Project Manager Assistant (PMA)

The PMA reports to the Manager of Project Management and serves as the interface between the laboratory's technical departments and the laboratory's clients. The responsibilities of this position include, but are not limited to:

- Collating data reports, expanded deliverables and CLP data packages for delivery to clients and reviews for accuracy
- Assisting the CSMs and PMs in the reporting process
- Printing reports as needed for Project Managers
- Monitoring report due dates for timely delivery
- Providing clerical support to the CSMs, PMs and other laboratory staff as needed
- Generating credit or debit invoices to ensure proper payment in compliance with client requirements as established and communicated
- Sending final data to clients via email or courier

4.2.23 Team Leader/Supervisor

The Team Leader/Supervisor reports directly to the Organics or Inorganics Manager and/or Laboratory Director or designee. The responsibilities of this position include, but are not limited to:

- Ensuring that analysts in their department adhere to applicable SOPs and the QA Manual. He/she performs frequent SOP review to determine if analysts are in compliance and if new, modified, and optimized measures are feasible and should be added to these documents.
- Overseeing training, development of performance objectives and standards of performance, appraisal (measurement of objectives), scheduling, counseling, discipline, and motivation of analysts and documents these activities in accordance with systems developed by the QA and Personnel Departments.
- Providing guidance to analysts in resolving problems encountered daily during sample prep/analysis in conjunction with the Technical Manager(s) and/or QA Manager. Each is

responsible ensuring 100% implementation of the data review and documentation, non-conformance and corrective action issues, the timely and accurate completion of performance evaluation samples and MDLs, for his/her department.

- Ensuring that all logbooks are maintained, current, and properly labeled or archived.
- Ensuring that all data is properly entered into the LIMS system and is reviewed and approved as required by laboratory documentation policy.
- Reporting all non-conformance conditions to the QA Manager and Department Manager.
- Ensuring that preventive maintenance is performed on instrumentation as detailed in the QA Manual or SOPs. He/she is responsible for developing and implementing a system for preventive maintenance, troubleshooting, and repairing or arranging for repair of instruments.
- Maintaining adequate and valid inventory of reagents, standards, spare parts, and other relevant resources required to perform daily analysis.
- Achieving optimum turnaround time on analyses and compliance with holding times.
- Assisting QA department with root cause investigations and corrective action proposals for responses to external and internal audit issues, system failures and client complaints.

4.2.24 Laboratory Analyst

Laboratory analysts are responsible for conducting analysis and performing all tasks assigned to them by the team leader or supervisor. The responsibilities of the analysts include, but are not limited to:

- Performing analyses by adhering to analytical and quality control protocols prescribed by current SOPs, this QA Manual, and project-specific plans honestly, accurately, timely, safely, and in the most cost-effective manner.
- Ensuring sample and data integrity by adhering to internal chain-of-custody procedures.
- Documenting standard and sample preparation, instrument calibration and maintenance, data calculations, sample matrix effects, and any observed non-conformance on bench sheets, lab notebooks, run logs, and/or the Non-Conformance Database.
- Reporting all non-conformance situations, instrument problems, matrix problems and QC failures, which might affect the reliability of the data, to their supervisor, Department Manager, and/or the QA Manager or member of QA staff.
- Performing 100% review of the data generated prior to entering and submitting for secondary level review. Performs data processing using available tools/software.
- Suggesting method improvements to their supervisor, the Technical Manager (s), and the QA Manager. These improvements, if approved, will be incorporated. Ideas for the optimum performance of their assigned area, for example, through the proper cleaning and maintenance of the assigned instruments and equipment, are encouraged.
- Working cohesively as a team in their department to achieve the goals of accurate results, optimum turnaround time, cost effectiveness, cleanliness, complete documentation, and personal knowledge of environmental analysis.
    - A “work cell” is considered to be all those individuals who see a sample through the complete process of preparation, extraction, and analysis. To ensure that the entire preparation, extraction, and analysis process is completed by a group of capable individuals, the laboratory shall ensure that each member of the work cell (including a new member entering an already existing work cell) demonstrates capability in his/her area of responsibility in the sequence. Even though the work cell operates as a “team,”

the demonstration of capability at each individual step in the sequence, as performed by each individual analyst/team member, remains of utmost importance. A work cell may NOT be defined as a group of analysts who perform the same step in the same process (for example, extractions for Method 8270), represented by one analyst who has demonstrated capability for that step.

4.2.25 Sample Management Manager

The Sample Receiving/Login Manager reports to the Laboratory Director and Client Services Manager. The responsibilities of this position include, but are not limited to:

- Ensuring implementation of proper sample receipt procedures, including maintenance of chain-of-custody.
- Reporting nonconformances associated with condition-upon-receipt of samples.
- Ensuring accurate login of samples into the LIMS.
- Ensuring that all samples are stored in the proper environment.
- Assisting Environmental Health and Safety staff with sample disposal.

4.2.26 Field Service Technician

The Field Service Technicians report to the Sample Management Department Manager. The responsibilities of the Field Service Technician include, but are not limited to:

- Performing sample collection and sample pick-up
- Ensuring sample containers are prepared for sampling
- Performing field tests and measurements and operating and maintaining equipment used for those purposes.

4.2.27 Environmental Health and Safety Coordinator

The Health and Safety Coordinator reports to the Laboratory Director and ensures that systems are maintained for the safe operation of the laboratory. The EH&S Coordinator :

- Conduct ongoing, necessary safety training and conduct new employee safety orientation.
- Assist in developing and maintaining the Chemical Hygiene/Safety Manual.
- Administer dispersal of all Safety Data Sheet (SDS) information.
- Perform regular chemical hygiene and housekeeping instruction.
- Give instruction on proper labeling and practice.
- Serve as chairman of the laboratory safety committee.
- Provide and train personnel on protective equipment.
- Oversee the inspection and maintenance of general safety equipment – fire extinguishers, safety showers, eyewash fountains, etc. and ensure prompt repairs as needed.
- Supervise and schedule fire drills and emergency evacuation drills.
- Determine what initial and subsequent exposure monitoring, if necessary to determine potential employee exposure to chemicals used in the laboratory.
- When determined necessary, conduct exposure monitoring assessments.
- Determine when a complaint of possible over-exposure is “reasonable” and should be referred for medical consultation.
- Assist in the internal and external coordination of the medical consultation/monitoring program conducted by TestAmerica’s medical consultants.

4.2.28 Hazardous Waste Coordinator

The Hazardous Waste Coordinator reports directly to the Laboratory Director. The duties include, but are not limited to:

- Staying current with the hazardous waste regulations
- Continuing training on hazardous waste issues
- Reviewing and updating annually the Hazardous Waste Contingency Plan in the Environmental Health & Safety Manual
- Auditing the staff with regard to compliance with the Hazardous Waste Contingency Plan
- Contacting the hazardous waste subcontractors for review of procedures and opportunities for minimization of waste

4.3 DEPUTIES

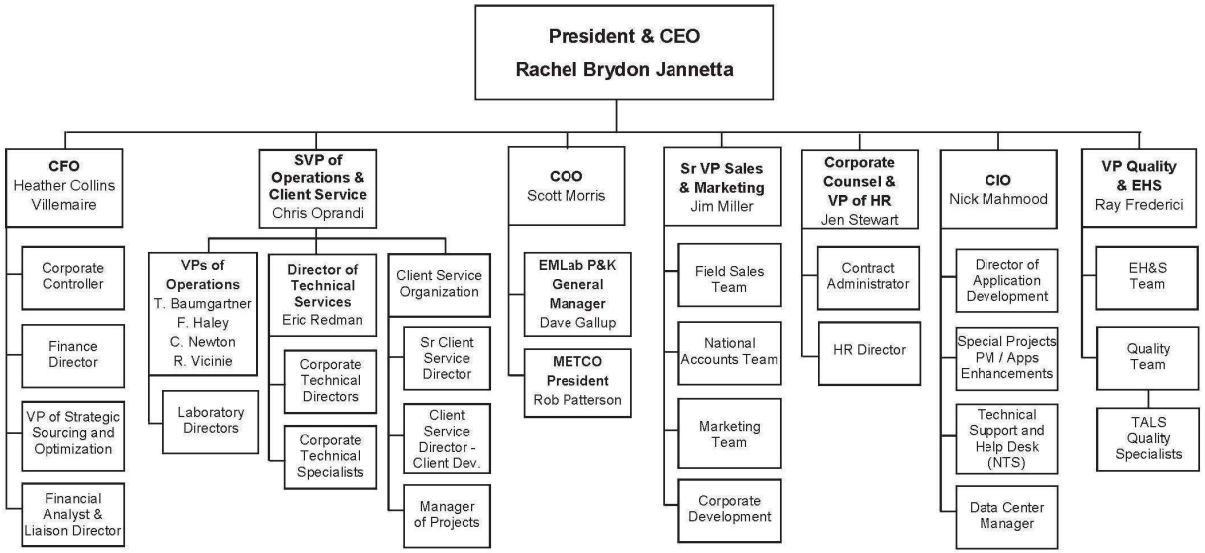
The following table defines who assumes the responsibilities of key personnel in their absence:

Key Personnel	Deputy	Comment
Laboratory Director: Deborah Lowe	Project Technical Manager – Dave Dunlap	NELAP Technical Manager (entire laboratory)
Quality Assurance Manager: Virginia Zusman	Quality Assurance Specialist: Pam Dudeck	
Technical Director: Larry Matko	Laboratory Director: Deborah Lowe	NELAP Technical Manager (Lipids & 8141)
Organics Department Manager: Sharon Bacha	Designated Senior GC and GCMS Analyst	NELAP Technical Manager (Organics)
Inorganics Department Manager: Roseann Ruyechan	Designated Metals and Wet Chemistry Supervisors / Senior Analyst	NELAP Technical Manager (Inorganics, Inorganics-Non-metals)
Organic Prep Team Leader: Sharon Bacha/Larry Matko	Designated Senior Organic Prep Analyst	
Sample Management Department Manager: Christina Kovitch	Lab Director or Designated person in the Sample Management group	

If the NELAP Technical Manager is absent for a period of time exceeding 15 consecutive calendar days, the Laboratory Director must designate another full time staff member meeting the qualifications of the Technical Manager to temporarily perform this function. If the absence exceeds 35 consecutive calendar days, the primary accrediting authority must be notified in writing.

Figure 4-1 - Corporate and Laboratory Organization Charts **Executive Committee**

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

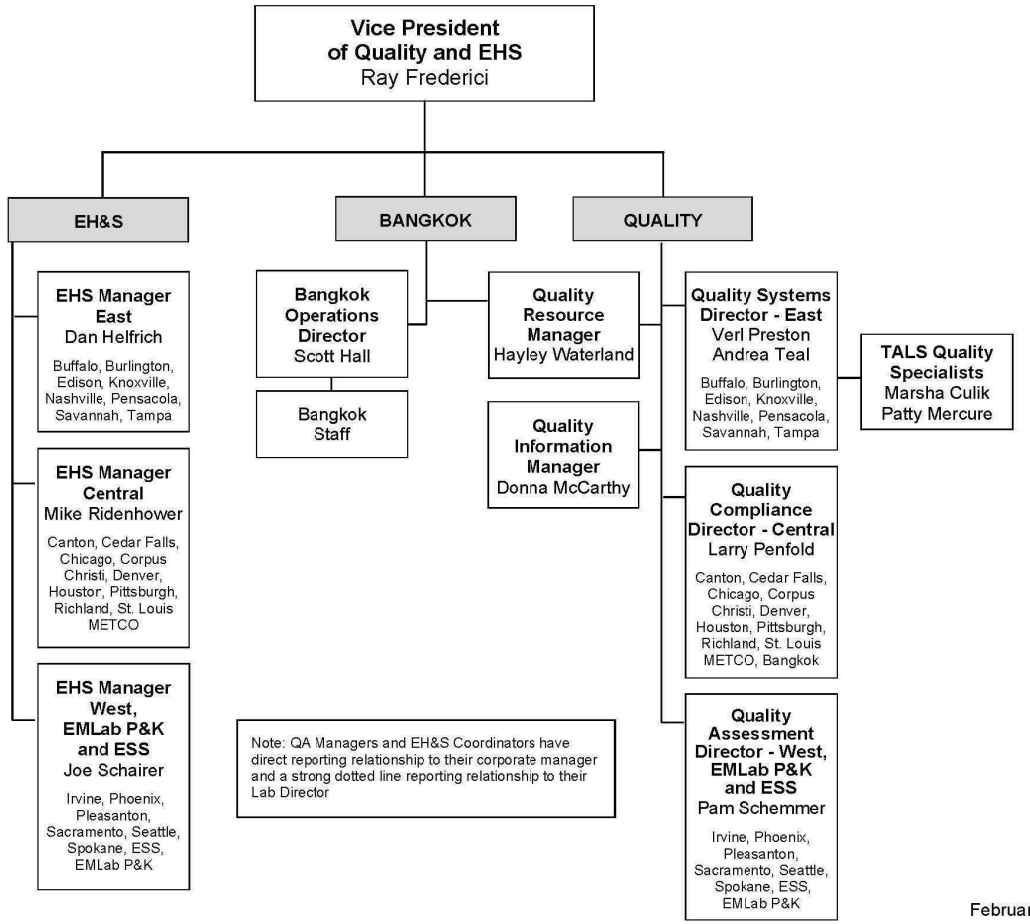


February 27 2017

Note: Organization Charts are subject to change, contact the laboratory for the most recent version

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

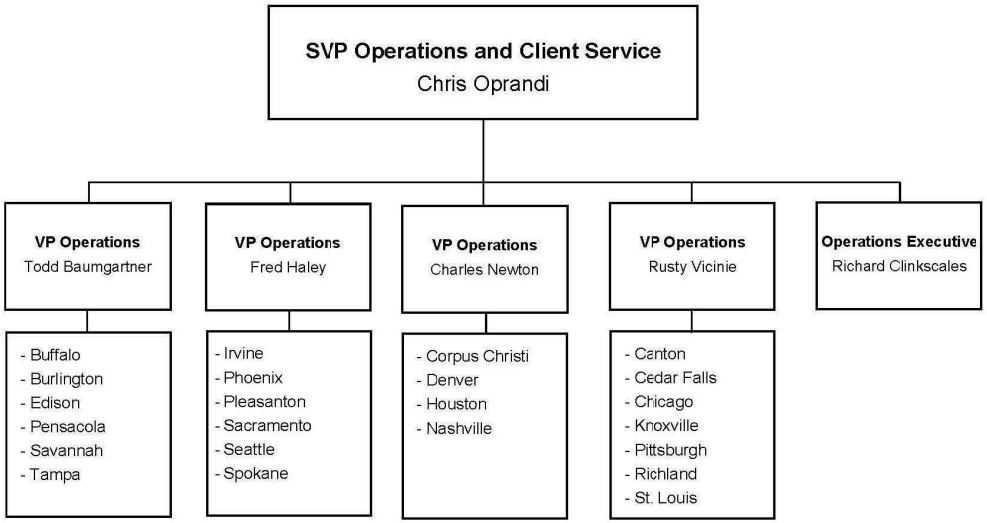
Quality, EHS, Bangkok



February 24 2017

Note: Organization Charts are subject to change, contact the laboratory for the most recent version

TestAmerica Laboratories Operations



February 24, 2017

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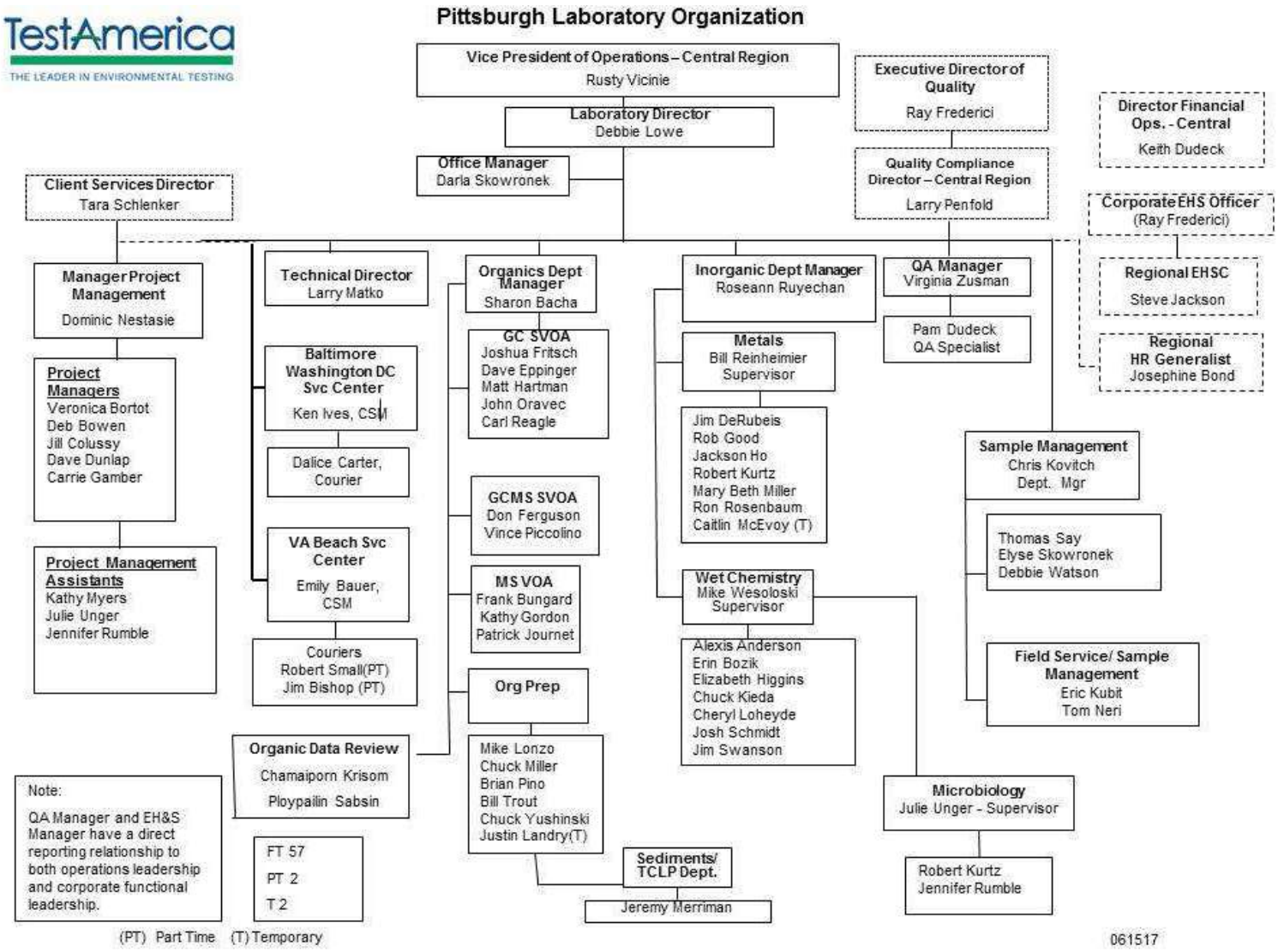


Note: Organization Charts are subject to change, contact the laboratory for the most recent version

SECTION 5

QUALITY SYSTEM

5.1 Quality Policy Statement

It is TestAmerica's Policy to:

- Provide data of known quality to its clients by adhering to approved methodologies, regulatory requirements and the QA/QC protocols.
- Effectively manage all aspects of the laboratory and business operations by the highest ethical standards.
- Continually improve systems and provide support to quality improvement efforts in laboratory, administrative and managerial activities. TestAmerica recognizes that the implementation of a quality assurance program requires management's commitment and support as well as the involvement of the entire staff.
- Provide clients with the highest level of professionalism and the best service practices in the industry.
- To comply with the ISO/IEC 17025:2005(E) International Standard, the 2009 TNI Standard and to continually improve the effectiveness of the management system.

Every staff member at the laboratory plays an integral part in quality assurance and is held responsible and accountable for the quality of their work. It is, therefore, required that all laboratory personnel are trained and agree to comply with applicable procedures and requirements established by this document.

5.2 Ethics And Data Integrity

TestAmerica is committed to ensuring the integrity of its data and meeting the quality needs of its clients. The elements of TestAmerica's Ethics and Data Integrity Program include:

- Ethics Policy (Corporate Policy No. CW-L-P-004) and Employee Ethics Statements
- Ethics and Compliance Officers (ECOs)
- A Training Program
- Self-governance through disciplinary action for violations
- A Confidential mechanism for anonymously reporting alleged misconduct and a means for conducting internal investigations of all alleged misconduct. (Corporate SOP No. CW-L-S-002)
- Procedures and guidance for recalling data if necessary (Corporate SOP No. CW-Q-S-005)
- Effective external and internal monitoring system that includes procedures for internal audits (Section 15, laboratory SOP No. PT-QA-002, Internal Auditing)
- Produce results, which are accurate and include QA/QC information that meets client pre-defined Data Quality Objectives (DQOs)
- Present services in a confidential, honest and forthright manner
- Provide employees with guidelines and an understanding of the Ethical and Quality Standards of our Industry
- Operate our facilities in a manner that protects the environment and the health and safety of employees and the public

- Obey all pertinent federal, state and local laws and regulations and encourage other members of our industry to do the same
- Educate clients as to the extent and kinds of services available
- Assert competency only for work for which adequate personnel and equipment are available and for which adequate preparation has been made
- Promote the status of environmental laboratories, their employees, and the value of services rendered by them

5.3 Quality System Documentation

The laboratory's Quality System is communicated through a variety of documents.

- Quality Assurance Manual – Each laboratory has a lab specific quality assurance manual.
- Corporate SOPs and Policies - Corporate SOPs and Policies are developed for use by all relevant laboratories. They are incorporated into the laboratory's normal SOP distribution, training and tracking system. Corporate SOPs may be general or technical.
- Work Instructions - A subset of procedural steps, tasks or forms associated with an operation of a management system (e.g., checklists, preformatted bench sheets, forms).
- Laboratory SOPs – General and Technical
- Laboratory QA/QC Policy Memorandums

5.3.1 Order of Precedence

In the event of a conflict or discrepancy between policies, the order of precedence is as follows:

- Corporate Quality Management Plan (CQMP)
- Corporate SOPs and Policies
- Laboratory QA/QC Policy Memorandum
- Laboratory Quality Assurance Manual (QAM)
- Laboratory SOPs and Policies
- Other (Work Instructions (WI), memos, flow charts, etc.)

Note: The laboratory has the responsibility and authority to operate in compliance with regulatory requirements of the jurisdiction in which the work is performed. Where the CQMP conflicts with those regulatory requirements, the regulatory requirements of the jurisdiction shall hold primacy. The laboratory's QAM shall take precedence over the CQMP in those cases.

5.4 QA/QC Objectives For The Measurement Of Data

Quality Assurance (QA) and Quality Control (QC) are activities undertaken to achieve the goal of producing data that accurately characterize the sites or materials that have been sampled. Quality Assurance is generally understood to be more comprehensive than Quality Control. Quality Assurance can be defined as the integrated system of activities that ensures that a product or service meets defined standards.

Quality Control is generally understood to be limited to the analyses of samples and to be synonymous with the term *"analytical quality control"*. QC refers to the routine application of statistically based procedures to evaluate and control the accuracy of results from analytical measurements. The QC program includes procedures for estimating and controlling precision and bias and for determining reporting limits.

Request for Proposals (RFPs) and Quality Assurance Project Plans (QAPP) provide a mechanism for the client and the laboratory to discuss the data quality objectives in order to ensure that analytical services closely correspond to client needs. The client is responsible for developing the QAPP. In order to ensure the ability of the laboratory to meet the Data Quality Objectives (DQOs) specified in the QAPP, clients are advised to allow time for the laboratory to review the QAPP before being finalized. Additionally, the laboratory will provide support to the client for developing the sections of the QAPP that concern laboratory activities.

Historically, laboratories have described their QC objectives in terms of precision, accuracy, representativeness, comparability, completeness, selectivity and sensitivity.

5.4.1 Precision

The laboratory objective for precision is to meet the performance for precision demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Precision is defined as the degree of reproducibility of measurements under a given set of analytical conditions (exclusive of field sampling variability). Precision is documented on the basis of replicate analysis, usually duplicate or matrix spike (MS) duplicate samples.

5.4.2 Accuracy

The laboratory objective for accuracy is to meet the performance for accuracy demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Accuracy is defined as the degree of bias in a measurement system. Accuracy may be documented through the use of laboratory control samples (LCS) and/or MS. A statement of accuracy is expressed as an interval of acceptance recovery about the mean recovery.

5.4.3 Representativeness

The laboratory objective for representativeness is to provide data which is representative of the sampled medium. Representativeness is defined as the degree to which data represent a characteristic of a population or set of samples and is a measurement of both analytical and field sampling precision. The representativeness of the analytical data is a function of the procedures used in procuring and processing the samples. The representativeness can be documented by the relative percent difference between separately procured, but otherwise identical samples or sample aliquots.

The representativeness of the data from the sampling sites depends on both the sampling procedures and the analytical procedures. The laboratory may provide guidance to the client regarding proper sampling and handling methods in order to assure the integrity of the samples.

5.4.4 Comparability

The comparability objective is to provide analytical data for which the accuracy, precision, representativeness and reporting limit statistics are similar to these quality indicators generated by other laboratories for similar samples, and data generated by the laboratory over time.

The comparability objective is documented by inter-laboratory studies carried out by regulatory agencies or carried out for specific projects or contracts, by comparison of periodically generated statements of accuracy, precision and reporting limits with those of other laboratories.

5.4.5 Completeness

The completeness objective for data is 90% (or as specified by a particular project), expressed as the ratio of the valid data to the total data over the course of the project. Data will be considered valid if they are adequate for their intended use. Data usability will be defined in a QAPP, project scope or regulatory requirement. Data validation is the process for reviewing data to determine its usability and completeness. If the completeness objective is not met, actions will be taken internally and with the data user to improve performance. This may take the form of an audit to evaluate the methodology and procedures as possible sources for the difficulty or may result in a recommendation to use a different method.

5.4.6 Selectivity

Selectivity is defined as: The capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. Target analytes are separated from non-target constituents and subsequently identified/detected through one or more of the following, depending on the analytical method: extractions (separation), digestions (separation), interelement corrections (separation), use of matrix modifiers (separation), specific retention times (separation and identification), confirmations with different columns or detectors (separation and identification), specific wavelengths (identification), specific mass spectra (identification), specific electrodes (separation and identification), etc..

5.4.7 Sensitivity

Sensitivity refers to the amount of analyte necessary to produce a detector response that can be reliably detected (Method Detection Limit) or quantified (Reporting Limit).

5.5 Criteria For Quality Indicators

The laboratory maintains a Quality Control Limit Summary (from LIMS) that contains tables that summarizes the precision and accuracy acceptability limits for analyses performed at TestAmerica Pittsburgh. This summary includes an effective date, is updated each time new limits are generated and is managed by the laboratory's QA department. Limits are archived within the LIMS when replaced. Unless otherwise noted, limits within these tables are laboratory generated. Some acceptability limits are derived from US EPA methods when they are required. Where US EPA method limits are not required, the laboratory has developed limits from evaluation of data from similar matrices. Criteria for development of control limits is contained in Section 24 and laboratory SOP No. PT-QA-021, *Laboratory Quality Control Program*.

5.6 Statistical Quality Control

Statistically-derived precision and accuracy limits are required by selected methods (such as SW-846) and programs. The laboratory routinely utilizes statistically-derived limits to evaluate method performance and determine when corrective action is appropriate. Analysts are restricted to using only the current limits within LIMS, controlled as discussed above. The

Quality Assurance department maintains an archive of all limits used within the laboratory. These limits are maintained in the LIMS as part of the analytical historical record. If a method defines the QC limits, the method limits are used. For further details refer to SOP No. PT-QA-021.

If a method, or program, defines the QC limits, the required limits are used, unless laboratory developed limits are tighter.

If a method requires the generation of historical limits, the lab develops such limits from recent data in the QC database of the LIMS following the guidelines described in Section 24 and laboratory SOP No. PT-QA-021. All calculations and limits are documented and dated when approved and effective. On occasion, a client may request contract-specified limits for a specific project.

Current QC limits are entered and maintained in the LIMS analyte database. As sample results and the related QC are entered into LIMS, the sample QC values are compared with the limits in LIMS to determine if they are within the acceptable range. The analyst then evaluates if the sample needs to be rerun or re-extracted/rerun or if a comment should be added to the report explaining the reason for the QC outlier.

5.6.1 QC Charts

The generation and use of QC Charts (Control Charts) are described in laboratory SOP No. PT-QA-021. The QA department evaluates control charts to determine if adjustments need to be made or for corrective actions to methods. All findings are documented and kept on file.

5.7 Quality System Metrics

In addition to the QC parameters discussed above, the entire Quality System is evaluated on a monthly basis through the use of specific metrics (refer to Section 16). These metrics are used to drive continuous improvement in the laboratory's Quality System.

5.8 Laboratory Certification/Accreditation

The Laboratory Quality System is designed to meet the requirements of all governing bodies through which it holds certification / accreditation.

- A list of certifications and accredited scopes is maintained by the QA Department, and current certificates are posted in the laboratory lobby. Expired certificates are maintained in the QA archive.
- Certification renewal is completed on an annual basis for most state agencies.
- The laboratory indicates clearly in its reports which certifications it holds. This list includes which test methods and analytes are not covered under the applicable certification.
- If certification is lost or suspended, the laboratory shall update the reporting information to reflect this.

SECTION 6

DOCUMENT CONTROL

6.1 Overview

The QA Department is responsible for the control of documents used in the laboratory to ensure that approved, up-to-date documents are in circulation and out-of-date (obsolete) documents are archived or destroyed. The following documents, at a minimum, must be controlled:

- Laboratory Quality Assurance Manual
- Laboratory Standard Operating Procedures (SOP)
- Laboratory Policies
- Work Instructions and Forms
- Logbooks and Calculation Spreadsheets
- Corporate Policies and Procedures distributed outside the intranet
- External documents that are used as part of the laboratory's Quality System

Corporate Quality posts Corporate Manuals, SOPs, Policies, Work Instructions, White Papers and Training Materials on the company intranet site. These Corporate documents are only considered controlled when they are read on the intranet site. Printed copies are considered uncontrolled unless the laboratory physically distributes them as controlled documents. A detailed description of the procedure for issuing, authorizing, controlling, distributing, and archiving Corporate documents is found in Corporate SOP No. CW-Q-S-001, *Corporate Document Control and Archiving*. The laboratory's internal document control procedure is defined in laboratory SOP No. PT-QA-010, *Document Development and Control*.

The laboratory QA Department also maintains access to various references and document sources integral to the operation of the laboratory. This includes reference methods and regulations. Instrument manuals (hard or electronic copies) are also maintained by the laboratory.

The laboratory maintains control of records for raw analytical data and supporting records such as audit reports and responses, logbooks, standard logs, training files, MDL studies, Proficiency Testing (PT) studies, certifications and related correspondence, and corrective action reports and Nonconformance Memos (NCMs). Raw analytical data consists of bound logbooks, instrument printouts, any other notes, magnetic media, electronic data and final reports.

6.2 Document Approval And Issue

The pertinent elements of a document control system for each document include a unique document title and number, pagination, the total number of pages of the item or and 'end of document' page, the effective date, revision number and the laboratory's name. The QA personnel are responsible for the maintenance of this system.

Controlled documents are authorized by the QA Department. In order to develop a new document, a technical or department manager submits an electronic or paper draft to the QA Department for suggestions and approval before use. Upon approval, QA personnel add the identifying version information to the document and retain that document as the official document on file. That document is then provided to all applicable operational units (may

include electronic access). Controlled documents are identified as such and records of their distribution are kept by the QA Department. Document control may be achieved by either electronic or hardcopy distribution.

The QA Department maintains a list of the official versions of controlled documents.

Quality System Policies and Procedures will be reviewed at a minimum of every two years, or more often as required, and revised as appropriate. Changes to documents occur when a procedural change warrants.

6.3 Procedures For Document Control Policy

For creation of or changes to SOPs and QA manual, refer to Corporate SOP No. CW-Q-S-002, *Writing a Standard Operating Procedure (SOP)* and laboratory SOP No. PT-QA-010. The laboratory SOP also defines the process of revising SOPs.

Uncontrolled copies must not be used within the laboratory. Controlled documents are marked as such, and posted to the intranet (OASIS) SharePoint site by the QA department. Controlled distribution is achieved electronically. Previous revisions and back-up data are stored on a restricted access drive by the QA department. Details of the numbering system, required format, and controlled distribution of documents are described in laboratory SOP No. PT-QA-010. Editable copies are stored on a restricted access drive.

Forms, worksheets, work instructions and information are organized by department by the QA office. Controlled electronic versions are distributed through the intranet and hard copies can be printed out as needed. Editable versions are stored on a restricted access drive. All forms used in the laboratory are tracked in the controlled documents database which can be accessed by the QA department and the IT group. The procedure for the care of these documents is in laboratory SOP No. PT-QA-010.

6.4 Obsolete Documents

All invalid or obsolete documents are removed from general laboratory access, or otherwise prevented from unintended use. The laboratory has specific procedures as described above to accomplish this. In general, obsolete documents are collected from employees according to distribution lists and are marked obsolete on the cover or destroyed. At least one copy of the obsolete document is archived according to laboratory SOP No. PT-QA-019, *Records Information Management*.

SECTION 7

SERVICE TO THE CLIENT

7.1 Overview

The laboratory has established procedures for the review of work requests and contracts, oral or written. The procedures include evaluation of the laboratory's capability and resources to meet the contract's requirements within the requested time period. All requirements, including the methods to be used, must be adequately defined, documented and understood. For many environmental sampling and analysis programs, testing design is site or program specific and does not necessarily "fit" into a standard laboratory service or product. It is the laboratory's intent to provide both standard and customized environmental laboratory services to our clients.

A thorough review of technical and QC requirements contained in contracts is performed to ensure project success. The appropriateness of requested methods, and the lab's capability to perform them must be established. Projects, proposals and contracts are reviewed for adequately defined requirements and the laboratory's capability to meet those requirements. Alternate test methods that are capable of meeting the clients' requirements may be proposed by the lab. A review of the lab's capability to analyze non-routine analytes is also part of this review process.

All projects, proposals and contracts are reviewed for the client's requirements in terms of compound lists, test methodology requested, sensitivity (detection and reporting levels), accuracy, and precision requirements (%Recovery and RPD). The reviewer ensures that the laboratory's test methods are suitable to achieve these requirements and that the laboratory holds the appropriate certifications and approvals to perform the work. The laboratory and any potential subcontract laboratories must be certified, as required, for all proposed tests.

The laboratory must determine if it has the necessary physical, personnel and information resources to meet the contract, and if the personnel have the expertise needed to perform the testing requested. Each proposal is checked for its impact on the capacity of the laboratory's equipment and personnel. As part of the review, the proposed turnaround time will be checked for feasibility.

Electronic or hard copy deliverable requirements are evaluated against the laboratory's capacity for production of the documentation.

If the laboratory cannot provide all services but intends to subcontract such services, whether to another TestAmerica facility or to an outside firm, this will be documented and discussed with the client prior to contract approval. (Refer to Section 8 for Subcontracting Procedures.)

The laboratory informs the client of the results of the review if it indicates any potential conflict, deficiency, lack of accreditation, or inability of the lab to complete the work satisfactorily. Any discrepancy between the client's requirements and the laboratory's capability to meet those requirements is resolved in writing before acceptance of the contract. It is necessary that the contract be acceptable to both the laboratory and the client. Amendments initiated by the client and/or TestAmerica, are documented in writing.

All contracts, QAPPs, Sampling and Analysis Plans (SAPs), contract amendments, and documented communications become part of the project record.

The same contract review process used for the initial review is repeated when there are amendments to the original contract by the client, and the participating personnel are informed of the changes.

7.2 Review Sequence And Key Personnel

Appropriate personnel will review the work request at each stage of evaluation.

For routine projects and other simple tasks, a review by the Project Manager (PM) is considered adequate. The PM confirms that the laboratory has any required certifications, that it can meet the clients' data quality and reporting requirements and that the lab has the capacity to meet the clients turn around needs. It is recommended that, where there is a sales person assigned to the account, an attempt should be made to contact that sales person to inform them of the incoming samples.

For new, complex or large projects, the proposed contract is given to the Client Relationship Manager or Proposal Team, who will decide which lab will receive the work based on the scope of work and other requirements, including certification, testing methodology, and available capacity to perform the work. The contract review process is outlined in TestAmerica's Corporate Policy No. CA-L-P-002, *Contract Compliance Policy*.

This review encompasses all facets of the operation. The scope of work is distributed to the appropriate personnel, as needed based on scope of contract, to evaluate all of the requirements shown above (not necessarily in the order below):

- Contract Administrator
- VP of Operations
- The Laboratory Project Management
- The Laboratory Director / Technical Manager
- Laboratory and/or Corporate Quality
- Laboratory and/or Corporate EH&S
- The laboratory Project Manager reviews the formal laboratory quote. The Laboratory Director makes final acceptance for their facility.

The Sales Director, Contract Administrator, Account Executive or Proposal Coordinator then submits the final proposal to the client.

In the event that one of the above personnel is not available to review the contract, his or her back-up will fulfill the review requirements.

The Contracts Director maintains copies of all signed contracts. In the Pittsburgh laboratory, copies of contracts are maintained in the laboratory network public drive by the sales/marketing personnel.

7.3 Documentation

Appropriate records are maintained for every contract or work request. All stages of the contract review process are documented and include records of any significant changes. Contracts review documentation is forwarded to the Human Resources Coordinator and is maintained in the network public drive.

The contract will be distributed to and maintained by the appropriate sales/marketing personnel and the Account Manager. A copy of the contract and formal quote will be filed with the laboratory PM and the Lab Director.

Records are maintained of pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract. The PM keeps a phone log or electronic mail of conversations with the client.

7.3.1 Project-Specific Quality Planning

Communication of contract specific technical and QC criteria is an essential activity in ensuring the success of site specific testing programs. To achieve this goal, the laboratory assigns a PM to each client. It is the PM's responsibility to ensure that project-specific technical and QC requirements are effectively evaluated and communicated to the laboratory personnel before and during the project. QA department involvement may be needed to assist in the evaluation of custom QC requirements.

PM's are the primary client contact and they ensure resources are available to meet project requirements. Although PM's do not have direct reports or staff in production, they coordinate opportunities and work with laboratory management and supervisory staff to ensure available resources are sufficient to perform work for the client's project. Project management is positioned between the client and laboratory resources.

Prior to work on a new project, the dissemination of project information and/or project opening meetings may occur to discuss schedules and unique aspects of the project. Items to be discussed may include the project technical profile, turnaround times, holding times, methods, analyte lists, reporting limits, deliverables, sample hazards, or other special requirements. The PM introduces new projects to the laboratory staff through project kick-off meetings or to the supervisory staff during production meetings. These meetings provide direction to the laboratory staff in order to maximize production and client satisfaction, while maintaining quality. In addition, project notes may be associated with each sample batch as a reminder upon sample receipt and analytical processing.

During the project, any change that may occur within an active project is agreed upon between the client/regulatory agency and the PM/laboratory. These changes (e.g., use of a non-standard method or modification of a method) and approvals must be documented prior to implementation. Documentation pertains to any document, e.g., letter, e-mail, variance, contract addendum, which has been signed by both parties.

Such changes are also communicated to the laboratory during production and operations meetings. Such changes are updated to the project notes and are introduced to the managers at these meetings. The laboratory staff is then introduced to the modified requirements via the PM or the individual laboratory Technical Manager. After the modification is implemented into the

laboratory process, documentation of the modification is made in the case narrative of the data report(s).

The laboratory strongly encourages client visits to the laboratory and for formal/informal information sharing session with employees in order to effectively communicate ongoing client needs as well as project specific details for customized testing programs.

7.4 Special Services

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. It is the laboratory's goal to meet all client requirements in addition to statutory and regulatory requirements. The laboratory has procedures to ensure confidentiality to clients (Section 25).

The laboratory's standard procedures for reporting data are described in Section 25. Special services are also available and provided upon request. These services include:

- Reasonable access for our clients or their representatives to the relevant areas of the laboratory for the witnessing of tests performed for the client
- Assist client-specified third party data validators as specified in the client's contract
- Supplemental information pertaining to the analysis of their samples

  Note: An additional charge may apply for additional data/information that was not requested prior to the time of sample analysis or previously agreed upon.

7.5 Client Communication

Project managers are the primary communication link to the clients. They shall inform their clients of any delays in project completion as well as any non-conformances in either sample receipt or sample analysis. Project management will maintain ongoing client communication throughout the entire client project.

Technical or Department Managers, or their designees, are available to discuss any technical questions or concerns that the client may have.

7.6 Reporting

The laboratory works with our clients to produce any special communication reports required by the contract.

7.7 Client Surveys

The laboratory assesses both positive and negative client feedback. The results are used to improve overall laboratory quality, client service and testing activities. TestAmerica's Sales and Marketing teams periodically develops lab and client specific surveys to assess client satisfaction. Survey results and both complaints and compliments are tracked in the monthly quality metrics report.

SECTION 8

SUBCONTRACTING OF TESTS

8.1 Overview

For the purpose of this quality manual, the phrase subcontract laboratory refers to a laboratory external to the TestAmerica laboratories. The phrase "work sharing" refers to internal transfers of samples between the TestAmerica laboratories. The term outsourcing refers to the act of subcontracting tests.

When contracting with our clients, the laboratory makes commitments regarding the services to be performed and the data quality for the results to be generated. When the need arises to outsource testing for our clients because project scope, changes in laboratory capabilities, capacity or unforeseen circumstances, we must be assured that the subcontractors or work sharing laboratories understand the requirements and will meet the same commitments we have made to the client. Refer to Corporate SOP No. CA-L-S-004, *Subcontracting*, and CA-C-S-001, *Worksharing Process*.

When outsourcing analytical services, the laboratory will assure, to the extent necessary, that the subcontract or work sharing laboratory maintains a program consistent with the requirements of this document, the requirements specified in TNI/ISO 17025 and/or the client's Quality Assurance Project Plan (QAPP). All QC guidelines specific to the client's analytical program are transmitted to the subcontractor and agreed upon before sending the samples to the subcontract facility. Additionally, work requiring accreditation will be placed with an appropriately accredited laboratory. The laboratory performing the subcontracted work will be identified in the final report, as will non-TNI accredited work where required.

Project Managers (PMs) and Account Executives (AE) for the Export Lab (TestAmerica laboratory that transfers samples to another laboratory) are responsible for obtaining client approval prior to subcontracting any samples. The laboratory will advise the client of a subcontract arrangement in writing and when possible approval from the client shall be retained in the project folder. Standard TestAmerica Terms & Conditions include the flexibility to subcontract samples within the TestAmerica laboratories. Therefore, additional advance notification to clients for intra-laboratory subcontracting is not necessary unless specifically required by a client contract.

Note: In addition to the client, some regulating agencies, (e.g, USDA) or contracts may require notification prior to placing such work. Client notification and approval must be documented.

8.2 Qualifying And Monitoring Subcontractors

Whenever a PM, Account Executive (AE) or Customer Service Manager (CSM) becomes aware of a client requirement or laboratory need where samples must be outsourced to another laboratory, the other laboratory(s) shall be selected based on the following:

- Subcontractors specified by the client – In these circumstances, the client assumes responsibility for the quality of the data generated from the use of a subcontractor.
- Subcontractors reviewed by TestAmerica – Firms which have been reviewed by the company and are known to meet standards for accreditations (e.g. State, TNI); technical specifications; legal and financial information.

A list of vendors is available on the TestAmerica intranet site.

All TestAmerica laboratories are pre-qualified for work sharing provided they hold the appropriate accreditations, can adhere to the project/program requirements. Client approval is not necessary unless specifically required by the contract. The originating laboratory is responsible for communicating all technical, quality, and deliverable requirements as well as other contract needs. (See Corporate SOP No. CA-C-S-001 for details).

8.2.1 When the potential sub-contract laboratory has not been previously approved, Account Executives or PMs may nominate a laboratory as a subcontractor based on need. The decision to nominate a laboratory must be approved by the Laboratory Director. The Laboratory Director requests that the Project Manager or Account Executive begin the process of approving the subcontract laboratory as outlined in Corporate SOP No. CA-L-S-004, Subcontracting. The client must provide acknowledgement that the samples can be sent to that facility (an e-mail is sufficient documentation or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented).

Once the appropriate accreditation and legal information is received by the laboratory, it is evaluated for acceptability (where applicable) and forwarded to the Corporate Quality Information Manager (QIM) for review. After the Corporate QIM reviews the documents for completeness, the information is forwarded to the Finance Department for formal signature and contracting with the laboratory. The approved vendor will be added to the approved subcontractor list on the intranet site and the finance group is concurrently notified for JD Edwards.

The client will assume responsibility for the quality of the data generated from the use of a subcontractor they have requested the lab to use. The qualified subcontractors on the intranet site are known to meet minimal standards. TestAmerica does not certify laboratories. The subcontractor is on our approved list and can only be recommended to the extent that we would use them.

8.3 Oversight and Reporting

8.3.1 The status and performance of qualified subcontractors will be monitored periodically by the Corporate Quality department. Any problems identified will be brought to the attention of TestAmerica's Corporate Finance, Legal or Corporate Quality personnel.

- Complaints shall be investigated. Documentation of the complaint, investigation and corrective action will be maintained in the subcontractor's file on the intranet site. Complaints are posted using the Vendor Performance Report.
- Information shall be updated on the intranet when new information is received from the subcontracted laboratories.

Subcontractors in good standing will be retained on the intranet listing. CSO personnel will notify all TestAmerica laboratories, Corporate Quality and Corporate Contracts if any laboratory requires removal from the intranet site. This notification will be posted on the intranet site and e-mailed to all CSO personnel, Laboratory Directors, QA Managers, and Sales Personnel.

Prior to initially sending samples to the subcontracted laboratory, the PM confirms their certification status to determine if it's current and scope-inclusive. The information is documented within the project records.

8.3.2 For continued use of a subcontractor, verification of certification is placed upon the subcontractor for the defined project. Samples are subcontracted under Chain of Custody with the program defined as 'Accreditation Required' and the following statement for verification upon sample receipt:

Note: Since laboratory accreditations are subject to change, TestAmerica Laboratories, Inc. places the ownership of method, analyte & accreditation compliance upon our subcontract laboratories. This sample shipment is forwarded under Chain of Custody. If the laboratory does not currently maintain accreditation in the State of Origin listed above for analytes/tests/matrix being analyzed, the samples must be shipped back to the TestAmerica laboratory or other instructions will be provided. Any changes to accreditation status should be brought to TestAmerica Laboratories, Inc. attention immediately. If all requested accreditations are current to date, return the signed Chain of Custody attesting to said compliance to TestAmerica Laboratories, Inc.

For TestAmerica laboratories, certifications can be viewed on the company's TotalAccess Database.

8.3.3 All subcontracted samples must be accompanied by a TestAmerica Chain of Custody (COC). A copy of the original COC sent by the client must be available in TALS for all samples workshared within TestAmerica. Client COCs are only forwarded to external subcontractors when samples are shipped directly from the project site to the subcontractor lab. Under routine circumstances, client COCs are not provided to external subcontractors.

Through communication with the subcontracted laboratory, the PM monitors the status of the subcontracted analyses, facilitates successful execution of the work, and ensures the timeliness and completeness of the analytical report.

Non-TNI accredited work must be identified in the subcontractor's report as appropriate. If TNI accreditation is not required, the report does not need to include this information.

Reports submitted from subcontractor laboratories are not altered and are included in their original form in the final project report. This clearly identifies the data as being produced by a subcontractor facility. If subcontract laboratory data is incorporated into the laboratories EDD (i.e., imported), the report must explicitly indicate which lab produced the data for which methods and samples.

Note: The results submitted by a TestAmerica work sharing laboratory may be transferred electronically and the results reported by the TestAmerica work sharing lab are identified on the final report. The report must explicitly indicate which lab produced the data for which methods and samples. The final report must include a copy of the completed COC for all work sharing reports.

8.4 Contingency Planning

The full qualification of a subcontractor may be waived ~~process temporarily~~ to meet emergency needs; however, this decision & justification must be documented in the project files, and the 'Purchase Order Terms And Conditions For Subcontracted Laboratory Services' must be sent with the samples and COC.

In the event this provision is utilized, the laboratory (e.g., PM) will be required to verify and document the applicable accreditations of the subcontractor. All other quality and accreditation requirements will still be applicable, but the subcontractor need not have signed a subcontract with TestAmerica at this time.

The use of any emergency subcontractor will require the PM to complete a JDE New Vendor Add Form in order to process payment to the vendor and add them to TALS. This form requires the user to define the subcontractor's category/s of testing and the reason for testing.

SECTION 9

PURCHASING SERVICES AND SUPPLIES

9.1 Overview

Evaluation and selection of suppliers and vendors is performed, in part, on the basis of the quality of their products, their ability to meet the demand for their products on a continuous and short term basis, the overall quality of their services, their past history, and competitive pricing. This is achieved through evaluation of objective evidence of quality furnished by the supplier, which can include certificates of analysis, recommendations, and proof of historical compliance with similar programs for other clients. To ensure that quality critical consumables and equipment conform to specified requirements, which may affect quality, all purchases from specific vendors are approved by a member of the supervisory or management staff. Capital expenditures are made in accordance with Corporate SOP No. CW-F-S-007, *Fixed Asset Acquisitions, Retention and Safeguarding*.

Contracts will be signed in accordance with TestAmerica's Corporate Policy No. CW-F-P-002, *Company-Wide Authorization Matrix*. Request for Proposals (RFP's) will be issued where more information is required from the potential vendors than just price. Process details are available in TestAmerica's Corporate Policy No. CW-F-P-004, *Procurement and Contracts Policy*. RFP's allow TestAmerica to determine if a vendor is capable of meeting requirements such as supplying all of the TestAmerica facilities, meeting required quality standards and adhering to necessary ethical and environmental standards. The RFP process also allows potential vendors to outline any additional capabilities they may offer.

9.2 Glassware

Glassware used for volumetric measurements must be Class A or verified for accuracy according to laboratory procedure. Pyrex (or equivalent) glass should be used where possible. For safety purposes, thick-wall glassware should be used where available.

9.3 Reagents, Standards & Supplies

Purchasing guidelines for equipment and reagents must meet the requirements of the specific method and testing procedures for which they are being purchased. Solvents and acids are pre-tested in accordance with TestAmerica's Corporate SOP No. CA-Q-S-001, *Solvent & Acid Lot Testing and Approval Program*. Approval information for the solvents and acids tested under Corporate SOP No. CA-Q-S-001 is stored on the TestAmerica intranet SharePoint, under Solvent Approvals. A master list of all tested materials, as well as the certificates of analysis for the materials, is stored in the same location. Additional approval and traceability instructions

are found in laboratory SOP No. PT-QA-006, *Procurement of Standards and Materials; Labeling and Traceability*.

9.3.1 Purchasing

Chemical reagents, solvents, glassware, and general supplies are ordered as needed to maintain sufficient quantities on hand. Materials used in the analytical process must be of a known quality. The wide variety of materials and reagents available makes it advisable to specify recommendations for the name, brand, and grade of materials to be used in any determination. This information is contained in the method SOP. The analyst completes the Material Request Sheet when requesting reagents, standards, or supplies, or they may check the item out of the on-site consignment system that contains items approved for laboratory use.

If an item is not in the consignment system, the analyst must obtain approval from the area team leader/supervisor and Laboratory Director prior to placing the order. The analyst must provide the master item number (from the master item list that has been approved by the Technical Manager), item description, package size, catalogue page number, and the quantity needed. If an item being ordered is not the exact item requested, approval must be obtained from the Technical Manager prior to placing the order. The responsible section manager places the order.

9.3.2 Receiving

It is the responsibility of the Sample Receiving department to receive the shipment. It is the responsibility of the analyst or manager who ordered the materials to document the date the materials were received. Once the ordered reagents or materials are received, the analyst or designee compares the information on the label or packaging to the original order to ensure that the purchase meets the quality level specified. This is documented through the addition of the received date and reviewers initials to the packing slip.

Lot numbers of solvents and acids are checked against the approved solvent/acid list. If the material is listed as unapproved, or is not listed, it is sequestered and returned to the vendor. Alternatively, the laboratory may test the material for the intended use, and if it is acceptable, document the approval on the approval list. Records of any testing performed locally are maintained by the QA department, and lots approvals and certificates of analysis are stored on the TestAmerica intranet Pittsburgh SharePoint site.

Materials may not be released for use in the laboratory until they have been inspected, verified as suitable for use, and the inspection/verification has been documented.

Safety Data Sheets (SDSs) are available online through the Company's intranet website. Anyone may review these for relevant information on the safe handling and emergency precautions of on-site chemicals.

9.3.3 Specifications

Methods in use in the laboratory specify the grade of reagent that must be used in the procedure. If the quality of the reagent is not specified, analytical reagent grade will be used. It is the responsibility of the analyst to check the procedure carefully for the suitability of grade of reagent.

Chemicals must not be used past the manufacturer's expiration date and must not be used past the expiration time noted in a method SOP. If expiration dates are not provided, the laboratory may contact the manufacturer to determine an expiration date.

The laboratory assumes a five year expiration date on inorganic dry chemicals and solvents unless noted otherwise by the manufacturer or by the reference source method. Chemicals/solvents should not be used past the manufacturer's or SOPs expiration date unless 'verified' (refer to item 3 listed below).

- An expiration date **cannot** be extended if the dry chemical/solvent is discolored or appears otherwise physically degraded, the dry chemical/solvent must be discarded.

- Expiration dates can be extended if the dry chemical/solvent is found to be satisfactory based on acceptable performance of quality control samples (Continuing Calibration Verification (CCV), Blanks, Laboratory Control Sample (LCS), etc.).

- If the dry chemical/solvent is used for the preparation of standards, the expiration dates can be extended 6 months if the dry chemical/solvent is compared to an unexpired independent source in performing the method and the performance of the dry chemical/solvent is found to be satisfactory. The comparison must show that the dry chemical/solvent meets CCV limits. The comparison studies are maintained with each lab department and copy forwarded to QA department. Recertification is documented in the LIMS.

Wherever possible, standards must be traceable to national or international standards of measurement or to national or international reference materials. Records to that effect are available to the user.

Compressed gases in use are checked for pressure and secure positioning daily. The minimum total pressure must be 500 psig or the tank must be replaced. To prevent a tank from going to dryness, close observation of the tank gauge must take place as pressure decreases towards 500psig, or the tank must be replaced. The quality of the gases must meet method or manufacturer specification or be of a grade that does not cause any analytical interference.

Water used in the preparation of standards or reagents must have a specific conductivity of less than 1- µmho /cm (or specific resistivity of greater than 1.0 megohm-cm) at 25°C. The specific conductivity is checked and recorded daily. If the water's specific conductivity is greater than the specified limit, the Facility Manager and appropriate Technical Managers/Supervisors must be notified immediately in order to notify all departments, decide on cessation (based on intended use) of activities, and make arrangements for correction.

The laboratory may purchase reagent grade (or other similar quality) water for use in the laboratory. This water must be certified "clean" by the supplier for all target analytes or otherwise verified by the laboratory prior to use. This verification is documented.

Standard lots are verified before first time use if the laboratory switches manufacturers or has historically had a problem with the type of standard.

Purchased bottleware used for sampling must be certified clean and the certificates must be maintained. If uncertified sampling bottleware is purchased, all lots must be verified clean prior to use. This verification must be maintained.

NOTE: Each bottleware type must be documented as clean down to the laboratory MDL for all target analytes for use with samples from Wisconsin.

Records of manufacturer's certification and traceability statements are maintained in files or binders in each laboratory section. These records include date of receipt, lot number (when applicable), and expiration date (when applicable). Incorporation of the item into the record indicates that the analyst has compared the new certificate with the previous one for the same purpose and that no difference is noted, unless approved and so documented by the Department Manager or QA Manager.

9.3.4 Storage

Reagent and chemical storage is important from the aspects of both integrity and safety. Light-sensitive reagents may be stored in brown-glass containers. Storage conditions are per the Corporate Environmental Health & Safety Manual (Corp. Doc. No. CW-E-M-001), method SOPs, or manufacturer instructions.

9.4 Purchase Of Equipment / Instruments / Software

When a new piece of equipment is needed, either for additional capacity or for replacing inoperable equipment, the analyst or supervisor makes a supply request to the Department Manager and/or the Laboratory Director. If they agree with the request, the procedures outlined in Corporate Policy No. CA-T-P-001, *Qualified Products List*, are followed. A decision is made as to which piece of equipment can best satisfy the requirements. The appropriate written requests are completed and purchasing places the order.

Upon receipt of a new or used piece of equipment, an identification name is assigned and added to the equipment list. IT must also be notified so that they can synchronize the instrument for back-ups. Its capability is assessed to determine if it is adequate or not for the specific application. For instruments, a calibration curve is generated, followed by MDLs, Demonstration of Capabilities (DOCs), and other relevant criteria (refer to Section 19).

For software, its operation must be deemed reliable and evidence of instrument verification must be retained by the IT Department. Software certificates supplied by the vendors are filed with the LIMS Administrator. The manufacturer's operation manual is retained in the laboratory in a designated area or near the instrument.

9.5 Services

Service to analytical instruments (except analytical balances) is performed on an as needed basis. Routine preventative maintenance is discussed in Section 20. The need for service is determined by analysts and/or Technical Managers. The service providers that perform the services are approved by the Laboratory or Technical Director.

Analytical balances are serviced and calibrated annually in accordance with laboratory SOP No. PT-QA-012, *Selection and Calibration of Balances and Weights*. The calibration and maintenance services are performed on-site, and the balances are returned to use immediately following successful calibration. When the calibration certificates are received (usually within 24 hours of the service), they are reviewed, and documentation of the review is filed with the certificates. If the calibration was unsuccessful, the balance is immediately removed from service and segregated pending either further maintenance or disposal.

Calibration services for support equipment such as thermometers, weight sets, autopipettors, etc, are obtained from vendors with current and valid ISO 17025 accreditation for calibration of the specific piece of equipment. Prior to utilizing the vendor's services, the vendor's accreditation status is verified. Once the equipment has been calibrated, the calibration certificates are reviewed by the QA department, and documentation of the review is filed with the calibration certificates. The equipment is then returned to service within the laboratory.

9.6 Suppliers

TestAmerica selects vendors through a competitive proposal / bid process, strategic business alliances or negotiated vendor partnerships (contracts). This process is defined in the Corporate Policy No. CW-F-P-004. The level of control used in the selection process is dependent on the anticipated spending amount and the potential impact on TestAmerica business. Vendors that provide test and measuring equipment, solvents, standards, certified containers, instrument related service contracts or subcontract laboratory services shall be subject to more rigorous controls than vendors that provide off-the-shelf items of defined quality that meet the end use requirements. The JD Edwards purchasing system includes all suppliers/vendors that have been approved for use.

Evaluation of suppliers is accomplished by ensuring the supplier ships the product or material ordered and that the material is of the appropriate quality. This is documented by signing off on packing slips or other supply receipt documents. The purchasing documents contain the data that adequately describe the services and supplies ordered.

Any issues of vendor performance are to be reported immediately by the laboratory staff to the Corporate Purchasing Group by completing a Vendor Performance Report.

The Corporate Purchasing Group will work through the appropriate channels to gather the information required to clearly identify the problem and will contact the vendor to report the problem and to make any necessary arrangements for exchange, return authorization, credit, etc.

As deemed appropriate, the Vendor Performance Reports will be summarized and reviewed to determine corrective action necessary, or service improvements required by vendors

The laboratory has access to a listing of all approved suppliers of critical consumables, supplies and services. This information is provided through the JD Edwards purchasing system.

9.6.1 New Vendor Procedure

TestAmerica employees who wish to request the addition of a new vendor must complete a J.D. Edwards Vendor Add Request Form available on OASIS.

New vendors are evaluated based upon criteria appropriate to the products or services provided as well as their ability to provide those products and services at a competitive cost. Vendors are also evaluated to determine if there are ethical reasons or potential conflicts of interest with TestAmerica employees that would make it prohibitive to do business with them as well as their financial stability. The QA Department and/or the Technical Director are consulted with vendor and product selection that have an impact on quality.

SECTION 10

COMPLAINTS

10.1 Overview

The laboratory considers an effective client complaint handling processes to be of significant business and strategic value. Listening to and documenting client concerns captures 'client knowledge' that enables our operations to continually improve processes and client satisfaction. An effective client complaint handling process also provides assurance to the data user that the laboratory will stand behind its data, service obligations and products.

A client complaint is any expression of dissatisfaction with any aspect of our business services (e.g., communications, responsiveness, data, reports, invoicing and other functions) expressed by any party, whether received verbally or in written form. Client inquiries, complaints or noted discrepancies are documented, communicated to management, and addressed promptly and thoroughly.

The laboratory has procedures for addressing both external and internal complaints with the goal of providing satisfactory resolution to complaints in a timely and professional manner.

The nature of the complaint is identified, documented and investigated, and an appropriate action is determined and taken. In cases where a client complaint indicates that an established policy or procedure was not followed, the QA Department must evaluate whether a special audit must be conducted to assist in resolving the issue. A written confirmation or letter to the client, outlining the issue and response taken is recommended as part of the overall action taken.

The process of complaint resolution and documentation utilizes the procedures outlined in Section 12 (Corrective Actions) and is documented following laboratory SOP No. PT-QA-016, *Non-Conformance and Corrective Action System*.

10.2 External Complaints

An employee that receives a complaint initiates the complaint resolution process by first documenting the complaint in the database, according to laboratory SOP No. PT-QA-016.

Complaints fall into two categories: correctable and non-correctable. An example of a correctable complaint would be one where a report re-issue would resolve the complaint. An example of a non-correctable complaint would be one where a client complains that their data was repeatedly late. Non-correctable complaints should be reviewed for preventive action measures to reduce the likelihood of future occurrence and mitigation of client impact.

The general steps in the complaint handling process are:

- Receiving and Documenting Complaints
- Complaint Investigation and Service Recovery
- Process Improvement

The laboratory shall inform the initiator of the complaint of the results of the investigation and the corrective action taken, if any.

10.3 Internal Complaints

Internal complaints include, but are not limited to: errors and non-conformances, training issues, internal audit findings, and deviations from methods. Corrective actions may be initiated by any staff member who observes a nonconformance and shall follow the procedures outlined in Section 12. In addition, Corporate Management, Sales and Marketing and IT may initiate a complaint by contacting the laboratory or through the corrective action system described in Section 12.

10.4 Management Review

The number and nature of client complaints is reported by the QA Manager to the laboratory and Quality Director in the QA Monthly report. Monitoring and addressing the overall level and nature of client complaints and the effectiveness of the solutions is part of the Annual Management Review (Section 16).

SECTION 11

CONTROL OF NON-CONFORMING WORK

11.1 Overview

When data discrepancies are discovered or deviations and departures from laboratory SOPs, policies and/or client requests have occurred, corrective action is taken immediately. First, the laboratory evaluates the significance of the nonconforming work. Then, a corrective action plan is initiated based on the outcome of the evaluation. If it is determined that the nonconforming work is an isolated incident, the plan could be as simple as adding a qualifier to the final results and/or making a notation in the case narrative. If it is determined that the nonconforming work is a systematic or improper practices issue, the corrective action plan could include a more in depth investigation and a possible suspension of an analytical method. In all cases, the actions taken are documented using the laboratory's corrective action system (refer to Section 12).

Due to the frequently unique nature of environmental samples, sometimes departures from documented policies and procedures are needed. When an analyst encounters such a situation, the problem is presented to their manager for advice. The maanger may elect to discuss it with the Laboratory Director or QA Manager or have a PM contact the client to decide on a logical course of action. Once an approach is agreed upon, the analyst documents it using the laboratories non-conformance/corrective action system described in Section 12. This information can then be supplied to the client in the form of a case narrative with the report.

Project Management may encounter situations where a client may request that a special procedure be applied to a sample that is not standard lab practice. Based on a technical evaluation, the lab may accept or opt to reject the request based on technical or ethical merit. An example might be the need to report a compound that the lab does not normally report. The lab would not have validated the method for this compound following the procedures in Section 19. The client may request that the compound be reported based only on the calibration. Such a request would need to be approved by the Laboratory Director and QA Manager, documented and included in the project folder. Deviations **must** also be noted on the final report with a statement that the compound is not reported in compliance with TNI (or the analytical method) requirements and the reason. Data being reported to a non-TNI state would need to note the change made to how the method is normally run.

11.2 Responsibilities And Authorities

Under certain circumstances, the Laboratory Director, a Technical Manager, or a member of the QA team may authorize departures from documented procedures or policies. The departures may be a result of procedural changes due to the nature of the sample; a one-time procedure for a client; QC failures with insufficient sample to reanalyze, etc. In most cases, the client will be informed of the departure prior to the reporting of the data. Any departures must be well documented using the laboratory's corrective action procedures. This information is documented on a Nonconformance Memo (NCM) and may also be documented in logbooks and/or data review checklists as appropriate. Any impacted data must be referenced in a case narrative and/or flagged with an appropriate data qualifier.

Any misrepresentation or possible misrepresentation of analytical data discovered by any laboratory staff member must be reported to facility Senior Management within 24-hours. The Senior Management staff is comprised of the Laboratory Director, the QA Manager, and the Technical Managers. The reporting of issues involving alleged violations of the company's Data Integrity or Manual Integration procedures must be conveyed to an ECO (e.g., the VP-QA/EHS) and the laboratory's Quality Director within 24 hours of discovery.

Whether an inaccurate result was reported due to calculation or quantitation errors, data entry errors, improper practices, or failure to follow SOPs, the data must be evaluated to determine the possible effect.

The Laboratory Director, QA Manager, ECOs, VP of Operations, and the Quality Directors have the authority and responsibility to halt work, withhold final reports, or suspend an analysis for due cause as well as authorize the resumption of work.

11.3 Evaluation Of Significance And Actions Taken

For each nonconforming issue reported, an evaluation of its significance and the level of management involvement needed is made. This includes reviewing its impact on the final data, whether or not it is an isolated or systematic issue, and how it relates to any special client requirements.

Corporate SOP No. CW-Q-S-005, *Data Recalls*, is the procedure to be followed when it is discovered that erroneous or biased data may have been reported to clients or regulatory agencies.

Corporate SOP No. CW-L-S-002, *Internal Investigations*, is the procedure to be followed for investigation and correction of situations involving alleged incidents of misconduct or violation of the company's ethics policy.

Laboratory level decisions are documented and approved using the laboratory's standard nonconformance/corrective action reporting in lieu of the data recall determination form contained in TestAmerica's Corporate SOP No. CW-Q-S-005.

11.4 Prevention Of Nonconforming Work

If it is determined that the nonconforming work could recur, further corrective actions must be made following the laboratory's corrective action system. Periodically as defined by the laboratory's preventive action schedule, or on a monthly basis, the QA Department evaluates non-conformances to determine if any nonconforming work has been repeated multiple times. If so, the laboratory's corrective action process must be followed.

11.5 Method Suspension/Restriction (Stop Work Procedures)

In some cases, it may be necessary to suspend/restrict the use of a method or target compound which constitutes significant risk and/or liability to the laboratory. Suspension/restriction procedures can be initiated by any of the persons noted in Section 11.2, Paragraph 4.

Prior to suspension/restriction, confidentiality will be respected, and the problem with the required corrective and preventive action will be stated in writing and presented to the Laboratory Director.

The Laboratory Director shall arrange for the appropriate personnel to meet with the QA Manager as needed. This meeting shall be held to confirm that there is a problem, that suspension/restriction of the method is required and will be concluded with a discussion of the steps necessary to bring the method/target or test fully back on line. In some cases, that may not be necessary if all appropriate personnel have already agreed there is a problem and there is agreement on the steps needed to bring the method, target or test fully back on line. The QA Manager will also initiate a corrective action report as described in Section 12 if one has not already been started. A copy of any meeting notes and agreed upon steps should be faxed or e-mailed by the laboratory to the appropriate VP of Operations and member of Corporate QA. This fax/e-mail acts as notification of the incident.

After suspension/restriction, the lab will hold all reports to clients pending review. No faxing, mailing or distributing through electronic means may occur. The report must not be posted for viewing on the internet. It is the responsibility of the Laboratory Director to hold all reporting and to notify all relevant laboratory personnel regarding the suspension/restriction (e.g., Project Management, Log-in, etc.). Clients will NOT generally be notified at this time. Analysis may proceed in some instances depending on the non-conformance issue.

Within 72 hours, the QA Manager will determine if compliance is now met and reports can be released, OR determine the plan of action to bring work into compliance, and release work. A team, with all principals involved (Laboratory Director, Technical Manager, QA Manager) can devise a start-up plan to cover all steps from client notification through compliance and release of reports. Project Management, and the Directors of Client Services and Sales and Marketing must be notified if clients must be notified or if the suspension/restriction affects the laboratory's ability to accept work. The QA Manager must approve start-up or elimination of any restrictions after all corrective action is complete. This approval is given by final signature on the completed corrective action report.

SECTION 12

CORRECTIVE ACTION

12.1 Overview

A major component of TestAmerica's Quality Assurance (QA) Program is the problem investigation and feedback mechanism designed to keep the laboratory staff informed on quality related issues and to provide insight to problem resolution. When nonconforming work or departures from policies and procedures in the quality system or technical operations are identified, the corrective action procedure provides a systematic approach to assess the issues, restore the laboratory's system integrity, and prevent reoccurrence. Corrective actions are documented using Non-Conformance Memos (NCM) in LIMS or the Corrective Action Reports (CAR) using the corrective action database (refer to Figure 12-1).

12.2 General

Problems within the quality system or within analytical operations may be discovered in a variety of ways, such as QC sample failures, internal or external audits, proficiency testing (PT) performance, client complaints, staff observation, etc.

The purpose of a corrective action system is to:

- Identify non-conformance events and assign responsibility(s) for investigating.
- Resolve non-conformance events and assign responsibility for any required corrective action.
- Identify systematic problems before they become serious.
- Identify and track client complaints and provide resolution.

12.2.1 Non-Conformance Memo (NCM) - is used to document the following types of corrective actions:

- Deviations from an established procedure or SOP
- QC outside of limits (non-matrix related)
- Isolated reporting / calculation errors
- Client Complaints
- Discrepancies in materials / goods received vs. manufacturer packing slips
- Anomalies that occur during sample receipt, preparation or analysis

12.2.2 Corrective Action Report (CAR) - is used to document the following types of corrective actions:

- Questionable trends that are found in the review of NCMs
- Issues found while reviewing NCMs that warrant further investigation
- Internal and external audit findings
- Failed or Unacceptable PT results
- Corrective actions that cross multiple departments in the laboratory
- Systematic reporting / calculation errors.
- Client complaints

- Data recall investigations
- Identified poor process or method performance trends
- Excessive revised reports

This will provide background documentation to enable root cause analysis and preventive action.

12.3 Closed Loop Corrective Action Process

Any employee in the company can initiate a corrective action. There are four main components to a closed-loop corrective action process once an issue has been identified: Cause Analysis, Selection and Implementation of Corrective Actions (both short and long term), Monitoring of the Corrective Actions, and Follow-up.

12.3.1 Cause Analysis

- Upon discovery of a non-conformance event, the event must be defined and documented. An NCM or CAR must be initiated. Someone is assigned to investigate the issue and the event is investigated for root cause. Table 12-1 provides some general guidelines on determining responsibility for assessment.
- The cause analysis step is the key to the process as a long term corrective action cannot be determined until the cause is determined.
- If the root cause is not readily obvious, the Technical Director, Laboratory Director, Technical Manager, or QA Manager (or QA designee) is consulted.

12.3.2 Selection and Implementation of Corrective Actions

- Where corrective action is needed, the laboratory shall identify potential corrective actions. The action(s) most likely to eliminate the problem and prevent recurrence are selected and implemented. Responsibility for implementation is assigned.
- Corrective actions shall be to a degree appropriate to the magnitude of the problem identified through the cause analysis.
- Whatever corrective action is determined to be appropriate, the laboratory shall document and implement the changes. The NCM or CAR is used for this documentation.

12.3.3 Root Cause Analysis

Root Cause Analysis is a class of problem solving (investigative) methods aimed at identifying the basic or causal factor(s) that underlie variation in performance or the occurrence of a significant failure. The root cause may be buried under seemingly innocuous events, many steps preceding the perceived failure. At first glance, the immediate response is typically directed at a symptom and not the cause. Typically, root cause analysis would be best with three or more incidents to triangulate a weakness. Corporate SOP No. CA-Q-S-009, *Root Cause Analysis*, describes this procedure.

Systematically analyze and document the Root Causes of the more significant problems that are reported. Identify, track, and implement the corrective actions required to reduce the likelihood of recurrence of significant incidents. Trend the Root Cause data from these incidents

to identify Root Causes that, when corrected, can lead to dramatic improvements in performance by eliminating entire classes of problems.

Identify the one event associated with problem and ask why this event occurred. Brainstorm the root causes of failures; for example, by asking why events occurred or conditions existed; and then why the cause occurred 5 consecutive times until you get to the root cause. For each of these sub events or causes, ask why it occurred. Repeat the process for the other events associated with the incident.

Root cause analysis does not mean the investigation is over. Look at technique, or other systems outside the normal indicators. Often creative thinking will find root causes that ordinarily would be missed, and continue to plague the laboratory or operation.

12.3.4 Monitoring of the Corrective Actions

- The Technical Manager and QA Manager are responsible to ensure that the corrective action taken was effective.
- Ineffective actions are documented and re-evaluated until acceptable resolution is achieved. Technical Managers are accountable to the Laboratory Director to ensure final acceptable resolution is achieved and documented appropriately.
- Each NCM and CAR is entered into a database for tracking purposes and a monthly summary of all NCMs is reviewed to aid in ensuring that the appropriate corrective actions have taken effect.
- TestAmerica laboratories uses the Incident/Corrective Action Tracker (iCAT) database for tracking incidents requiring corrective action. An incident is an event triggering the need for one or more corrective actions as distinct from a corrective action, a potential deficiency stemming from an incident that requires investigation and possibly fixing. The database is independent of TALS, available to all local and Corporate managers, and capable of notifying and tracking multiple corrective actions per event, dates, and personnel. iCAT allows associated document upload, categorization (such as, external/internal audit, client service concerns, data quality issues, proficiency testing, etc.), and trend analysis. Refer to Figure 12-1.
- The QA Manager reviews monthly NCMs and CARs for trends. Highlights are included in the QA monthly report (refer to Section 16). If a significant trend develops that adversely affects quality, an audit of the area is performed and corrective action implemented.
- Any out-of-control situations that are not addressed acceptably at the laboratory level may be reported to the Corporate Quality Director by the QA Manager, indicating the nature of the out-of-control situation and problems encountered in solving the situation.

12.3.5 Follow-up Audits

- Follow-up audits may be initiated by the QA Manager and shall be performed as soon as possible when the identification of a nonconformance casts doubt on the laboratory's compliance with its own policies and procedures, or on its compliance with state or federal requirements.
- These audits often follow the implementation of the corrective actions to verify effectiveness. An additional audit would only be necessary when a critical issue or risk to business is discovered.

(Also refer to Section 15.1.4, Special Audits.)

12.4 Technical Corrective Actions

In addition to providing acceptance criteria and specific protocols for technical corrective actions in the method SOPs, the laboratory has general procedures to be followed to determine when departures from the documented policies and procedures and quality control have occurred (refer to Section 11). The documentation of these procedures is through the use of an NCM or CAR.

Table 12-1 includes examples of general technical corrective actions. For specific criteria and corrective actions, refer to the analytical methods or specific method SOPs. The laboratory may also maintain Work Instructions on these items that are available upon request.

Table 12-1 provides some general guidelines for identifying the individual(s) responsible for assessing each QC type and initiating corrective action. The table also provides general guidance on how a data set should be treated if associated QC measurements are unacceptable. Specific procedures are included in Method SOPs, Work Instructions, QAM Sections 19 and 20. All corrective actions are reviewed monthly, at a minimum, by the QA Manager and highlights are included in the QA monthly report.

To the extent possible, samples shall be reported only if all quality control measures are acceptable. If the deficiency does not impair the usability of the results, data will be reported with an appropriate data qualifier and/or the deficiency will be noted in the case narrative. Where sample results may be impaired, the Project Manager is notified by an NCM and appropriate corrective action (e.g., reanalysis) is taken and documented.

12.5 Basic Corrections

When mistakes occur in records, each mistake shall be crossed-out, [not obliterated (e.g. no white-out)], and the correct value entered alongside. All such corrections shall be initialed (or signed) and dated by the person making the correction. In the case of records stored electronically, the original “uncorrected” file must be maintained intact and a second “corrected” file is created.

This same process applies to adding additional information to a record. All additions made later than the initial must also be initialed (or signed) and dated.

When corrections are due to reasons other than obvious transcription errors, the reason for the corrections (or additions) shall also be documented.

Table 12-1

Example – General Corrective Action Procedures

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Initial Instrument Blank *(Analyst)*	- Instrument response < MDL	- Prepare another blank. - If same response, determine cause of contamination: reagents, environment, instrument equipment failure, etc..
Initial Calibration Standards *(Analyst, Technical Manager(s))*	- Correlation coefficient > 0.99 or standard concentration value - Read-back errors within acceptance range - % Recovery within acceptance range - See details in Method SOP	- Reanalyze standards. - If still unacceptable, remake standards and recalibrate instrument.
Independent Calibration Verification (Second Source) *(Analyst, Technical Manager(s))*	- % Recovery within control limits	- Remake and reanalyze standard. - If still unacceptable, then remake calibration standards or use new primary standards and recalibrate instrument.
Continuing Calibration Standards *(Analyst, Data Reviewer)*	% Recovery within control limits	- Reanalyze standard. - If still unacceptable, then recalibrate and rerun affected samples.
Matrix Spike / Matrix Spike Duplicate (MS/MSD) *(Analyst, Data Reviewer)*	- % Recovery within limits documented in LIMS	- If the acceptance criteria for duplicates or matrix spikes are not met because of matrix interferences, the acceptance of the analytical batch is determined by the validity of the LCS. - If the LCS is within acceptable limits the batch is acceptable. - The results of the duplicates, matrix spikes and the LCS are reported with the data set. - For matrix spike or duplicate results outside criteria the data for that sample shall be reported with qualifiers.

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Laboratory Control Sample (LCS) *(Analyst, Data Reviewer)*	- % Recovery within limits specified in LIMS	- Batch must be re-prepared and re-analyzed. This includes any allowable marginal exceedance. When not using marginal exceedances, the following exceptions apply: 1) when the acceptance criteria for the positive control are exceeded high (i.e., high bias) and there are associated samples that are non-detects, then those non-detects may be reported with data qualifying codes; 2) when the acceptance criteria for the positive control are exceeded low (i.e., low bias), those sample results may be reported if they exceed a maximum regulatory limit/decision level with data qualifying codes. **Note:** If there is insufficient sample or the holding time cannot be met, contact client and report with flags.
Surrogates *(Analyst, Data Reviewer)*	- % Recovery within limits of method or within three standard deviations of the historical mean	- Individual sample must be repeated. Place comment in LIMS. - Surrogate results outside criteria shall be reported with qualifiers.
Method Blank (MB) *(Analyst, Data Reviewer)*	< Reporting Limit [1] For common lab contaminants, no analytes detected at greater than and equal to RL.	- Reanalyze blank. - If still positive, determine source of contamination. If necessary, reprocess (i.e. digest or extract) entire sample batch. Report blank results. - Qualify the result(s) if the concentration of a targeted analyte in the MB is at or above the reporting limit and is > 1/10 of the amount measured in the sample.
Proficiency Testing (PT) Samples *(QA Manager, Technical Manager(s))*	- Criteria supplied by PT Supplier	- Any failures or warnings must be investigated for cause. Failures may result in the need to repeat a PT sample to show the problem is corrected.
Internal / External Audits *(QA Manager, Technical Manager(s), Laboratory Director)*	- Defined in Quality System documentation such as SOPs, QAM, etc.	- Non-conformances must be investigated through CAR system and necessary corrections must be made.
Reporting / Calculation Errors (Depends on issue – possible individuals include: Analysts, Data Reviewers, Project Managers, *Technical Manager(s)*, QA Manager, Corporate QA, Corporate Management)	- Corporate SOP CW-Q-S-005, Data Recall	- Corrective action is determined by type of error. Follow the procedures in Corporate SOP CW-L-S-002 or laboratory SOP PT-QA-016.

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Client Complaints *(Project Managers, Lab Director, Sales and Marketing)*	-	- Corrective action is determined by the type of complaint. For example, a complaint regarding an incorrect address on a report will result in the report being corrected and then follow-up must be performed on the reasons the address was incorrect (e.g., database needs to be updated).
QA Monthly Report (Refer to Section 16 for an example) (QA Manager, Lab Director, *Technical Manager(s)*)	- QAM, SOPs	- Corrective action is determined by the type of issue. For example, CARs for the month are reviewed and possible trends are investigated.
Health and Safety Violation (Safety Officer, Lab Director, *Technical Manager(s)*)	- Environmental Health and Safety (EHS) Manual	- Non-conformance is investigated and corrected through CAR system.

Note:

1. Except as noted below for certain compounds, the method blank should be below the reporting limit unless there is a client specific requirement or method requirement to be evaluated to a lower level. Concentrations up to five times the reporting limit will be allowed for the ubiquitous laboratory and reagent contaminants: methylene chloride, toluene, acetone, 2-butanone and phthalates provided they appear in similar levels in the reagent blank and samples. This allowance presumes that the detection limit is significantly below any regulatory limit to which the data are to be compared and that blank subtraction will not occur. For benzene and ethylene dibromide (EDB) and other analytes for which regulatory limits are extremely close to the detection limit, the method blank must be below the method detection limit.

Figure 12-1

Example – Corrective Action Report (iCAT)

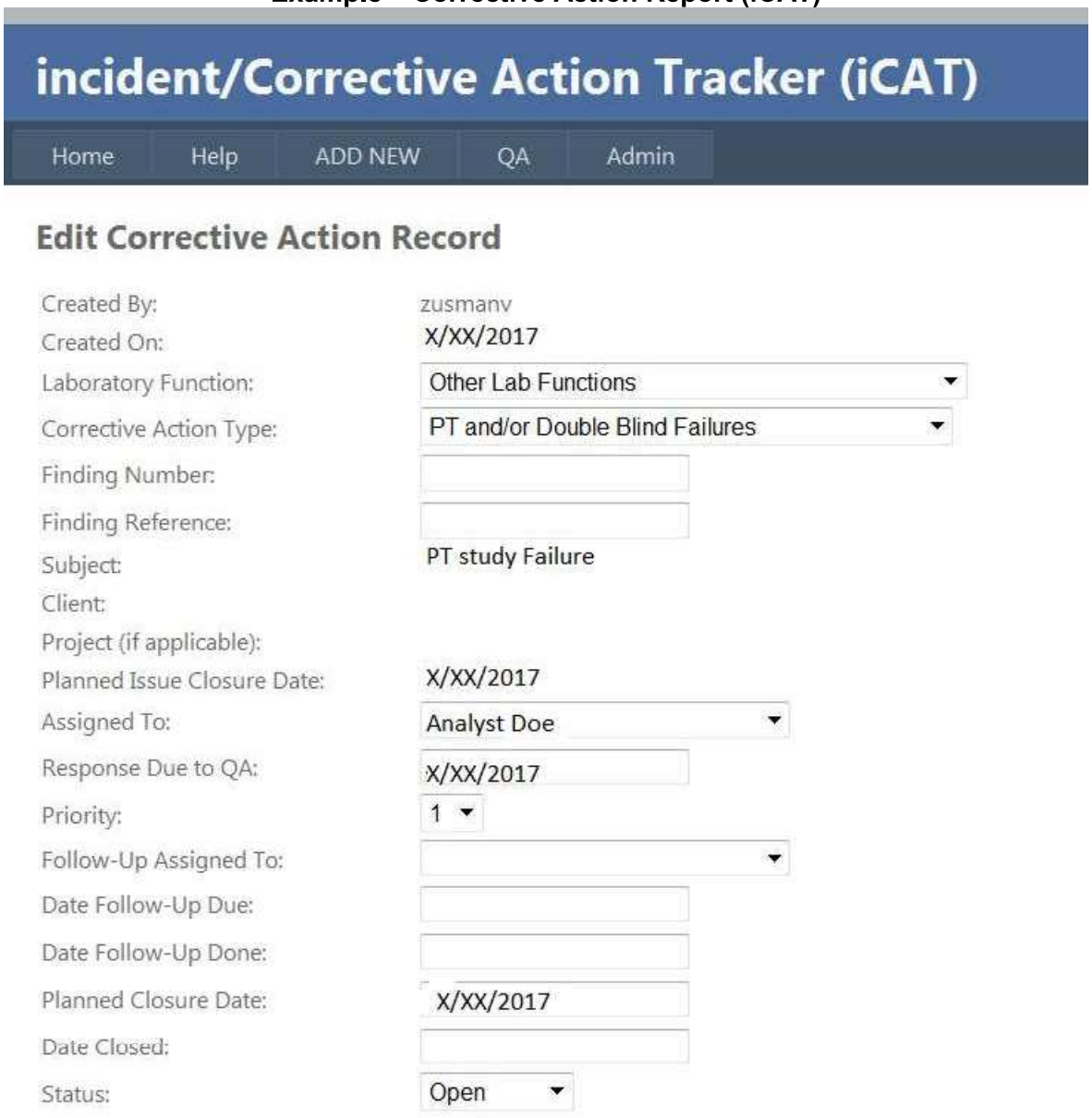


Figure 12-1

Example – Corrective Action Report (iCAT) Cont.

Describe the Required Action:

Investigation/Response:

Root Cause:

Corrective Action Plan:

Select for Notification

Selected	Name	Title
☐		

SECTION 13

PREVENTIVE ACTION / IMPROVEMENT

13.1 Overview

The laboratory's preventive action programs improve or eliminate potential causes of nonconforming product and/or nonconformance to the quality system. This preventive action process is a proactive and continuous process if improvement activities that can be initiated through feedback from clients, employees, business providers, and affiliates. The QA Department has the overall responsibility to ensure that the preventive action process is in place, and that relevant information on actions is submitted for management review.

Dedicating resources to an effective preventive action system emphasizes the laboratory's commitment to its Quality Program. It is beneficial to identify and address negative trends before they develop into complaints, problems and corrective actions. Additionally, the laboratory continually strives to improve customer service and client satisfaction through continuous improvements to laboratory systems.

Opportunities for improvement may be discovered through any of the following:

- management system reviews
- review of the monthly QA Metrics Report
- trending NCMs
- review of control charts and QC results
- trending proficiency testing (PT) results
- trending client complaints
- review of process operations
- staff observation and suggestions

The monthly Management Systems Metrics Report shows performance indicators in all areas of the laboratory and quality system. These areas include revised reports, corrective actions, audit findings, internal auditing and data authenticity audits, client complaints, PT samples, holding time violations, SOPs, ethics training, etc. The metrics report is reviewed monthly by laboratory management, Corporate QA and TestAmerica's Executive Committee. These metrics are used in evaluating the management and quality system performance on an ongoing basis and provide a tool for identifying areas for improvement.

Items identified as continuous improvement opportunities to the management system may be issued as goals from the annual management systems review, recommendations from internal audits, white papers, Lesson Learned, Technical Services audit report, Technical Best Practices, or as Corporate or management initiatives.

The laboratory's corrective action process is integral to implementation of preventive actions. A critical piece of the corrective action process is the implementation of actions to prevent further occurrence of a non-compliance event. Historical review of corrective action and non-conformances provides a valuable mechanism for identifying preventive action opportunities.

13.1.1 The following elements are part of a preventive action/process improvement system:

- Identification of an opportunity for preventive action or process improvement
- Process for the preventive action or improvement
- Define the measurements of the effectiveness of the process once undertake

- Execution of the preventive action or improvement
- Evaluation of the plan using the defined measurements
- Verification of the effectiveness of the preventive action or improvement
- Close-Out by documenting any permanent changes to the Quality System as a result of the Preventive Action or Process Improvement. Documentation of Preventive Action/ Process Improvement is incorporated into the monthly QA reports, corrective action process and management review.

13.1.2 Any Preventive Actions/ Process Improvements undertaken or attempted shall be taken into account during the Annual Management Systems Review (Section 16). A highly detailed report is not required; however a summary of success and failure within the preventive action program is sufficient to provide management with a measurement for evaluation.

13.2 Management Of Change

The Management of Change process is designed to manage significant events and changes that occur within the laboratory. Through these procedures, the potential risks inherent with a new event or change are identified and evaluated. The risks are minimized or eliminated through pre-planning and the development of preventive measures. The types of indicators monitored under this collective system include:

Change Type	Examples
Facility Changes	-movement of prep or instrument groups to a new location in the laboratory -introduction of significant changes in air handling or gas and solvent delivery systems -significant room additions or renovations -significant electrical or network upgrades or changes
Major Accreditation Changes	-voluntary surrender of accreditations no longer deemed necessary to the laboratory -loss of accreditation -addition of new accreditation programs
Reagents and Waste Streams	- new chemicals/reagents not previously used in the laboratory -deletion of chemicals/reagents that will mean they are no longer used at all in the laboratory -major changes to the volume of chemicals/reagents being used - a new waste stream must be developed Note: See EHS for changes in waste streams
Addition or Deletion of Laboratory Capabilities	-implementation of new regulated methods -"retiring" of active methods -method development for "in-house" methods Note: New regulatory methods and method development require specific processes and documentation before the process can begin or the method can enter production. See QA and EHS for requirements.
LIMS changes	-large system upgrades -additions of new capabilities Note: These changes are handled on a Corporate level
Key Personnel Changes	-key personnel promotions and their effect on that individuals group (experience, productivity, leadership, manpower) -key personnel losses -impact of new personnel that may add new experience or capabilities to the laboratory
New Types of Instrumentation	-addition of a new instrument class/technology -significant instrument upgrades that impact sensitivity, productivity or capability Note: New instrumentation requires collection and submission of instrument IDOC information before entering production. See QA for requirements.

Changes in Quality Systems and Policies	-implementation of a new Corrective Action System -changes to the Internal Audit program -implementation of uploads for Proficiency Testing samples

SECTION 14

CONTROL OF RECORDS

The laboratory maintains a records management system appropriate to its needs and that complies with applicable standards or regulations as required. The system produces unequivocal, accurate records that document all laboratory activities. The laboratory retains all original observations, calculations and derived data, calibration records and a copy of the analytical report for a minimum of five years after it has been issued. Exceptions for programs with longer retention requirements are discussed in section 14.1.2.

14.1 Overview

The laboratory has established procedures for identification, collection, indexing, access, filing, storage, maintenance and disposal of quality and technical records. A record index is listed in Table 14-1. More detailed information on retention of specific records is provided in Corporate Policy No.CW-L-P-001, *Records Retention Policy*, and Work Instruction No. CW-L-WI-001, *TestAmerica Records Retention/Storage Schedule*. Quality records are maintained by the Quality Assurance (QA) department electronically on the Pittsburgh laboratory's designated network drive which is backed up as part of the regular network backup. Records are of two types; either electronic or hard copy paper formats, depending on whether the record is computer or hand generated (some records may be in both formats). Technical records are maintained by the CSO group, HR, and the QA department and as outlined in laboratory SOP No. PT-QA-019.

Table 14-1 Record Index[1]

	Record Types [1]:	Retention Time:
Technical Records	- Raw Data - Logbooks[2] - Standards - Certificates - Analytical Records - MDLs/IDLs/DOCs - Lab Reports	5 Years from analytical report issue*
Official Documents	- Quality Assurance Manual (QAM) - Work Instructions - Policies - SOPs - Policy Memorandums - Manuals - Published Methods	Indefinitely
QA Records	- Certifications - Method and Software Validation / Verification Data	Indefinitely

	Record Types [1]:	Retention Time:
QA Records	- Internal & External Audits/Responses - Corrective/Preventive Actions - Management Reviews - Data Investigation	5 Years from archival* **Data Investigation:** 5 years or the life of the affected raw data storage whichever is greater (beyond 5 years if ongoing project or pending investigation)
Project Records	- Sample Receipt & COC Documents - Contracts and Amendments - Correspondence - QAPP - SAP - Telephone Logbooks - Lab Reports	5 Years from analytical report issue*
Administrative Records	Financial and Business Operations	Refer to CW-L-WI-001
	EH&S Manual, Permits	Indefinitely
	Disposal Records	Indefinitely
	Employee Handbook	Indefinitely
	Personnel files, Employee Signature & Initials, Administrative Training Records (e.g., Ethics)	Refer to HR Manual
	Administrative Policies	Indefinitely
	Technical Training Records	7 years
	Legal Records	Indefinitely
	HR Records	Refer to CW-L-WI-001
	IT Records	Refer to CW-L-WI-001
	Corporate Governance Records	Refer to CW-L-WI-001
	Sales & Marketing	5 years
	Real Estate	Indefinitely

[1] Record Types encompass hardcopy and electronic records.
[2] Examples of Logbook types: Maintenance, Instrument Run, Preparation (standard and samples), Standard and Reagent Receipt, Archiving, Balance Calibration, Temperature (hardcopy or electronic records).
* Exceptions listed in Table 14-2.

14.1.1 All records are stored and retained in such a way that they are secure and readily retrievable at the laboratory facility or an offsite location that provides a suitable environment to prevent damage or deterioration and to prevent loss at the laboratory or the Iron Mountain data storage facility. All records shall be protected against fire, theft, loss, environmental deterioration, and vermin. In the case of electronic records, electronic or magnetic sources, storage media are protected from deterioration caused by magnetic fields and/or electronic deterioration.

Access to the data is limited to laboratory and company employees and shall be documented with an access log. Records archived off-site are stored in a secure location where a record is maintained of any entry into the storage facility. Whether on-site or off-site storage is used, logs are maintained in each storage box to note removal and return of records. Retention of records are maintained on-site at the laboratory for at least 1 year after their generation and moved offsite for the remainder of the required storage time. Records are maintained for a minimum of five years unless otherwise specified by a client or regulatory requirement.

For raw data and project records, record retention shall be calculated from the date the project report is issued. For other records, such as Controlled Documents, QA, or Administrative Records, the retention time is calculated from the date the record is formally retired. Records related to the programs listed in Table 14-2 have lengthier retention requirements and are subject to the requirements in Section 14.1.3.

14.1.2 Programs with Longer Retention Requirements

Some regulatory programs have longer record retention requirements than the standard record retention time. These are detailed in Table 14-2 with their retention requirements. In these cases, the longer retention requirement is enacted. If special instructions exist such that client data cannot be destroyed prior to notification of the client, the container or box containing that data is marked as to who to contact for authorization prior to destroying the data.

Table 14-2 Special Record Retention Requirements

Program	[1]Retention Requirement
Drinking Water – All States	10 years (lab reports and raw data)
Commonwealth of MA – All environmental data 310 CMR 42.14	10 years
FIFRA – 40 CFR Part 160	Retain for life of research or marketing permit for pesticides regulated by EPA
Housing and Urban Development (HUD) Environmental Lead Testing	10 years
Alaska	10 years
Louisiana – All	10 years
Michigan Department of Environmental Quality – all environmental data	10 years
Ohio VAP	10 years and State contact prior to disposal
TSCA - 40 CFR Part 792	10 years after publication of final test rule or negotiated test agreement
OSHA	30 years

[1]Note: Extended retention requirements must be noted with the archive documents or addressed in facility-specific records retention procedures.

14.1.3 The laboratory has procedures to protect and back-up records stored electronically and to prevent unauthorized access to or amendment of these records. All analytical data is maintained as hard copy or in a secure readable electronic format. For analytical reports that are maintained as copies in PDF format, refer to Section 19.14.1 and laboratory SOP No. PT-QA-019, Records Information Management, for more information.

14.1.4 The record keeping system allows for historical reconstruction of all laboratory activities that produced the analytical data, as well as rapid recovery of historical data (Records stored off site should be accessible within 2 days of a request for such records). The history of the sample from when the laboratory took possession of the samples must be readily understood through the documentation. This shall include inter-laboratory transfers of samples and/or extracts.

- The records include the identity of personnel involved in sampling, sample receipt, preparation, or testing. All analytical work contains the initials (at least) of the personnel involved. The laboratory's copy of the chain of custody is stored with the invoice and the work order sheets generated by the LIMS. Details of the COC linking procedure are described in SOP No. PT-SR-001. The chain of custody would indicate the name of the sampler. Any sampling notes provided with the chain of custody are also scanned into LIMS.
- All information relating to the laboratory facilities equipment, analytical test methods, and related laboratory activities, such as sample receipt, sample preparation, or data verification are documented.
- The record keeping system facilitates the retrieval of all working files and archived records for inspection and verification purposes (e.g., set format for naming electronic files, set format for what is included with a given analytical data set are described in SOP No. PT-QA-019. Instrument data is stored sequentially by instrument. Run logs are maintained for each instrument; a copy of each day's run long is stored in the electronic files along with the data to aid in re-constructing an analytical sequence. Where an analysis is performed without an instrument, bound logbooks or bench sheets are used to record and file data or the data is entered directly into the LIMS as the analysis is done. Standard and reagent information is recorded in electronic standard log in LIMS, and is associated with each preparation and analytical batch for which they are used.
- Changes to hardcopy records shall follow the procedures outlined in Section 12 and 19. Changes to electronic records in LIMS or instrument data are recorded in audit trails.
- The reason for a signature or initials on a document is clearly indicated in the records such as "sampled by," "prepared by," "reviewed by", or "analyzed by".
- All generated data, except those that are generated by automated data collection systems, are recorded directly, promptly and legibly in permanent dark ink.
- Hard copy data may be scanned into PDF format for record storage as long as the scanning process can be verified in order to ensure that no data is lost and the data files and storage media must be tested to verify the laboratory's ability to retrieve the information prior to the destruction of the hard copy that was scanned. The procedure for this verification can be found in SOP No. PT-QA-019.
- Also refer to Section 19.14.1 'Computer and Electronic Data Related Requirements'.

14.2 Technical And Analytical Records

14.2.1 The laboratory retains records of original observations, derived data and sufficient information to establish an audit trail, calibration records, staff records and a copy of each analytical report issued, for a minimum of five years unless otherwise specified by a client or regulatory requirement. The records for each analysis shall contain sufficient information to enable the analysis to be repeated under conditions as close as possible to the original. The records shall include the identity of laboratory personnel responsible for the sampling, performance of each analysis and reviewing results.

14.2.2 Observations, data and calculations are recorded real-time and are identifiable to the specific task.

14.2.3 Changes to hardcopy records shall follow the procedures outlined in Section 12 and 19. Changes to electronic records in LIMS or instrument data are recorded in audit trails.

The essential information to be associated with analysis, such as strip charts, tabular printouts, computer data files, analytical notebooks, and run logs, include:

- Laboratory sample ID code;
- Date of analysis; Time of Analysis is also required if the holding time is seventy-two (72) hours or less, or when time critical steps are included in the analysis (e.g., drying times, incubations, etc.); instrumental analyses have the date and time of analysis recorded as part of their general operations. Where a time critical step exists in an analysis, location for such a time is included as part of the documentation in a specific logbook, on a benchsheet or in LIMS.
- Instrumentation identification and instrument operating conditions/parameters. Operating conditions/parameters are typically recorded in instrument maintenance logs where available.
- analysis type;
- all manual calculations and manual integrations;
- analyst's or operator's initials/signature;
- sample preparation including cleanup, separation protocols, incubation periods or subculture, ID codes, volumes, weights, instrument printouts, meter readings, calculations, reagents;
- test results;
- standard and reagent origin, receipt, preparation, and use;
- calibration criteria, frequency and acceptance criteria;
- data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions;
- quality control protocols and assessment;
- electronic data security, software documentation and verification, software and hardware audits, backups, and records of any changes to automated data entries; and
- Method performance criteria including expected quality control requirements. These are indicated both in the LIMS and on specific analytical report formats.

14.2.4 All logbooks used during receipt, preparation, storage, analysis, and reporting of samples or monitoring of support equipment shall undergo a documented supervisory or peer review on a monthly basis.

14.3 Laboratory Support Activities

In addition to documenting all the above-mentioned activities, the following are retained QA records and project records (previous discussions in this section relate where and how these data are stored):

- all original raw data, whether hard copy or electronic, for calibrations, samples and quality control measures, including analysts' work sheets and data output records (chromatograms, strip charts, and other instrument response readout records);
- a written description or reference to the specific test method used which includes a description of the specific computational steps used to translate parametric observations into a reportable analytical value;
- copies of final reports;
- archived SOPs;
- correspondence relating to laboratory activities for a specific project;

- all corrective action reports, audits and audit responses;
- proficiency test results and raw data; and
- results of data review, verification, and crosschecking procedures

14.3.1 Sample Handling Records

Records of all procedures to which a sample is subjected while in the possession of the laboratory are maintained. These include but are not limited to records pertaining to:

- sample preservation including appropriateness of sample container and compliance with holding time requirement;
- sample identification, receipt, acceptance or rejection and login;
- sample storage and tracking including shipping receipts, sample transmittal / COC forms; and
- procedures for the receipt and retention of samples, including all provisions necessary to protect the integrity of samples.

14.4 Administrative Records

The laboratory also maintains the administrative records in either electronic or hard copy form. Refer to Table 14-1.

14.5 Records Management, Storage And Disposal

All records (including those pertaining to test equipment), certificates and reports are safely stored, held secure and in confidence to the client. Certification related records are available upon request.

All information necessary for the historical reconstruction of data is maintained by the laboratory. Records that are stored only on electronic media must be supported by the hardware and software necessary for their retrieval.

Records that are stored or generated by computers or personal computers have hard copy, write-protected backup copies, or an electronic audit trail controlling access.

The laboratory has a record management system (a.k.a., document control) for control of laboratory notebooks/benchsheets, instrument/equipment logbooks, and records for data reduction, validation and reporting. Laboratory notebooks are issued on a per analysis basis, as needed, and are numbered sequentially. All sample data are recorded in LIMS. Bench sheets are filed sequentially. Standards are maintained in the electronic standards in LIMS. Records are considered archived when noted as such in the records management system (a.k.a., document control).

14.5.1 Transfer of Ownership

In the event that the laboratory transfers ownership or goes out of business, the laboratory shall ensure that the records are maintained or transferred according to client's instructions. Upon ownership transfer, record retention requirements shall be addressed in the ownership transfer agreement and the responsibility for maintaining archives is clearly established. In addition, in cases of bankruptcy, appropriate regulatory and state legal requirements concerning laboratory records must be followed. In the event of the closure of the laboratory, all records will revert to the control of the Corporate headquarters. Should the entire company cease to exist, as much notice as possible will be given to clients and the accrediting bodies who have worked with the

laboratory during the previous 5 years of such action.

14.5.2 Records Disposal

Records are removed from the archive and destroyed after 5 years unless otherwise specified by a client or regulatory requirement. On a project specific or program basis, clients may need to be notified prior to record destruction. Records are destroyed in a manner that ensures their confidentiality such as shredding, mutilation or incineration. (Refer to Tables 14-1 and 14-2).

Electronic copies of records must be destroyed by erasure or physically damaging off-line storage media so no records can be read.

If a third party records management company is hired to dispose of records, a "Certificate of Destruction" is required.

SECTION 15

AUDITS

15.1 Internal Audits

Internal audits are performed to verify that laboratory operations comply with the requirements of the lab's quality system and with the external quality programs under which the laboratory operates. Audits are planned and organized by the QA staff. Personnel conducting the audits should be independent of the area being evaluated. Auditors will have sufficient authority, access to work areas, and organizational freedom necessary to observe all activities affecting quality and to report the assessments to laboratory management and when requested to Corporate management.

Audits are conducted and documented as described in the Corporate SOP No. CW-Q-S-003, *Internal Auditing*. More detail on the specific elements for internal audits and data audit is described in Pittsburgh Laboratory SOP No. PT-QA-002, *Internal Auditing*. The types and frequency of routine internal audits are shown in Table 15-1. Special or ad hoc assessments may be conducted as needed under the direction of the QA staff.

Table 15-1 Types of Internal Audits and Frequency

Description	Performed by	Frequency
Quality Systems Audits	QA Department, QA approved designee, or Corporate QA	All areas of the laboratory annually
Method Audits QA Technical Audits	Joint responsibility: a) QA Manager or designee b) Technical Manager or Designee (Refer to CW-Q-S-003)	50% of methods annually

Description	Performed by	Frequency
SOP Method Compliance	Joint responsibility: c) QA Manager or designee d) Technical Manager or Designee (Refer to CW-Q-S-003)	Every 2 years
Special	QA Department or Designee	Surveillance or spot checks performed as needed, e.g., to confirm corrective actions from other audits.
Performance Testing	Analysts with QA oversight	Two successful per year for each TNI field of testing or as dictated by regulatory requirements

15.1.1 Annual Quality Systems Audit

An annual quality systems audit is required to ensure compliance to analytical methods and SOPs, TestAmerica's Data Integrity and Ethics Policies, TNI quality systems, client and state requirements, and the effectiveness of the internal controls of the analytical process, including, but not limited to, data review, quality controls, preventive action and corrective action. The completeness of earlier corrective actions is assessed for effectiveness & sustainability. The audit is divided into sections for each operating or support area of the lab, and each section is comprehensive for a given area. The area audits may be performed on a rotating schedule throughout the year to ensure adequate coverage of all areas. This schedule may change as situations in the laboratory warrant.

Effectiveness of training will be determined during our annual QA systems evaluation. Evidence of successful training includes:

- Audit and surveillance results, control charts, proficiency testing results, data analysis, corrective and preventive actions, customer feedback, and management reviews in efforts to monitor trends and continually improve the quality system:
- Adequate documentation of training within operational areas, including one-on-one technical training for individual technologies, and particularly for people cross-trained.
- Analysts knowledge of QA Manual and SOPs. Analysts following SOPs, i.e., practice matches SOPs.
- Analysts regularly communicate to supervisors and QA if SOPs need revision.

15.1.2 QA Technical Audits

QA technical audits assess data authenticity and analyst integrity. These audits are based on client projects, associated sample delivery groups, and the methods performed. Reported results are compared to raw data to verify the authenticity of results. The validity of calibrations and QC results are compared to data qualifiers, footnotes, and case narratives. Documentation is assessed by examining run logs and records of manual integrations. Manual calculations are checked. Where possible, electronic audit miner programs (e.g., Chrom AuditMiner) are used to identify unusual manipulations of the data deserving closer scrutiny. QA technical audits will include all methods within a two-year period. All analysts and data reviewers should be reviewed over the course of a two year period through at least one QA Technical Audit.

15.1.3 SOP Method Compliance

Compliance of all SOPs with the source methods and compliance of the operational groups with the SOPs will be assessed by the QA department, Technical Manager, or qualified designee at least every two years. It is also recommended that the work of each newly hired analyst is assessed within 3 months of working independently, (e.g., completion of method IDOC). In addition, as analysts add methods to their capabilities, reviews (new IDOC) of the analyst work products will be performed within 3 months of completing the documented training.

15.1.4 Special Audits

Special audits are conducted on an as needed basis, generally as a follow up to specific issues such as client complaints, corrective actions, PT results, data audits, system audits, validation comments, regulatory audits or suspected ethical improprieties. Special audits are focused on a specific issue, and report format, distribution, and timeframes are designed to address the nature of the issue.

15.1.5 Performance Testing

The laboratory participates semi-annually in performance audits conducted through the analysis of PT samples provided by a third party. The laboratory generally participates in the following types of PT studies: Water Pollution Program, Water Supply Program, Hazardous Waste Program, client supplied PTs and Lab internal PTs.

It is TestAmerica's policy that PT samples be treated as typical samples in the production process. Furthermore, where PT samples present special or unique problems, in the regular production process they may need to be treated differently, as would any special or unique request submitted by any client. The QA Manager must be consulted and in agreement with any decisions made to treat a PT sample differently due to some special circumstance.

Unacceptable PT results are required to be entered into the laboratory's Corrective Action system (iCAT). In some cases it may be necessary for blind QC samples to be submitted to the laboratory to show a return to control.

15.2 EXTERNAL AUDITS

External audits are performed when certifying agencies or clients conduct on-site inspections or submit performance testing samples for analysis. It is TestAmerica's policy to cooperate fully with regulatory authorities and clients. The laboratory makes every effort to provide the auditors with access to personnel, documentation, and assistance. Laboratory supervisors are responsible for providing corrective actions to the QA Manager who coordinates the response for any deficiencies discovered during an external audit. Audit responses are due in the time allotted by the client or agency performing the audit. When requested, a copy of the audit report and the labs corrective action plan will be forwarded to Corporate Quality.

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. The client may only view data and systems related directly to the client's work. All efforts are made to keep other client information confidential.

15.2.1 Confidential Business Information (CBI) Considerations

During on-site audits, auditors may come into possession of information claimed as business confidential. A business confidentiality claim is defined as "a claim or allegation that business information is entitled to confidential treatment for reasons of business confidentiality or a request for a determination that such information is entitled to such treatment." When information is claimed as business confidential, the laboratory must place on (or attach to) the information at the time it is submitted to the auditor, a cover sheet, stamped or typed legend or other suitable form of notice, employing language such as "trade secret", "proprietary" or "company confidential". Confidential portions of documents otherwise non-confidential must be clearly identified. CBI may be purged of references to client identity by the responsible laboratory official at the time of removal from the laboratory. However, sample identifiers may not be obscured from the information. Additional information regarding CBI can be found in within the 2009 TNI standards.

15.3 Audit Findings

Audit findings are documented using the corrective action process database (iCAT system). The laboratory's corrective action responses for both types of audits may include action plans that could not be completed within a predefined timeframe. In these instances, a completion date must be set and agreed to by operations management and the QA Manager.

Developing and implementing corrective actions to findings is the responsibility of the Technical Manager where the finding originated. Findings that are not corrected by specified due dates are reported monthly to management in the QA monthly report. When requested a copy of the audit report and the labs corrective action plan will be forwarded to Corporate Quality.

If any audit finding casts doubt on the effectiveness of the operations or on the correctness or validity of the laboratory's test results, the laboratory shall take timely corrective action, and shall notify clients in writing if the investigations show that the laboratory results have been affected. Once corrective action is implemented, a follow-up audit is scheduled to ensure that the problem has been corrected.

Clients must be notified promptly, in writing, of any event such as the identification of defective measuring or test equipment that casts doubt on the validity of results given in any test report or amendment to a test report. The investigation must begin within 24-hours of discovery of the problem and all efforts are made to notify the client within two weeks after completion of the investigation.

SECTION 16

MANAGEMENT REVIEWS

16.1 Quality Assurance Report

A comprehensive QA Report shall be prepared each month by the laboratory's QA Department and forwarded to the Laboratory Director, Technical Managers, their Quality Director as well as the VP of Operations. All aspects of the QA system are reviewed to evaluate the suitability of policies and procedures. During the course of the year, the Laboratory Director, VP of Operations, or Corporate QA may request that additional information be added to the report.

On a monthly basis, Corporate QA compiles information from all the monthly laboratory reports. The Corporate Quality Directors prepare a report that includes a compilation of all metrics and notable information and concerns regarding the QA programs within the laboratories. The report also includes a listing of new regulations that may potentially impact the laboratories. This report is presented to the Senior Management Team and VPs of Operations.

16.2 Annual Management Review

The senior lab management team (Laboratory Director, QA Manager, and Technical Managers) conducts a review annually of its quality systems and LIMS to ensure its continuing suitability and effectiveness in meeting client and regulatory requirements and to introduce any necessary changes or improvements. It will also provide a platform for defining goals & objectives and action items that feed into the laboratory planning system. Corporate Operations and Corporate QA personnel is to be included in this meeting at the discretion of the Laboratory Director. The LIMS review consists of examining any audits, complaints or concerns that have been raised through the year that are related to the LIMS. The laboratory will summarize any critical findings that cannot be solved by the lab and report them to Corporate IT.

The Management System Review (see Corporate SOP No. CW-Q-S-004, *Management System Review*, and Work Instruction No. CW-Q-WI-003) uses information generated during the preceding year to assess the "big picture" by ensuring that routine actions taken and reviewed on a monthly basis are not components of larger systematic concerns. The monthly review should keep the quality systems current and effective, therefore, the annual review is a formal senior management process to review specific existing documentation. Significant issues from the following documentation are compiled or summarized by the QA Manager prior to the review meeting:

- Matters arising from the previous annual review
- Prior Monthly QA Reports issues
- Laboratory QA Metrics
- Review of report reissue requests
- Review of client feedback and complaints
- Issues arising from any prior management or staff meetings
- Minutes from prior senior lab management meetings - Issues that may be raised from these meetings include:

    - Adequacy of staff, equipment and facility resources.
    - Adequacy of policies and procedures.
    - Future plans for resources and testing capability and capacity.

- The annual internal double blind PT program sample performance
- Compliance to the Ethics Policy and Data Integrity Plan, including any evidence/incidents of inappropriate actions or vulnerabilities related to data Integrity
- Review of Corrective and Preventative Actions, assessments by external bodies and recommendations for improvement

A report is generated by the QA Manager and management. The report is distributed to the appropriate VP of Operation and the Quality Director. The report includes, but is not limited to:

- The date of the review and the names and titles of participants
- A reference to the existing data quality related documents and topics that were reviewed
- Quality system or operational changes or improvements that will be made as a result of the review [e.g., an implementation schedule including assigned responsibilities for the changes (Action Table)]

Changes to the quality systems requiring update to the laboratory QA Manual shall be included in the next revision of the QA Manual.

16.3 Potential Integrity Related Managerial Reviews

Potential integrity issues (data or business related) must be handled and reviewed in a confidential manner until such time as a follow-up evaluation, full investigation, or other appropriate actions have been completed and issues clarified. TestAmerica's Corporate Internal Investigation and Data Recall SOPs shall be followed (SOP No. CW-L-S-002 and CW-Q-S-005). All investigations that result in finding of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients.

TestAmerica's President and CEO, Executive VP of Operations, VP of Client & Technical Services, VPs of Operation, and Quality Directors receive a monthly report from the VP-QA/EHS summarizing any current data integrity or data recall investigations. The VP's of Operation are also made aware of progress on these issues for their specific labs.

SECTION 17

PERSONNEL

17.1 Overview

The laboratory's management believes that its highly qualified and professional staff is the single most important aspect in assuring a high level of data quality and service. The staff consists of professionals and support personnel as outlined in the organization chart in Figure 4-1.

All personnel must demonstrate competence in the areas where they have responsibility. Any staff that is undergoing training shall have appropriate supervision until they have demonstrated their ability to perform their job function on their own. Staff shall be qualified for their tasks based on appropriate education, training, experience and/or demonstrated skills as required.

The laboratory employs sufficient personnel with the necessary education, training, technical knowledge and experience for their assigned responsibilities.

All personnel are responsible for complying with all QA/QC requirements that pertain to the laboratory and their area of responsibility. Each staff member must have a combination of experience and education to adequately demonstrate a specific knowledge of their particular area of responsibility. Technical staff must also have a general knowledge of lab operations, test methods, QA/QC procedures and records management.

Laboratory management is responsible for formulating goals for lab staff with respect to education, training and skills and ensuring that the laboratory has a policy and procedures for identifying training needs and providing training of personnel. The training shall be relevant to the present and anticipated responsibilities of the lab staff.

The laboratory only uses personnel that are employed by or under contract to, the laboratory. Contracted personnel, when used, must meet competency standards of the laboratory and work in accordance to the laboratory's quality system.

17.2 Education And Experience Requirements For Technical Personnel

The laboratory makes every effort to hire analytical staffs that possess a college degree (AA, BA, BS) in an applied science with some chemistry in the curriculum. Exceptions can be made based upon the individual's experience and ability to learn. For supervisory positions, the Pennsylvania DEP has education and experience requirements that must be met by the Pittsburgh laboratory personnel, and these are reflected in Table 17-1 below. Selection of qualified candidates for laboratory employment begins with documentation of minimum education, training, and experience prerequisites needed to perform the prescribed task. Minimum education and training requirements for TestAmerica employees are outlined in job descriptions and are generally summarized for analytical staff in the table below.

The laboratory maintains job descriptions for all personnel who manage, perform or verify work affecting the quality of the environmental testing the laboratory performs. Job Descriptions are located on the TestAmerica intranet site's Human Resources web-page (Also see Section 4 for position descriptions/responsibilities).

Experience and specialized training are occasionally accepted in lieu of a college degree (basic lab skills such as using a balance, pipette or quantitation techniques, etc., are also considered).

Table 17-1 General Requirements for Analytical Staff

Specialty	Education	Experience
Extractions, Digestions, some electrode methods (pH, DO, Redox, etc.), or Titrimetric and Gravimetric Analyses	H.S. Diploma	On the job training (OJT)
GFAA, CVAA, FLAA, Single component or short list Chromatography (e.g., Fuels, BTEX-GC, IC	A college degree in an applied science or 2 years of college and at least 1 year of college chemistry	Or 2 years prior analytical experience is required

Specialty	Education	Experience
ICP, ICPMS, Long List or complex chromatography (e.g., Pesticides, PCB, Herbicides, HPLC, etc.), GCMS	A college degree in an applied science or 2 years of college chemistry	or 5 years of prior analytical experience
Spectra Interpretation	A college degree in an applied science or 2 years of college chemistry	And 2 years relevant experience Or 5 years of prior analytical experience
Technical Manager (s) – **General**	Bachelors Degree in an applied science or engineering with 24 semester hours in chemistry An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years' experience in environmental analysis of representative analytes for which they will oversee
Technical Manager (s) – **Wet Chem** only (no advanced instrumentation)	Associates degree in an applied science or engineering or 2 years of college with 16 semester hours in chemistry	And 2 years relevant experience
Technical Managers - **Microbiology**	Bachelors degree in applied science with at least 16 semester hours in general microbiology and biology An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years of relevant experience
Technical Managers – **Microbiology** limited to analysis of fecal coliforms, total coliforms or heterotrophic bacteria	Associates degree in an applied science or engineering and at least 4 credit hours in biology	And 2 years of relevant experience

When an analyst does not meet these requirements, they can perform a task under the direct supervision of a qualified analyst, peer reviewer or Technical Manager, and are considered an analyst in training. The person supervising an analyst in training is accountable for the quality of the analytical data and must review and approve data and associated corrective actions.

17.3 Training

The laboratory is committed to furthering the professional and technical development of employees at all levels.

Orientation to the laboratory's policies and procedures, in-house method training, and employee attendance at outside training courses and conferences all contribute toward employee proficiency.

Table 17-2 Employee Training Examples

Required Training	Time Frame	Employee Type
Environmental Health & Safety	Prior to lab work	All
Ethics – New Hires	1 week of hire	All
Ethics – Comprehensive	90 days of hire	All
Data Integrity	30 days of hire	Technical and PMs
Quality Assurance	90 days of hire	All
Ethics – Comprehensive Refresher	Annually	All
Initial Demonstration of Capability (DOC)	Prior to unsupervised method performance	Technical

The laboratory maintains records of relevant authorization/competence, education, professional qualifications, training, skills and experience of technical personnel (including contracted personnel) as well as the date that approval/authorization was given. These records are kept on file at the laboratory. Also refer to "Demonstration of Capability" in Section 19.

The training of technical staff is kept up to date by:

- Each employee must have documentation in their training file that they have read, understood and agreed to follow the most recent version of the laboratory QA Manual and SOPs in their area of responsibility. This documentation is updated as SOPs are updated.
- Documentation from any training courses or workshops on specific equipment, analytical techniques or other relevant topics are maintained in their training file.
- Documentation of proficiency (refer to Section 19).
- An Ethics Agreement signed by each staff member (renewed each year) and evidence of annual ethics training.
- A Confidentiality Agreement signed by each staff member signed at the time of employment.
- Human Resources maintains documentation and attestation forms on employment status & records; benefit programs; timekeeping/payroll; and employee conduct (e.g., ethics violations). This information is maintained in the employee's secured personnel file.

Evidence of successful training could include such items as:

- Adequate documentation of training within operational areas, including one-on-one technical training for individual technologies, and particularly for people cross-trained.
- Analysts knowledge to refer to QA Manual for quality issues.
- Analysts following SOPs, i.e., practice matches SOPs.
- Analysts regularly communicate to supervisors and QA if SOPs need revision, rather than waiting for auditors to find problems.

Further details of the laboratory's training program are described in the Pittsburgh Laboratory SOP No. PT-QA-001, *Employee Orientation and Training*.

17.4 Data Integrity And Ethics Training Program

Establishing and maintaining a high ethical standard is an important element of a Quality System. Ethics and data integrity training is integral to the success of TestAmerica and is provided for each employee at TestAmerica. It is a formal part of the initial employee orientation within 1 week of hire followed by technical data integrity training within 30 days, comprehensive training within 90 days, and an annual refresher for all employees. Senior management at each facility performs the ethics training for their staff.

In order to ensure that all personnel understand the importance TestAmerica places on maintaining high ethical standards at all times; TestAmerica has established a Corporate Policy No. CW-L-P-004, *Ethics Policy*, and an Ethics Statement. All initial and annual training is documented by signature on the signed Ethics Statement demonstrating that the employee has participated in the training and understands their obligations related to ethical behavior and data integrity.

Violations of this Ethics Policy will not be tolerated. Employees who violate this policy will be subject to disciplinary actions up to and including termination. Criminal violations may also be referred to the Government for prosecution. In addition, such actions could jeopardize TestAmerica's ability to do work on Government contracts, and for that reason, TestAmerica has a Zero Tolerance approach to such violations.

Employees are trained as to the legal and environmental repercussions that result from data misrepresentation. Key topics covered in the presentation include:

- Organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting
- Ethics Policy
- How and when to report ethical/data integrity issues and confidential reporting
- Record keeping
- Discussion regarding data integrity procedures
- Specific examples of breaches of ethical behavior (e.g. peak shaving, altering data or computer clocks, improper macros, etc., accepting/offering kickbacks, illegal accounting practices, unfair competition/collusion)
- Internal monitoring, investigations, and data recalls
- Consequences for infractions, including potential for immediate termination, debarment, or criminal prosecution
- Importance of proper written narration / data qualification by the analyst and project manager with respect to those cases where the data may still be usable but are in one sense or another partially deficient

Additionally, a data integrity hotline (1-800-736-9407) is maintained by TestAmerica and administered by the Corporate Quality Department.

SECTION 18

ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS

18.1 Overview

The laboratory is a 33,000 ft^2 secure laboratory facility with controlled access and designed to accommodate an efficient workflow and to provide a safe and comfortable work environment for employees. All visitors sign in and are escorted by laboratory personnel. Access is controlled by various measures.

The laboratory is equipped with structural safety features. Each employee is familiar with the location, use, and capabilities of general and specialized safety features associated with their workplace. The laboratory provides and requires the use of protective equipment including safety glasses, protective clothing, gloves, etc., OSHA and other regulatory agency guidelines regarding required amounts of bench and fume hood space, lighting, ventilation (temperature and humidity controlled), access, and safety equipment are met or exceeded.

Traffic flow through sample preparation and analysis areas is minimized to reduce the likelihood of contamination. Adequate floor space and bench top area is provided to allow unencumbered sample preparation and analysis space. Sufficient space is also provided for storage of reagents and media, glassware, and portable equipment. Ample space is also provided for refrigerated sample storage before analysis and archival storage of samples after analysis. Laboratory HVAC and deionized water systems are designed to minimize potential trace contaminants.

The laboratory is separated into specific areas for sample receiving, sample preparation, volatile organic sample analysis, non-volatile organic sample analysis, inorganic sample analysis, microbiological sample analysis, and administrative functions.

18.2 Environment

Laboratory accommodation, test areas, energy sources, lighting are adequate to facilitate proper performance of tests. The facility is equipped with heating, ventilation, and air conditioning (HVAC) systems appropriate to the needs of environmental testing performed at this laboratory.

The environment in which these activities are undertaken does not invalidate the results or adversely affect the required accuracy of any measurements.

The laboratory provides for the effective monitoring, control and recording of environmental conditions that may affect the results of environmental tests as required by the relevant specifications, methods, and procedures. Such environmental conditions include humidity, voltage, temperature, and vibration levels in the laboratory. Systems are controlled and monitored to assure constant and consistent test conditions.

When any of the method or regulatory required environmental conditions change to a point where they may adversely affect test results, analytical testing will be discontinued until the environmental conditions are returned to the required levels.

Environmental conditions of the facility housing the computer network and LIMS are regulated to protect against raw data loss.

18.3 Work Areas

There is effective separation between neighboring areas when the activities therein are incompatible with each other. Examples include:

- Microbiological culture handling and sample incubation areas
- Volatile organic chemical handling areas, including sample preparation and waste disposal, and volatile organic chemical analysis areas

Access to and use of all areas affecting the quality of analytical testing is defined and controlled by secure access to the laboratory building as described below in the Building Security section.

Adequate measures are taken to ensure good housekeeping in the laboratory and to ensure that any contamination does not adversely affect data quality. These measures include regular cleaning to control dirt and dust within the laboratory. Work areas are available to ensure an unencumbered work area. Work areas include:

- Access and entryways to the laboratory
- Sample receipt areas
- Sample storage areas
- Chemical and waste storage areas
- Data handling and storage areas
- Sample processing areas
- Sample analysis areas

Refer to the following documents and procedures for specific requirements for microbiological laboratory facilities:

- Standard Methods, 9020B, Sec. 2
- TNI V1M5, 1.7.3.7.a

18.4 Floor Plan

A floor plan can be found in Appendix 1.

18.5 Building Security

Building keys and alarm codes are distributed to employees as necessary.

Visitors to the laboratory sign in and out in a visitor's logbook. A visitor is defined as any person who visits the laboratory who is not an employee of the laboratory. In addition to signing into the laboratory, the Environmental, Health and Safety Manual contains requirements for visitors and vendors. There are specific safety forms that must be reviewed and signed. Visitors (with the exception of company employees) are escorted by laboratory personnel at all times, or the location of the visitor is noted in the visitor's logbook.

SECTION 19

TEST METHODS AND METHOD VALIDATION

19.1 Overview

The laboratory uses methods that are appropriate to meet our clients' requirements and that are within the scope of the laboratory's capabilities. These include sampling, handling, transport, storage and preparation of samples, and, where appropriate, an estimation of the measurement of uncertainty as well as statistical techniques for analysis of environmental data.

Instructions are available in the laboratory for the operation of equipment as well as for the handling and preparation of samples. All instructions, Standard Operating Procedures (SOPs), reference methods and manuals relevant to the working of the laboratory are readily available to all staff. Deviations from published methods are documented (with justification) in the laboratory's approved SOPs. SOPs are submitted to clients for review at their request. Significant deviations from published methods require client approval and regulatory approval where applicable.

19.2 Standard Operating Procedures (SOPs)

The laboratory maintains SOPs that accurately reflect all phases of the laboratory such as assessing data integrity, corrective actions, handling customer complaints as well as all analytical methods and sampling procedures. The method SOPs are derived from the most recently promulgated/approved, published methods and are specifically adapted to the laboratory facility. Modifications or clarifications to published methods are clearly noted in the SOPs. All SOPs are controlled in the laboratory. A SOP list is included in Appendix 4. The most current list of SOPs is maintained in the QA SOP directory, Work Instruction PT-QA-WI-002.

- All SOPs contain a revision number, effective date, and appropriate approval signatures. Controlled copies are available to all staff.
- Procedures for writing an SOP are incorporated by reference to TestAmerica's Corporate SOP No. CW-Q-S-002, *Writing a Standard Operating Procedure*, or Pittsburgh SOP No. PT-QA-010, *Document Development and Control*.
- SOPs are reviewed at a minimum of every 2 years, and where necessary, revised to ensure continuing suitability and compliance with applicable requirements. SOPs related to drinking water testing are reviewed every year.

19.3 Laboratory Methods Manual

For each test method, the laboratory shall have available the published referenced method as well as the laboratory developed SOP.

Note: If more stringent standards or requirements are included in a mandated test method or regulation than those specified in this manual, the laboratory shall demonstrate that such requirements are met. If it is not clear which requirements are more stringent, the standard from the method or regulation is to be followed. Any exceptions or deviations from the referenced methods or regulations are noted in the specific analytical SOP.

The laboratory maintains an SOP Index (PT-QA-WI-002) for both technical and non-technical SOPs. Technical SOPs are maintained to describe a specific test method. Non-technical SOPs are maintained to describe functions and processes not related to a specific test method.

19.4 Selection Of Methods

Since numerous methods and analytical techniques are available, continued communication between the client and laboratory is imperative to assure the correct methods are utilized. Once client methodology requirements are established, this and other pertinent information is summarized by the Project Manager. These mechanisms ensure that the proper analytical methods are applied when the samples arrive for log-in. For non-routine analytical services (e.g., special matrices, non-routine compound lists), the method of choice is selected based on client needs and available technology. The methods selected should be capable of measuring the specific parameter of interest, in the concentration range of interest, and with the required precision and accuracy.

19.4.1 Sources of Methods

Routine analytical services are performed using standard EPA-approved methodology. In some cases, modification of standard approved methods may be necessary to provide accurate analyses of particularly complex matrices. When the use of specific methods for sample analysis is mandated through project or regulatory requirements, only those methods shall be used.

When clients do not specify the method to be used or methods are not required, the methods used will be clearly validated and documented in an SOP and available to clients and/or the end user of the data.

The analytical methods used by the laboratory are those currently accepted and approved by the U. S. EPA and the state or territory from which the samples were collected. Reference methods include:

- *Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act; Analysis and Sampling Procedures; 40CFR Part 136 as amended by Method Update Rule, Most Recent Publication*
- *Methods for Chemical Analysis of Water and Wastes, EPA 600 (4-79-020), 1983*
- *Methods for the Determination of Inorganic Substances in Environmental Samples, EPA-600/R-93/100, August 1993*
- *Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91/010, June 1991. Supplement I: EPA-600/R-94/111, May 1994*
- *Standard Methods for the Examination of Water and Wastewater, 18th/19th /20th /on-line edition; Eaton, A.D. Clesceri, L.S. Greenberg, A.E. Eds; American Water Works Association, Water Pollution Control Federation, American Public Health Association: Washington, D.C.*
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008, Final Update V, August 2015*
- *Annual Book of ASTM Standards, American Society for Testing & Materials (ASTM), Philadelphia, PA.*

- *Code of Federal Regulations (CFR) 40, Parts 136, 141, 172, 173, 178, 179 and 261*
- *Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities – Testing Manual, U.S. Army Corps of Engineers, January, 2003*

The laboratory reviews updated versions to all the aforementioned references for adaptation based upon capabilities, instrumentation, etc., and implements them as appropriate. As such, the laboratory strives to perform only the latest versions of each approved method as regulations allow or require.

Other reference procedures for non-routine analyses may include methods established by specific states (e.g., Underground Storage Tank methods), ASTM or equipment manufacturers. Sample type, source, and the governing regulatory agency requiring the analysis will determine the method utilized.

The laboratory shall inform the client when a method proposed by the client may be inappropriate or out of date. After the client has been informed, and they wish to proceed contrary to the laboratory's recommendation, it will be documented.

19.4.2 Demonstration of Capability

Before the laboratory may institute a new method and begin reporting results, the laboratory shall confirm that it can properly operate the method. In general, this demonstration does not test the performance of the method in real world samples, but in an applicable and available clean matrix sample. If the method is for the testing of analytes that are not conducive to spiking, demonstration of capability may be performed on quality control samples.

A demonstration of capability (DOC) is performed whenever there is a change in instrument type (e.g., new instrumentation), matrix, method or personnel (e.g., analyst hasn't performed the test within the last 12 months). The IDOC must meet the control limits specified in the reference method, if any, or meet method LCS criteria if no IDOC specific controls are provided. (see laboratory SOP No. PT-QA-001, *Employee Orientation and Training*, for details)

Note: The laboratory shall have a DOC for all analytes included in the methods that the laboratory performs, and proficiency DOCs for each analyst shall include all analytes that the laboratory routinely performs. Addition of non-routine analytes does not require new DOCs for all analysts if those analysts are already qualified for routine analytes tested using identical chemistry and instrument conditions.

The initial demonstration of capability must be thoroughly documented and approved by the Technical Director or Lab Director and QA Manager prior to independently analyzing client samples. All associated documentation must be retained in accordance with the laboratories archiving procedures.

The laboratory must have an approved SOP, demonstrate satisfactory performance, and conduct an MDL study (when applicable). There may be other requirements as stated within the published method or regulations (i.e., retention time window study).

Note: In some instances, a situation may arise where a client requests that an unusual analyte be reported using a method where this analyte is not normally reported. If the analyte is being reported for regulatory purposes, the method must meet all procedures outlined within this QA Manual (SOP, MDL, and DOC). If the client states that the information is not for regulatory purposes, the result may be reported as long as the following criteria are met:

- The instrument is calibrated for the analyte to be reported using the criteria for the method and ICV/CCV criteria are met (unless an ICV/CCV is not required by the method or criteria are per project DQOs).
- The laboratory's nominal or default reporting limit (RL) is equal to the quantitation limit (QL), must be at or above the lowest non-zero standard in the calibration curve and must be reliably determined. Project RLs are client specified reporting levels which may be higher than the QL. Results reported below the QL must be qualified as estimated values. Also see Section 19.6.1.3, Relationship of Limit of Detection (LOD) to Quantitation Limit (QL).
- The client request is documented and the lab informs the client of its procedure for working with unusual compounds. The final report must be footnoted: *Reporting Limit based on the low standard of the calibration curve.*

19.4.3 Initial Demonstration of Capability (IDOC) Procedures

Initial Demonstration and Capability (IDOC) procedure is described in laboratory SOP No. PT-QA-001.

A certification statement (Figure 19-1) shall be used to document the completion of each initial and continuing demonstration of capability. A copy of the certification is archived in the analyst's training file.

19.5 Laboratory Developed Methods And Non-Standard Methods

Any new method developed by the laboratory must be fully defined in an SOP and validated by qualified personnel with adequate resources to perform the method. Method specifications and the relation to client requirements must be clearly conveyed to the client if the method is a non-standard method (not a published or routinely accepted method). The client must also be in agreement to the use of the non-standard method.

19.6 Validation Of Methods

Validation is the confirmation by examination and the provision of objective evidence that the particular requirements for a specific intended use are fulfilled. Validation of a method is a planned activity. A coordinator is designated for the process, who's responsibility it is to communicate the process and progress to all involved personnel.

All non-standard methods, laboratory designed/developed methods, standard methods used outside of their scope, and major modifications to published methods must be validated to confirm they are fit for their intended use. The validation will be as extensive as necessary to meet the needs of the given application. The results are documented with the validation procedure used and contain a statement as to the fitness for use.

19.6.1 Method Validation and Verification Activities for All New Methods

While method validation can take various courses, the following activities can be required as part of method validation. Method validation records are designated QC records and are archived accordingly.

19.6.1.1 Determination of Method Selectivity

Method selectivity is the demonstrated ability to discriminate the analyte(s) of interest from other compounds in the specific matrix or matrices from other analytes or interference. In some cases to achieve the required selectivity for an analyte, a confirmation analysis is required as part of the method.

19.6.1.2 Determination of Method Sensitivity

Sensitivity can be both estimated and demonstrated. Whether a study is required to estimate sensitivity depends on the level of method development required when applying a particular measurement system to a specific set of samples. Where estimations and/or demonstrations of sensitivity are required by regulation or client agreement, such as the procedure in 40 CFR Part 136 Appendix B, under the Clean Water Act, these shall be followed.

19.6.1.3 Relationship of Limit of Detection (LOD) to the Quantitation Limit (QL)

An important characteristic of expression of sensitivity is the difference in the LOD and the QL. The LOD is the minimum level at which the presence of an analyte can be reliably concluded. The QL is the minimum concentration of analyte that can be quantitatively determined with acceptable precision and bias. For most instrumental measurement systems, there is a region where semi-quantitative data is generated around the LOD (both above and below the estimated MDL or LOD) and below the QL. In this region, detection of an analyte may be confirmed but quantification of the analyte is unreliable within the accuracy and precision guidelines of the measurement system. When an analyte is detected below the QL, and the presence of the analyte is confirmed by meeting the qualitative identification criteria for the analyte, the analyte can be reliably reported, but the amount of the analyte can only be estimated. If data is to be reported in this region, it must be done so with a qualification that denotes the semi-quantitative nature of the result.

19.6.1.4 Determination of Interferences

A determination that the method is free from interferences in a blank matrix is performed.

19.6.1.5 Determination of Range

Where appropriate to the method, the quantitation range is determined by comparison of the response of an analyte in a curve to established or targeted criteria. Generally the upper quantitation limit is defined by highest acceptable calibration concentration. The lower quantitation limit or QL cannot be lower than the lowest non-zero calibration level, and can be constrained by required levels of bias and precision.

19.6.1.6 Determination of Accuracy and Precision

Accuracy and precision studies are generally performed using replicate analyses, with a resulting percent recovery and measure of reproducibility (standard deviation, relative standard deviation) calculated and measured against a set of target criteria.

19.6.1.7 Documentation of Method

The method is formally documented in an SOP. If the method is a minor modification of a standard laboratory method that is already documented in an SOP, an SOP Attachment describing the specific differences in the new method is acceptable in place of a separate SOP.

19.6.1.8 Continued Demonstration of Method Performance

Continued demonstration of Method Performance is addressed in the SOP. Continued demonstration of method performance is generally accomplished by batch specific QC samples such as LCS, method blanks or PT samples.

19.7 Method Detection Limits (MDL)/ Limits Of Detection (LOD)

Method detection limits (MDL) are initially determined in accordance with 40 CFR Part 136, Appendix B or alternatively by other technically acceptable practices that have been accepted by regulators. MDL is also sometimes referred to as Limit of Detection (LOD). The MDL theoretically represents the concentration level for each analyte within a method at which the analyst is 99% confident that the true value can be differentiated from blanks. The MDL is determined for each analyte initially during the method validation process and updated as required in the analytical methods, whenever there is a significant change in the procedure or equipment, or based on project specific requirements. Generally, the analyst prepares at least seven replicates of solution spiked at one to five times the estimated method detection limit (most often at the lowest standard in the calibration curve) into the applicable matrix with all the analytes of interest. Each of these aliquots is extracted (including any applicable clean-up procedures) and analyzed in the same manner as the samples. All instruments used for analysis of client samples are included in the MDL study and verification. Where possible, the seven replicates should be analyzed over 2-4 days to provide a more realistic MDL. [To allow for some flexibility, this low level standard may be analyzed every batch or every week or some other frequency rather than doing the study all at once. In addition, a larger number of data points may be used if the appropriate t-value multiplier is used]

Refer to the Corporate SOP No. CA-Q-S-006 or laboratory SOP No. PT-QA-007, *Detection Limits*, for details on the laboratory's MDL process.

19.8 Instrument Detection Limits (IDL)

The IDL is sometimes used to assess the reasonableness of the MDLs or in some cases required by the analytical method or program requirements. IDLs are most used in metals analyses but may be useful in demonstration of instrument performance in other areas.

IDLs are calculated to determine an instrument's sensitivity independent of any preparation method. IDLs are calculated either using 7 replicate spike analyses, like MDL but without sample preparation, or by the analysis of 10 instrument blanks and calculating 3 x the absolute value of the standard deviation.

If IDL is > than the MDL, it may be used as the reported MDL.

19.9 Verification Of Detection And Reporting Limits

Once the MDL is determined, it must be verified on each by analyzing a quality control sample (prepared as a sample) at no more than 3 times the calculated MDL for single analyte analyses (e.g. most wet chemistry methods) and no more than 4 times the calculated MDL for multiple analyte methods (e.g. GC, GCMS, ICP, etc.). The analytes must be qualitatively identified. This verification does not apply to methods that are not readily spiked (e.g. pH, turbidity, etc.) or where the lab does not report to the MDL. If the MDL does not verify, then the lab will not report to the MDL, or redevelop their MDL or use the level where qualitative identification is established. MDLs must be verified at least annually. Refer to the laboratory SOP PT-QA-007 for further details.

When the laboratory establishes a quantitation limit, it must be initially verified by the analysis of a low level standard or QC sample at 1-2 times the reporting limit and annually thereafter. The annual requirement is waived for methods that have an annually verified MDL. The laboratory will comply with any regulatory requirements.

The laboratory quantitation limit is equivalent to the Limit of Quantitation (LOQ), which is at a concentration equal to or greater than the lowest non-zero calibration standard. The RL is a level at or above the LOQ that is used for specific project reporting purposes, as agreed to between the laboratory and the client. The RL cannot be lower than the LOQ concentration, but may be higher. The LOQ is at a concentration equal to, or greater than, the MDL.

19.10 Retention Time Windows

Most organic analyses and some inorganic analyses use chromatography techniques for qualitative and quantitative determinations. For every chromatography analysis or as specific in the reference method, each analyte will have a specific time of elution from the column to the detector. This is known as the analyte's retention time. The variance in the expected time of elution is defined as the retention time window. As the key to analyte identification in chromatography, retention time windows must be established on every column for every analyte used for that method. These records are kept with the files associated with an instrument for later quantitation of the analytes. Complete details are available in the laboratory SOPs.

19.11 Evaluation Of Selectivity

The laboratory evaluates selectivity by following the checks within the applicable analytical methods, which include mass spectral tuning, second column confirmation, ICP interelement interference checks, chromatography retention time windows, sample blanks, spectrochemical, atomic absorption or fluorescence profiles, co-precipitation evaluations and specific electrode response factors.

19.12 Estimation Of Uncertainty Of Measurement

19.12.1 Uncertainty is "a parameter associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand" (as defined by the International Vocabulary of Basic and General Terms in Metrology, ISO Geneva, 1993, ISBN 92-67-10175-1). Knowledge of the uncertainty of a measurement provides additional confidence in a result's validity. Its value accounts for all the factors which could possibly affect the result, such as adequacy of analyte definition, sampling, matrix effects and interferences, climatic conditions, variances in weights, volumes, and standards, analytical

procedure, and random variation. Some national accreditation organizations require the use of an "expanded uncertainty": the range within which the value of the measurand is believed to lie within at least a 95% confidence level with the coverage factor k=2.

19.12.2 Uncertainty is not error. Error is a single value, the difference between the true result and the measured result. On environmental samples, the true result is never known. The measurement is the sum of the unknown true value and the unknown error. Unknown error is a combination of systematic error, or bias, and random error. Bias varies predictably, constantly, and independently from the number of measurements. Random error is unpredictable, assumed to be Gaussian in distribution, and reducible by increasing the number of measurements.

19.12.3 The minimum uncertainty associated with results generated by the laboratory can be determined by using the Laboratory Control Sample (LCS) accuracy range for a given analyte. The LCS limits are used to assess the performance of the measurement system since they take into consideration all of the laboratory variables associated with a given test over time (except for variability associated with the sampling and the variability due to matrix effects). The percent recovery of the LCS is compared either to the method-required LCS accuracy limits or to the statistical, historical, in-house LCS accuracy limits.

19.12.4 To calculate the uncertainty for the specific result reported, multiply the result by the decimal of the lower end of the LCS range percent value for the lower end of the uncertainty range, and multiply the result by the decimal of the upper end of the LCS range percent value for the upper end of the uncertainty range. These calculated values represent uncertainties at approximately the 99% confidence level with a coverage factor of k =3. As an example, for a reported result of 1.0 mg/L with an LCS recovery range of 50 to 150%, the estimated uncertainty in the result would be 1.0 +/- 0.5 mg/L. Uncertainty determination is further described in Pittsburgh Laboratory SOP No. PT-QA-005, *Measurement Uncertainty*.

19.12.5 In the case where a well recognized test method specifies limits to the values of major sources of uncertainty of measurement and specifies the form of presentation of calculated results, no further discussion of uncertainty is required.

19.13 Sample Reanalysis Guidelines

Because there is a certain level of uncertainty with any analytical measurement, a sample re-preparation (where appropriate) and subsequent analysis (hereafter referred to as 'reanalysis') may result in either a higher or lower value from an initial sample analysis. There are also variables that may be present (e.g., sample homogeneity, analyte precipitation over time, etc.) that may affect the results of a reanalysis. Based on the above comments, the laboratory will reanalyze samples at a client's request with the following caveats. **Client specific Contractual Terms & Conditions for reanalysis protocols may supercede the following items.**

- Homogenous samples: If a reanalysis agrees with the original result to within the RPD limits for MS/MSD or Duplicate analyses, or within $\pm$ 1 reporting limit for samples $\leq$ 5x the reporting limit, the original analysis will be reported. At the client's request, both results may be reported.
- If the reanalysis does not agree (as defined above) with the original result, then the laboratory will investigate the discrepancy and reanalyze the sample a third time for confirmation if sufficient sample is available.

- Any potential charges related to reanalysis are discussed in the contract terms and conditions or discussed at the time of the request. The client will typically be charged for reanalysis unless it is determined that the lab was in error.
- Due to the potential for increased variability, reanalysis may not be applicable to Non-homogenous, Encore, and Sodium Bisulfate preserved samples. See the Area Technical Manager/Supervisor or Laboratory Director if unsure.

19.14 Control Of Data

The laboratory has policies and procedures in place to ensure the authenticity, integrity, and accuracy of the analytical data generated by the laboratory.

19.14.1 Computer and Electronic Data Related Requirements

The three basic objectives of our computer security procedures and policies are shown below. The laboratory is currently running the TALs LIMS which is a custom in-house developed LIMS system that has been highly customized to meet the needs of the laboratory. It is referred to as LIMS for the remainder of this section. The LIMS utilizes Microsoft SQL Server, which is an industry standard relational database platform. It is referred to as Database for the remainder of this section.

19.14.1.1 Maintain the Database Integrity: Assurance that data is reliable and accurate through data verification (review) procedures, password-protecting access, anti-virus protection, data change requirements, as well as an internal LIMS permissions procedure.

- LIMS Database Integrity is achieved through data input validation, internal user controls, and data change requirements.
- Spreadsheets and other software developed in-house must be verified with documentation through hand calculations prior to use. Cells containing calculations must be lock-protected and controlled.
- Instrument hardware and software adjustments are safeguarded through maintenance logs, audit trails and controlled access.

19.14.1.2 Ensure Information Availability: Protection against loss of information or service is ensured through scheduled back-ups, stable file server network architecture, secure storage of media, line filter, Uninterruptible Power Supply (UPS), and maintaining older versions of software as revisions are implemented.

19.14.1.3 Maintain Confidentiality: Ensure data confidentiality through physical access controls such as password protection or website access approval, when electronically transmitting data.

19.14.2 Data Reduction

The complexity of the data reduction depends on the analytical method and the number of discrete operations involved (e.g., extractions, dilutions, instrument readings and concentrations). The analyst calculates the final results from the raw data or uses appropriate computer programs to assist in the calculation of final reportable values.

For manual data entry, e.g., Wet Chemistry, the data is reduced by the analyst and then verified by the Department Manager or alternate analyst prior to updating the data in LIMS. The spreadsheets, or any other type of applicable documents, are signed by both the analyst and alternate reviewer to

confirm the accuracy of the manual entry(s). The applicable data/spreadsheet is scanned in LIMS with the batch.

Manual integration of peaks will be documented and reviewed and the raw data will be flagged in accordance with the TestAmerica Corporate SOP No. CA-Q-S-002, *Acceptable Manual Integration Practices*.

Analytical results are reduced to appropriate concentration units specified by the analytical method, taking into account factors such as dilution, sample weight or volume, etc. Blank correction will be applied only when required by the method or per manufacturer's indication; otherwise, it should not be performed. Calculations are independently verified by appropriate laboratory staff. Calculations and data reduction steps for various methods are summarized in the respective analytical SOPs or program requirements.

19.14.2.1 All raw data must be retained, including computer file (if appropriate), and/or run log. All criteria pertinent to the method must be recorded. The documentation is recorded at the time observations or calculations are made and must be signed or initialed/dated (month/day/year). It must be easily identifiable who performed which tasks if multiple people were involved.

19.14.2.2 In general, concentration results are reported in milligrams per liter (mg/l) or micrograms per liter (µg/l) for liquids and milligrams per kilogram (mg/kg) or micrograms per kilogram (µg/kg) for solids. For values greater than 10,000 mg/l, results can be reported in percent, i.e., 10,000 mg/l = 1**%**. Units are defined in each lab SOP.

19.14.2.3 In reporting, the analyst or the instrument output records the raw data result using values of known certainty plus one uncertain digit. If final calculations are performed external to LIMS, the results should be entered in LIMS with at least three significant figures. In general, results are reported to 2 significant figures on the final report.

19.14.2.4 For those methods that do not have an instrument printout or an instrumental output compatible with the LIMS System, the raw results and dilution factors are entered directly into LIMS by the analyst, and the software calculates the final result for the analytical report. LIMS has a defined significant figure criterion for each analyte.

19.14.2.5 The laboratory strives to import data directly from instruments or calculation spreadsheets to ensure that the reported data are free from transcription and calculation errors. For those analyses with an instrumental output compatible with the LIMS, the raw results and dilution factors are transferred into LIMS electronically after reviewing the quantitation report, and removing unrequested or poor spectrally-matched compounds. The analyst prints a copy of what has been entered to check for errors. This printout and the instrument's printout of calibrations, concentrations, retention times, chromatograms, and mass spectra, if applicable, are retained with the data file. The data file is stored on the server and every night backed up to a tape file.

19.14.3 Logbook / Worksheet Use Guidelines

Logbooks and worksheets are filled out 'real time' and have enough information on them to trace the events of the applicable analysis/task. (e.g. calibrations, standards, analyst, sample ID, date, time on short holding time tests, temperatures when applicable, calculations are traceable, etc.)

- Corrections are made following the procedures outlined in Section 12.
- Logbooks are controlled by the QA department. A record is maintained of all logbooks in the lab.
- Unused portions of pages must be "Z"'d out, signed and dated.
- Worksheets are created with the approval of the Technical Manager and QA Manager at the facility.
  - Any cells that perform calculations must have the calculation verified and the cell locked so that the formula cannot be changed.
  - The QA Manager controls all worksheets following the procedures in Section 6.

19.14.4 Review / Verification Procedures

Data review procedures comprise a set of computerized and manual checks applied at appropriate levels of the measurement process. See Pittsburgh Laboratory SOPs PT-QA-013, *Independent QA Data Review*; PT-QA-018, *Technical Data Review*; and PT-SR-001, *Sample Receipt and Login*; for details.

19.14.4.1 Log-In Review - The data review process starts at the sample receipt stage. Sample control personnel review chain-of-custody forms and project instructions from the project management group. This is the basis of the sample information and analytical instructions entered into the LIMS. The log-in instructions are reviewed by the personnel entering the information, and a second level review is conducted by the project management staff.

19.14.4.2 First Level Data Review - The next level of data review occurs with the analysts. As data are generated, analysts review their work to ensure that the results meet project and SOP requirements. First level reviews include inspection of all raw data (e.g., instrument output for continuous analyzers, chromatograms, spectra, and manual integrations), evaluation of calibration/calibration verification data in the day's analytical run, evaluation of QC data, documentation of standards and reagents, and reliability of sample results. The analyst transfers data into LIMS, data qualifiers are added as needed. All first level reviews are documented.

19.14.4.3 Second Level Data Review – All analytical data are subject to review by a second qualified analyst or supervisor. Second level reviews include inspection of all raw data (e.g., instrument output, chromatograms, and spectra) including 100% of data associated with any changes made by the primary analyst, such as manual integrations or reassignment of peaks to different analytes, or elimination of false negative analytes. The second review also includes evaluation of initial calibration/calibration verification data in the day's analytical run, evaluation of QC data, documentation of standards and reagents, reliability of sample results, qualifiers and NCM narratives. Manual calculations are checked in second level review. All second level reviews are documented.

Issues that deem further review include the following:

- QC data are outside the specified control limits for accuracy and precision
- Reviewed sample data does not match with reported results
- Unusual detection limit changes are observed
- Samples having unusually high results
- Samples exceeding a known regulatory limit
- Raw data indicating some type of contamination or poor technique
- Inconsistent peak integration
- Transcription errors
- Results outside of calibration range

19.14.4.4 Unacceptable analytical results may require reanalysis of the samples. Any problems are brought to the attention of the Laboratory Director, Project Manager, Quality Assurance Manager, Technical Director, Department Manager or section Supervisor for further investigation. Corrective action is initiated whenever necessary.

19.14.4.5 The results are then entered or directly transferred into the computer database and a hard copy (or .pdf) is printed for the client.

19.14.4.6 As a final review prior to the release of the report, the Project Manager (or designee) reviews the results for appropriateness and completeness. This review and approval ensures that client requirements have been met and that the final report has been properly completed. The process includes, but is not limited to, verifying that chemical relationships are evaluated, COC is followed, cover letters/ narratives are present, flags are appropriate, and project specific requirements are met.

19.14.4.7 Any project that requires a data package is subject to a tertiary data review for transcription errors and acceptable quality control requirements. The Project Manager (or designee) then signs the final report. They also check the report for any clerical or invoicing errors. When complete, the report is sent out to the client.

19.14.4.8 As a further check of the system, the QA department reviews both selected and random analytical batches and final reports.

19.14.4.9 A visual summary of the flow of samples and information through the laboratory, as well as data review and validation, is presented in Figure 19-2.

19.14.5 Manual Integrations

Computerized data systems provide the analyst with the ability to re-integrate raw instrument data in order to optimize the interpretation of the data. Though manual integration of data is an invaluable tool for resolving variations in instrument performance and some sample matrix problems, when used improperly, this technique would make unacceptable data appear to meet quality control acceptance limits. Improper re-integrations lead to legally indefensible data, a poor reputation, or possible laboratory decertification. Because guidelines for re-integration of data are not provided in the methods and most methods were written prior to widespread implementation of computerized data systems, the laboratory trains all analytical staff on proper manual integration techniques using Corporate SOP No. CA-Q-S-002.

19.14.5.1 The analyst must adjust baseline or the area of a peak in some situations, for example when two compounds are not adequately resolved or when a peak shoulder needs to be separated from the peak of interest. The analyst must use professional judgment and common sense to determine when manual integrating is required. Analysts are encouraged to ask for assistance from a senior analyst or manager when in doubt.

19.14.5.2 Analysts shall not increase or decrease peak areas for the sole purpose of achieving acceptable QC recoveries that would have otherwise been unacceptable. The intentional recording or reporting of incorrect information (or the intentional omission of correct information) is against company principles and policy and is grounds for immediate termination.

19.14.5.3 Client samples, performance evaluation samples, and quality control samples are all treated equally when determining whether or not a peak area or baseline should be manually adjusted.

19.14.5.4 All manual integrations receive a second level review. Manual integrations must be indicated on an expanded scale “after” chromatograms such that the integration performed can be easily evaluated during data review. Expanded scale “before” chromatograms are also required for all manual integrations on QC parameters (calibrations, calibration verifications, laboratory control samples, internal standards, surrogates, etc.) unless the laboratory has another documented Corporate approved procedure in place that can demonstrate an active process for detection and deterrence of improper integration practices.

Figure 19-1

Example - Demonstration of Capability Documentation

DEMONSTRATION OF CAPABILITIY (DOC)

Laboratory Name:_____
Laboratory Address:_____
Method:_____ Matrix:_____
Date:_____ Analyst(s):_____
Source of Analyte(s):_____

Analytical Results

Analyst	Conc. (Units)	Rep 1	Rep 2	Rep 3	Rep 4	Avg. % Recovery	% RSD

% RSD = Percent relative standard deviation = standard deviation divided by average % Recovery

Raw data reference: _____

Certification Statement:

We, the undersigned, certify that:

1. The analyst identified above, using the cited test method with the specifications in the cited SOP, which is in use at this facility for the analysis of samples under the laboratory's Quality Assurance Plan, has completed the Demonstration of Capability (DOC).
2. The test method(s) was performed by the analyst identified on this certificate.
3. A copy of the test method and the laboratory-specific SOPs are available for all personnel on site. These documents have been reviewed by the analyst as part of this DOC.
4. The data associated with the demonstration of capability are true, accurate, complete, and self-explanatory.
5. All raw data necessary to reconstruct and validate these analyses have been retained at the facility, and the associated information is well organized and available for review.

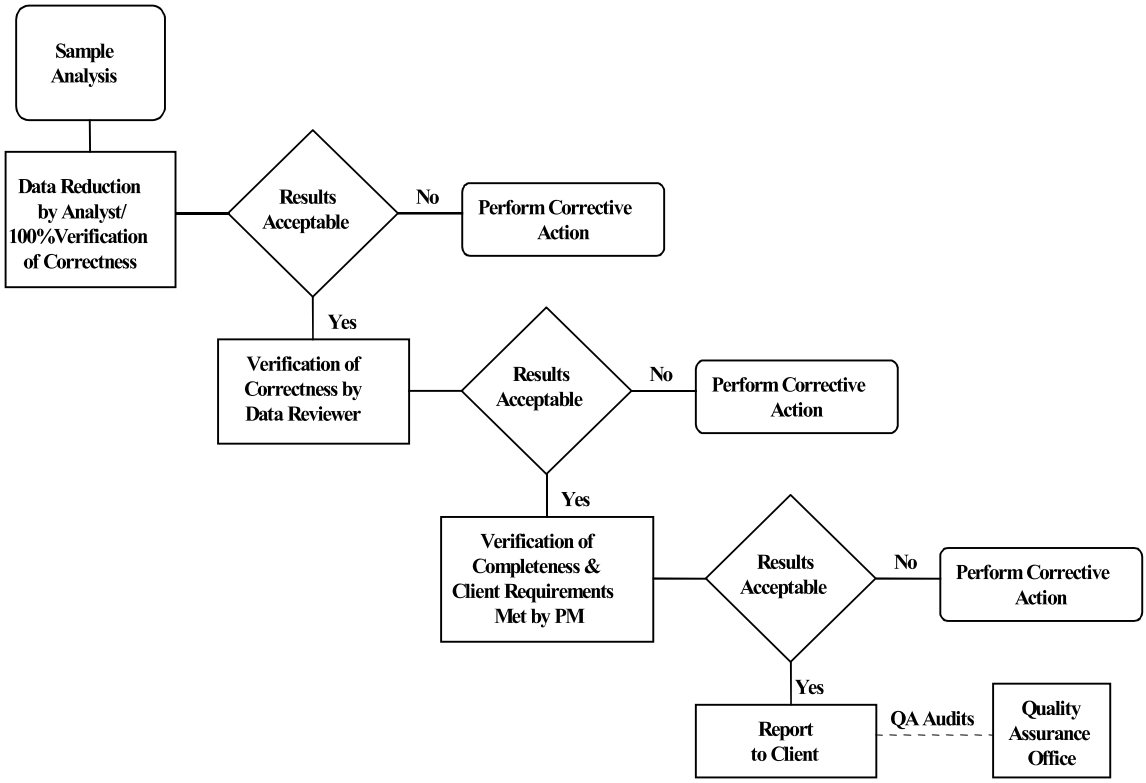
_____ _____
Analyst Signature Date

_____ _____
Technical Manager Signature Date

_____ _____
Quality Assurance Coordinator Signature Date

Figure 19-2

Work Flow



SECTION 20

EQUIPMENT AND CALIBRATIONS

20.1 Overview

The laboratory purchases the most technically advanced analytical instrumentation for sample analyses. Instrumentation is purchased on the basis of accuracy, dependability, efficiency and sensitivity. Each laboratory is furnished with all items of sampling, preparation, analytical testing and measurement equipment necessary to correctly perform the tests for which the laboratory has capabilities. Each piece of equipment is capable of achieving the required accuracy and complies with specifications relevant to the method being performed. Before being placed into use, the equipment (including sampling equipment) is calibrated and checked to establish that it meets its intended specification. The calibration routines for analytical instruments establish the range of quantitation. Calibration procedures are specified laboratory analytical SOPs. Also see Corporate Policy No. CA-Q-P-003, *Calibration Curves and Selection of Calibration Points*.

A list of laboratory instrumentation types is presented in Table 20-1.

Equipment is only operated by authorized and trained personnel. Manufacturer's instructions for equipment use are readily accessible to all appropriate laboratory personnel.

20.2 Preventive Maintenance

The laboratory follows a well-defined maintenance program to ensure proper equipment operation and to prevent the failure of laboratory equipment or instrumentation during use. This program of preventive maintenance helps to avoid delays due to instrument failure.

Routine preventive maintenance procedures and frequency, such as cleaning and replacements, should be performed according to the procedures outlined in the manufacturer's manual. Qualified personnel must also perform maintenance when there is evidence of degradation of peak resolution, a shift in the calibration curve, loss of sensitivity, or failure to continually meet one of the quality control criteria.

Table 20-2 lists examples of scheduled routine maintenance. It is the responsibility of each Technical Manager to ensure that instrument maintenance logs are kept for all equipment in his/her department. Preventative maintenance procedures may also be outlined in analytical SOPs or instrument manuals. Further detail for equipment maintenance is included in SOP No. PT-QA-022 and individual analytical SOPs. (Note: for some equipment, the log used to monitor performance is also the maintenance log. Multiple pieces of equipment may share the same log as long as it is clear as to which instrument is associated with an entry.)

Instrument maintenance logs are controlled and are used to document instrument problems, instrument repair and maintenance activities. Maintenance logs shall be kept for all major pieces of equipment. Instrument maintenance logs may also be used to specify instrument parameters.

- Documentation must include all major maintenance activities such as contracted preventive maintenance and service and in-house activities such as the replacement of electrical components, lamps, tubing, valves, columns, detectors, cleaning and adjustments.

- Each entry in the instrument log includes the Analyst's initials, the date, a detailed description of the problem (or maintenance needed/scheduled), a detailed explanation of the solution or maintenance performed, and a verification that the equipment is functioning properly (state what was used to determine a return to control. e.g. CCV run on *'date'* was acceptable, or instrument recalibrated on 'date' with acceptable verification, etc.) must also be documented in the instrument records.

- When maintenance or repair is performed by an outside agency, service receipts detailing the service performed can be affixed into the logbooks adjacent to pages describing the maintenance performed. This attached document must be signed across the page entered and the logbook so that it is clear that a page is missing if only half a signature is found in the logbook.

If an instrument requires repair (subjected to overloading or mishandling, gives suspect results, or otherwise has shown to be defective or outside of specified limits) it shall be taken out of operation and tagged as out-of-service or otherwise isolated until such a time as the repairs have been made and the instrument can be demonstrated as operational by calibration and/or verification or other test to demonstrate acceptable performance. The laboratory shall examine the effect of this defect on previous analyses.

In the event of equipment malfunction that cannot be resolved, service shall be obtained from the instrument vendor manufacturer, or qualified service technician, if such a service can be tendered. If on-site service is unavailable, arrangements shall be made to have the instrument shipped back to the manufacturer for repair. Back-up instruments, which have been approved, for the analysis shall perform the analysis normally carried out by the malfunctioning instrument. If the back-up is not available and the analysis cannot be carried out within the needed timeframe, the samples shall be subcontracted.

If an instrument is sent out for service or transferred to another facility, it must be recalibrated and the laboratory MDL verified (using an MDLV) prior to return to lab operations.

20.3 Support Equipment

This section applies to all devices that may not be the actual test instrument, but are necessary to support laboratory operations. These include but are not limited to: balances, ovens, refrigerators, freezers, incubators, water baths, field sampling devices, temperature measuring devices, thermal/pressure sample preparation devices and volumetric dispensing devices if quantitative results are dependent on their accuracy, as in standard preparation and dispensing or dilution into a specified volume. All raw data records associated with the support equipment are retained to document instrument performance.

Support equipment that provides quantitative results are calibrated or calibration verified to a recognized national metrology standard, such as NIST, where available, over the expected range of use. The acceptability for use shall be according to the needs of the analysis or application for which the equipment is being used.

Calibration and calibration verification scheduling and documentation for support equipment is maintained by the QA department. All equipment is labeled with the most recent calibration information and the next verification due date.

20.3.1 Weights and Balances

The accuracy of the balances used in the laboratory is checked every working day, before use. All balances are placed on stable counter tops.

Each balance is checked prior to initial serviceable use with at least two certified ASTM type 1 weights spanning its range of use (weights that have been calibrated to ASTM type 1 weights may also be used for daily verification). ASTM type 1 weights used only for calibration of other weights (and no other purpose) are inspected for corrosion, damage or nicks at least annually and if no damage is observed, they are calibrated at least every 5 years by an outside calibration laboratory. Any weights (including ASTM Type 1) used for daily balance checks or other purposes are recalibrated/recertified annually to NIST standards (this may be done internally if laboratory maintains "calibration only" ASTM type 1 weights).

All balances are serviced annually by a qualified service representative, who supplies the laboratory with a certificate that identifies traceability of the calibration to the NIST standards.

All of this information is recorded in logs, and the recalibration/recertification certificates are kept on file. Refer to Pittsburgh Laboratory SOP No. PT-QA-012, *Selection and Calibration of Balances and Weights*, for details.

20.3.2 pH, Conductivity, and Turbidity Meters

The pH meters used in the laboratory are accurate to ± 0.1 pH units, and have a scale readability of at least 0.05 pH units. The meters automatically compensate for the temperature, and are calibrated with at least two working range buffer solutions before each use.

Conductivity meters are also calibrated before each use with a known standard to demonstrate the meters do not exceed an error of 1% or one umhos/cm.

Turbidity meters are also calibrated before each use. All of this information is documented in logs.

Consult pH and Conductivity, and Turbidity laboratory analytical SOPs for further information.

20.3.3 Thermometers

All thermometers are calibrated on an annual basis with a NIST-traceable thermometer. IR thermometers, digital probes and thermocouples are calibrated quarterly. IR thermometers are checked daily for calibration accuracy against an NIST thermometer daily before use.

- If the temperature measuring device is used over a range of 10℃ or less, then a single point verification within the range of use is acceptable;
- If the temperature measuring device is used over a range of greater than 10℃, then the verification must bracket the range of use.

IR thermometers, digital probes and thermocouples are calibrated quarterly.

Mercury or digital NIST thermometers are recalibrated every five years (unless thermometer has been exposed to temperature extremes or apparent separation of internal liquid) by an approved outside service and the provided certificate of traceability is kept on file. The NIST thermometer(s) have increments of at least 1 degree (0.5 degree or less increments are required for drinking water microbiological laboratories), and have ranges applicable to method

and certification requirements. The NIST traceable thermometers are used for no other purpose than to calibrate other thermometers.

All of this information is documented in logbooks. Monitoring method-specific temperatures, including incubators, heating blocks, water baths, and ovens, is documented in method or device-specific logbooks. More information on this subject can be found in Pittsburgh Laboratory SOP No. PT-QA-008, *Thermometer and Barometer Verification and Temperature Monitoring*.

20.3.4 Refrigerators/Freezer Units, Waterbaths, Ovens and Incubators

The temperatures of all refrigerator units and freezers used for sample and standard storage are monitored each working day. Sample storage temperatures are monitored continuously (24/7).

Ovens, waterbaths and incubators are monitored on days of use.

All of this equipment has a unique identification number, and is assigned a unique thermometer for monitoring.

Sample storage refrigerator temperatures are kept between > 0ºC and ≤ 6 ºC.

Specific temperature settings/ranges for other refrigerators, ovens waterbaths, and incubators can be found in method specific SOPs.

All of this information is documented in Daily Temperature Logbooks or electronically. Refer to laboratory SOP No. PT-QA-008.

20.3.5 Autopipettors, Dilutors, and Syringes

Mechanical volumetric dispensing devices, including burettes, (except Class A Glassware and glass microliter syringes) are given unique identification numbers and the delivery volumes are verified gravimetrically, at a minimum, on a quarterly basis. Glass micro-syringes are considered the same as Class A glassware.

For those dispensers that are not used for analytical measurements, a label is applied to the device stating that it is not calibrated. Any device not regularly verified cannot be used for any quantitative measurements. Pipette calibration is described in Pittsburgh Laboratory SOP No. PT-QA-017, *Aqueous Pipette Calibration*.

Micro-syringes are purchased from Hamilton Company. Each syringe is traceable to NIST. The laboratory keeps on file an “Accuracy and Precision Statement of Conformance” from Hamilton attesting established accuracy.

20.3.6 Autoclaves

Autoclave performance is verified prior to initial use and at least annually by a third party vendor, including verification of both temperature and pressure. The timer function is verified quarterly. Sterilization temperatures are recorded on a maximum temperature thermometer for each cycle. Records are maintained for each use including date, contents, maximum temperature reached, pressure, time in sterilization mode, total run time, and analyst’s initials. See Pittsburgh Laboratory SOP No. PT-MI-001 for details.

20.3.7 Field Sampling Devices (Isco Auto Samplers)

Each Auto Sampler (ISCO) is assigned a unique identification number in order to keep track of the calibration. This number is also recorded on the sampling documentation.

The Auto Sampler is calibrated semiannually by setting the sample volume to 100ml and recording the volume received. The results are filed in a logbook/binder. The Auto Sampler is programmed to run three (3) cycles and each of the three cycles is measured into a graduated cylinder to verify 100ml are received.

If the RSD (Relative Standard Deviation) between the 3 cycles is greater than 10%, the procedure is repeated and if the result is still greater than 10%, then the Auto Sampler is taken out of service until it is repaired and calibration verification criteria can be met. The results of this check are kept in a logbook/binder.

20.4 Instrument Calibrations

Calibration of analytical instrumentation is essential to the production of quality data. Strict calibration procedures are followed for each method. These procedures are designed to determine and document the method detection limits, the working range of the analytical instrumentation and any fluctuations that may occur from day to day.

Sufficient raw data records are retained to allow an outside party to reconstruct all facets of the initial calibration. Records contain, but are not limited to, the following: calibration date, method, instrument, analyst(s) initials or signatures, analysis date, analytes, concentration, response, type of calibration (Avg RF, curve, or other calculations that may be used to reduce instrument responses to concentration.)

Sample results must be quantitated from the initial calibration and may not be quantitated from any continuing instrument calibration verification unless otherwise required by regulation, method or program.

If the initial calibration results are outside of the acceptance criteria, corrective action is performed and any affected samples are reanalyzed if possible. If the reanalysis is not possible, any data associated with an unacceptable initial calibration will be reported with appropriate data qualifiers (refer to Section 12).

Note: Instruments are calibrated initially and as needed after that and at least annually.

20.4.1 Calibration Standards

Calibration standards are prepared using the procedures indicated in the Reagents and Standards section of the determinative method SOP. If a reference method does not specify the number of calibration standards, a minimum of 3 calibration points (exception being ICP and ICP/MS methods) will be used.

Standards for instrument calibration are obtained from a variety of sources. All standards are traceable to national or international standards of measurement, or to national or international standard reference materials.

The lowest concentration calibration standard that is analyzed during an initial calibration must be at or below the stated reporting limit for the method based on the final volume of extract (or sample).

The other concentrations define the working range of the instrument/method or correspond to the expected range of concentrations found in actual samples that are also within the working range of the instrument/method. Results of samples not bracketed by initial instrument calibration standards (within calibration range to at least the same number of significant figures used to report the data) must be reported as having less certainty, e.g., defined qualifiers or flags (additional information may be included in the case narrative). The exception to these rules is ICP and ICP-MS methods or other methods which define the working range with periodic linear dynamic range studies, rather than through the range of concentrations of daily calibration standards.

All initial calibrations are verified with a standard obtained from a second source and traceable to a national standard, when available (or vendor certified different lot if a second source is not available). For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst at a different time or by a different preparation would be considered a second source. This verification occurs immediately after the calibration curve has been analyzed, and before the analysis of any samples.

20.4.1.1 Calibration Verification

The calibration relationship established during the initial calibration must be verified at least daily as specified in the laboratory method SOPs in accordance with the referenced analytical methods and in the 2009 TNI standard. The process of calibration verification applies to both external standard and internal standard calibration techniques, as well as to linear and non-linear calibration models. Initial calibration verification is with a standard source secondary (second source standard) to the calibration standards, but continuing calibration verifications may use the same source standards as the calibration curve.

Note: The process of calibration verification referred to is fundamentally different from the approach called "calibration" in some methods. As described in those methods, the calibration factors or response factors calculated during calibration are used to update the calibration factors or response factors used for sample quantitation. This approach, while employed in other EPA programs, amounts to a daily single-point calibration.

All target analytes and surrogates, including those reported as non-detects, must be included in periodic calibration verifications for purposes of retention time confirmation and to demonstrate that calibration verification criteria are being met, i. e., RPD, per 2009 TNI Std. EL-V1M4 Sec. 1.7.2.

All samples must be bracketed by periodic analyses of standards that meet the QC acceptance criteria (e.g., calibration and retention time). The frequency is found in the determinative methods or SOPs.

Generally, the initial calibrations must be verified at the beginning of each 12-hour analytical shift during which samples are analyzed. (Some methods may specify more or less frequent verifications). The 12-hour analytical shift begins with the injection of the calibration verification standard (or the MS tuning standard in MS methods). The shift ends after the completion of the

analysis of the last sample, QC, or standard that can be injected within 12 hours of the beginning of the shift.

A continuing instrument calibration verification (CCV) must be repeated at the beginning and, for methods that have quantitation by external calibration models, at the end of each analytical batch. Some methods have more frequent CCV requirements see specific SOPs. Most Inorganic methods require the CCV to be analyzed after every 10 samples or injections, including matrix or batch QC samples.

Note: If an internal standard calibration is being used (GCMS methods, for example) then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

If the results of a CCV are outside the established acceptance criteria and analysis of a second consecutive (and immediate) CCV fails to produce results within acceptance criteria, corrective action shall be performed. Once corrective actions have been completed & documented, the laboratory shall demonstrate acceptable instrument / method performance by analyzing two consecutive CCVs, or a new initial instrument calibration shall be performed.

Sample analyses and reporting of data may not occur or continue until the analytical system is calibrated or calibration verified. However, data associated with an unacceptable calibration verification may be fully useable and may be reported, based upon discussion and approval of the client, under the following special conditions:

a) When the acceptance criteria for the CCV are exceeded high (i.e., high bias) and the associated samples within the batch are non-detects, then those non-detects may be reported with a footnote or case narrative explaining the high bias. Otherwise the samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted; or

b) When the acceptance criteria for the CCV are exceeded low (i.e., low bias), samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted.

Samples reported under one of the conditions identified above will be appropriately flagged.

20.4.1.2 Verification of Linear and Non-Linear Calibrations

Calibration verification for calibrations involves the calculation of the percent drift or the percent difference of the instrument response between the initial calibration and each subsequent analysis of the verification standard. These calculations are available in the laboratory method SOPs. Verification standards are evaluated based on the % Difference from the average CF or RF of the initial calibration or based on %Drift or %Recovery if a linear or quadratic curve is used.

Regardless of whether a linear or non-linear calibration model is used, if initial verification criterion is not met, then no sample analyses may take place until the calibration has been verified or a new initial calibration is performed that meets the specifications listed in the method SOPs. If the calibration cannot be verified after the analysis of a single verification standard, then adjust the instrument operating conditions and/or perform instrument maintenance, and

analyze another aliquot of the verification standard. If the calibration cannot be verified with the second standard, then a new initial calibration is performed.

- When the acceptance criteria for the calibration verification are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported. Otherwise, the samples affected by the unacceptable calibration verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted.

- When the acceptance criteria for the calibration verification are exceeded low, i.e., low bias, those samples affected by the unacceptable verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted. Alternatively, a reporting limit standard may be analyzed to demonstrate that the laboratory can still support non-detects at their reporting limit.

Note: Some programs require additional verification steps for linear and quadratic calibration – i.e. reading the lowest, or all, initial calibration level standard against the curve, or verification at a low and a high concentration. See analytical SOPs and project notes for details.

20.5 Tentatively Identified Compounds (TICs) – GC/MS Analysis

For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by the purpose of the analyses being conducted. Data system library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other.

Note: If the TIC compound is not part of the client target analyte list but is calibrated by the laboratory and is both qualitatively and/or quantitatively identifiable, it should not be reported as a TIC. If the compound is reported on the same form as true TICs, it should be qualified and/or narrated that the reported compound is qualitatively and quantitatively (if verification in control) reported compared to a known standard that is in control (where applicable).

For example, the RCRA permit or waste delisting requirements may require the reporting of non-target analytes. Only after visual comparison of sample spectra with the nearest library searches may the analyst assign a tentative identification.

20.6 GC/MS TUNING

Prior to any GCMS analytical sequence, including calibration, the instrument parameters for the tune and subsequent sample analyses within that sequence must be set.

Prior to tuning/auto-tuning the mass spec, the parameters may be adjusted within the specifications set by the manufacturer or the analytical method. These generally don't need any adjustment but it may be required based on the current instrument performance. If the tune verification does not pass it may be necessary to clean the source or perform additional maintenance. Any maintenance is documented in the maintenance log.

Table 20-1

TestAmerica Pittsburgh Instrumentation Type List
(see PT-QA-WI-045 for the most current full listing of instrumentation and equipment)

GC	GC/MS	ICP	ICP/MS	IC	Carbon Analyzer	Auto-Analyzer	Variable Spectro-photometer	Electrode Meter
√	√	√	√	√	√	√	√	√

Tables 20-2

Example - Schedule of Routine Maintenance
(See SOP No. PT-QA-022 for more instrument specific information)

Daily	Weekly	Monthly	Quarterly	Annually	As Needed
Check sample waste container level.	Check peristaltic pump: proper roller pressure, sample introduction tubing, correct pump rotation, and condition of drain tubing.	Clean all filters and fans.	Replace oil in roughing pumps.	Replace oil in turbo-molecular pump.	Check electronic settings for optimum sensitivity: resolution, mass calibration, ion optics, CEM, deflector voltage.
Check quartz torch condition.	Check condition of sampler and skimmer cones.	Check recirculator water level.			
Measure quartz torch for proper alignment.	Check and drain oil mist eliminator on roughing pumps.				
Clean spray chamber and nebulizer.					
Check oil level of roughing pumps.					

SECTION 21

MEASUREMENT TRACEABILITY

21.1 Overview

Traceability of measurements shall be assured using a system of documentation, calibration, and analysis of reference standards. Laboratory equipment that are peripheral to analysis and whose calibration is not necessarily documented in a test method analysis or by analysis of a reference standard shall be subject to ongoing certifications of accuracy. At a minimum, these must include procedures for checking specifications of ancillary equipment: balances, thermometers, temperature, Deionized (DI) and Reverse Osmosis (RO) water systems, automatic pipettes and other volumetric measuring devices. (Refer to Section 20.3). With the exception of Class A Glassware and Glass microliter syringes, quarterly accuracy checks are performed for all mechanical volumetric devices. Microsyringes can be verified at least semi-annually or disposed of after 6 months of use. Wherever possible, subsidiary or peripheral equipment is checked against standard equipment or standards that are traceable to national or international standards. Class A Glassware and Glass microliter syringes should be routinely inspected for chips, acid etching or deformity (e.g., bent needle). If the Class A glassware or syringe is suspect, the accuracy of the glassware will be assessed prior to use.

21.2 NIST-Traceable Weights And Thermometers

Reference standards of measurement shall be used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

For NIST-traceable weights and thermometers, the laboratory requires that all calibrations be conducted by a calibration laboratory accredited by A2LA, NVLAP (National Voluntary Laboratory Accreditation Program) or another accreditation organization that is a signatory to a MRA (Mutual Recognition Arrangement) of one or more of the following cooperations – ILAC (International Laboratory Accreditation Cooperation) or APLAC (Asia – Pacific Laboratory Accreditation Cooperation). A certificate and scope of accreditation is kept on file at the laboratory.

Additional details can be found in laboratory SOP No's. PT-QA-008 and PT-QA-012.

21.3 Reference Standards / Materials

Reference standards/materials, where commercially available, are traceable to certified reference materials. Commercially prepared reference standards, to the extent available, are purchased from vendors accredited by A2LA, NVLAP, ISO 9001:2000, ISO 17025. All reference standards from commercial vendors shall be accompanied by a certificate that includes at least the following information:

- Manufacturer
- Analytes or parameters calibrated
- Identification or lot number
- Calibration method

- Concentration with associated uncertainties
- Purity

If a standard cannot be purchased from a vendor that supplies a Certificate of Analysis, the purity of the standard is documented by analysis. The receipt of all reference standards must be documented in the LIMS. Reference standards are labeled with a unique Standard Identification Number and expiration date. All documentation received with the reference standard is retained as a QC record and references the Standard Identification Number.

All reference, primary and working standards/materials, whether commercially purchased or laboratory prepared, must be checked regularly to ensure that the variability of the standard or material from the 'true' value does not exceed method requirements. The accuracy of calibration standards is checked by comparison with a standard from a second source. In cases where a second standard manufacturer is not available, a vendor certified different lot is acceptable for use as a second source. For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst would be considered a second source. The appropriate Quality Control (QC) criteria for specific standards are defined in laboratory SOPs. In most cases, the analysis of an Initial Calibration Verification (ICV) or LCS (where there is no sample preparation) is used as the second source confirmation. These checks are generally performed as an integral part of the analysis method (e.g. calibration checks, laboratory control samples).

All standards and materials must be stored and handled according to method or manufacturer's requirements in order to prevent contamination or deterioration. Refer to the Corporate Environmental Health & Safety Manual or laboratory SOPs. For safety requirements, please refer to method SOPs and the laboratory Environmental Health and Safety Manual.

Standards and reference materials shall not be used after their expiration dates unless their reliability is verified by the laboratory and their use is approved by the Quality Assurance Manager. The laboratory has contingency procedures for re-verifying expired standards. See Pittsburgh Laboratory SOP No. PT-QA-006, *Procurement of Standards and Materials, Labeling and Traceability*.

21.4 Documentation And Labeling Of Standards, Reagents, And Reference Materials

Reagents must be at a minimum the purity required in the test method. The date of reagent receipt and the expiration date are documented. The lots for most of the common solvents and acids are tested for acceptability prior to company-wide purchase. (Refer to TestAmerica's Corporate SOP No. CA-Q-S-001, *Acid & Solvent Lot Testing and Approval*.)

All manufacturer or vendor supplied Certificate of Analysis or Purity must be retained, stored appropriately, and readily available for use and inspection. These records are maintained in the QA public drive and in the LIMS, scanned into Reagent log. Records must be kept of the date of receipt and date of expiration of standards, reagents and reference materials. In addition, records of preparation of laboratory standards, reagents, and reference materials must be retained, stored appropriately, and be readily available for use and inspection. For detailed information on documentation and labeling, please refer to laboratory analytical SOPs and SOP No. PT-QA-006.

Commercial materials purchased for preparation of calibration solutions, spike solutions, etc., are usually accompanied with an assay certificate or the purity is noted on the label. If the assay purity is 96% or better, the weight provided by the vendor may be used without correction. If the assay purity is less than 96% a correction will be made to concentrations applied to solutions prepared from the stock commercial material.

21.4.1 All standards, reagents, and reference materials that may affect quality must be labeled in an unambiguous manner. Standards are logged into the laboratory's LIMS system, and are assigned a unique identification number. The following information is typically recorded within LIMS.

- Standard ID
- Description of Standard
- Department
- Preparer's name
- Final volume and number of vials prepared
- Solvent type and lot number
- Preparation Date
- Expiration Date
- Standard source type (stock or daughter)
- Standard type (spike, surrogate, other)
- Parent standard ID (if applicable)
- Parent Standard Analyte Concentration (if applicable)
- Parent Standard Amount used (if applicable)
- Component Analytes
- Final concentration of each analyte
- Comment box (text field)

Records are maintained electronically for standard and reference material preparation. These records show the traceability to purchased stocks or neat compounds. These records also include method of preparation, date of preparation, expiration date and preparer's name or initials. Preparation procedures are provided in the laboratory analytical SOPs.

21.4.2 All standards, reagents, and reference materials must be clearly labeled with a minimum of the following information:

- Expiration Date (include prep date for reagents)
- Standard ID (from electronic standard log in LIMS)
- Special Health/Safety warnings if applicable

Records must also be maintained of the date of receipt for commercially purchased items or date of preparation for laboratory prepared items. Special Health/Safety warnings must also be available to the analyst. This information is maintained in standard/reagent log. Health and safety warning are in the SDS (Safety Data Sheets) which is accessed through the company intranet site.

21.4.3 In addition, the following information may be included:

- Date of receipt for commercially purchased items or date of preparation for laboratory prepared items
- Date opened (for multi-use containers, if applicable)
- Description of standard (if different from manufacturer's label or if standard was prepared in the laboratory)
- Recommended Storage Conditions
- Concentration (if applicable)
- Initials of analyst preparing standard or opening container

All containers of prepared reagents must include, expiration date and an ID number to trace back to preparation.

Procedures for preparation of reagents can be found in the Method SOPs.

Standard ID numbers must be traceable through associated logbooks, worksheets and raw data.

All reagents and standards must be stored in accordance to the following priority: 1) with the manufacturer's recommendations; 2) with requirements in the specific analytical methods as specified in the laboratory SOP.

SECTION 22

SAMPLING

22.1 Overview

The laboratory provides sampling services for the following matrices:

- Groundwater
- Wastewater
- Potable Water
- Wastes
- Soil and Sediment

The laboratory also offers the following services:

- Flow Monitoring
- Field Parameter Analysis

Field Analyses are address in TestAmerica Pittsburgh SOP No.'s:

- PT-FS-001 – Field Measurement of Dissolved Oxygen (DO)
- PT-FS-002 – Field Measurement of Total Residual Chlorine
- PT-FS-003 – Field Measurement of pH

22.2 Sampling Containers

The laboratory offers clean sampling containers for use by clients. These containers are obtained from reputable container manufacturers and meet EPA specifications as required. Certificates of cleanliness for bottles and preservatives are provided by the supplier and are maintained at the laboratory. Alternatively, the certificates may be maintained by the supplier and available to the laboratory on-line.
For detailed information regarding container/bottle order, refer to laboratory SOP No. PT-SR-002, *Bottle Order Preparation and Shipping*.

22.2.1 Preservatives

Upon request, preservatives are provided to the client in pre-cleaned sampling containers. In general, containers are purchased pre-preserved from the container supplier. Whether prepared by the laboratory or bought pre-preserved, the grades of the preservatives are at a minimum:

- Hydrochloric Acid – AR Select (ACS) or equivalent
- Methanol – Purge and Trap grade
- Nitric Acid – AR Select (ACS), Trace-Metals Grade or equivalent
- Sodium Hydroxide – AR Select (ACS) or equivalent
- Sulfuric Acid – AR Select (ACS) or equivalent
- Sodium Thiosulfate – ACS Grade or equivalent
- Sodium Bisulfate – ACS Grade or equivalent

22.3 Definition Of Holding Time

The date and time of sampling documented on the COC form establishes the day and time zero. As a general rule, when the maximum allowable holding time is expressed in “days” (e.g., 14 days, 28 days), the holding time is based on calendar day measured. Holding times expressed in “hours” (e.g., 6 hours, 24 hours, etc.) are measured from date and time zero. However, there are some programs that determine holding time compliance based on the date and specific time of analysis compared to the time of sampling regardless of how long the holding time is. Holding times for analysis include any necessary reanalysis.

22.4 Sampling Containers, Preservation Requirements, Holding Times

The container type, preservation, and holding time criteria specified in the SOPs are derived from the source documents for the methods. If method required holding times as specified in the SOPs or preservation requirements are not met, the reports will be qualified using a flag, footnote or case narrative. As soon as possible, or “ASAP”, is an EPA designation for tests for which rapid analysis is advised, but for which neither EPA nor the laboratory have a basis for a holding time.

22.5 Sample Aliquots / Subsampling

Taking a representative sub-sample from a container is necessary to ensure that the analytical results are representative of the sample collected in the field. The size of the sample container,

the quantity of sample fitted within the container, and the homogeneity of the sample need consideration when sub-sampling for sample preparation. It is the laboratory's responsibility to take a representative subsample or aliquot of the sample provided for analysis.

Analysts should handle each sample as if it is potentially dangerous. At a minimum, safety glasses, gloves, and lab coats must be worn when preparing aliquots for analysis.

Guidelines for subsampling are located in laboratory SOP No. PT-QA-024.

SECTION 23

HANDLING OF SAMPLES

Sample management procedures at the laboratory ensure that sample integrity and custody are maintained and documented from sampling/receipt through disposal. Details can be found in laboratory SOP No. PT-SR-001, *Sample Receipt and Login*, and PT-HS-001, *Pittsburgh Facility Addendum EH&S Manual*.

23.1 Chain Of Custody (COC)

The COC form is the written documented history of any sample and is initiated when bottles are sent to the field, or at the time of sampling. This form is completed by the sampling personnel and accompanies the samples to the laboratory where it is received and stored under the laboratory's custody. The purpose of the COC form is to provide a legal written record of the handling of samples from the time of collection until they are received at the laboratory. It also serves as the primary written request for analyses from the client to the laboratory. The COC form acts as a purchase order for analytical services when no other contractual agreement is in effect. An example of a COC form may be found in Figure 23-1.

23.1.1 Field Documentation

The information the sampler needs to provide at the time of sampling on the container label is:

- Sample identification
- Date and time
- Preservative

During the sampling process, the COC form is completed and must be legible (see Figure 23-1). This form includes information such as:

- Client name, address, phone number and fax number (if available)
- Project name and/or number
- The sample identification
- Date, time and location of sampling
- Sample collectors name
- The matrix description
- The container description
- The total number of each type of container

- Preservatives used
- Analysis requested
- Requested turnaround time (TAT)
- Any special instructions
- Purchase Order number or billing information (e.g. quote number) if available
- The date and time that each person received or relinquished the sample(s), including their signed name.

When the sampling personnel deliver the samples directly to TestAmerica personnel, the samples are stored in a cooler with ice, as applicable, and remain solely in the possession of the client's field technician until the samples are delivered to the laboratory personnel. The sample collector must assure that each container is in his/her physical possession or in his/her view at all times, or stored in such a place and manner to preclude tampering. The field technician relinquishes the samples in writing on the COC form to the sample control personnel at the laboratory or to a TestAmerica courier. When sampling personnel deliver the samples through a common carrier (Fed-Ex, UPS), the CoC relinquished date/time is completed by the field personnel and samples are released to the carrier. Samples are only considered to be received by lab when personnel at the fixed laboratory facility have physical contact with the samples.

Note: Independent couriers are not required to sign the COC form. The COC is usually kept in the sealed sample cooler. The receipt from the courier is stored in the LIMS login along with the CoC.

23.1.2 Legal / Evidentiary Chain-of-Custody

If samples are identified for legal/evidentiary purposes on the COC, login will complete the custody seal retain the shipping record with the COC, and initiate an internal COC for laboratory use by analysts and a sample disposal record.

23.2 Sample Receipt

Samples are received at the laboratory by designated sample receiving personnel and a unique laboratory project identification number is assigned. Each sample container shall be assigned a unique sample identification number that is cross-referenced to the client identification number such that traceability of test samples is unambiguous and documented. Each sample container is affixed with a durable sample identification label. Sample acceptance, receipt, tracking and storage procedures are summarized in the following sections.

23.2.1 Laboratory Receipt

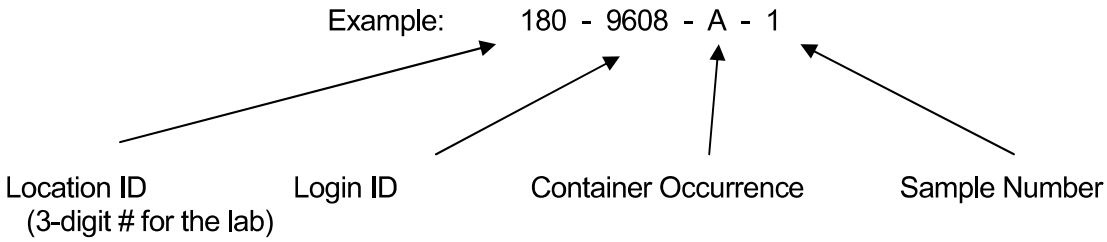
When samples arrive at the laboratory, sample receiving personnel inspect the coolers and samples. The integrity of each sample must be determined by comparing sample labels or tags with the COC and by visual checks of the container for possible damage. Samples and COC must meet the laboratory Sample Acceptance Policy (Figure 23-2). Any non-conformance, irregularity, or compromised sample receipt must be documented in LIMS on the Sample Receipt checklist (Figure 23-3), and must be brought to the immediate attention of the client. The COC, shipping documents, documentation of any non-conformance, irregularity, or

compromised sample receipt, record of client contact, and resulting instructions become part of the project record. This procedure is further described in laboratory SOP No. PT-SR-001.

23.2.1.1 Unique Sample Identification

All samples that are processed through the laboratory receive a unique sample identification to ensure that there can be no confusion regarding the identity of such samples at anytime. This system includes identification for all samples, subsamples and subsequent extracts and/or digestates.

The laboratory assigns a unique identification (e.g., Sample ID) code to each sample container received at the laboratory. This Primary ID is made up of the following information (consisting of 4 components):



The above example states that TestAmerica Pittsburgh Laboratory (Location 180). Login ID is 9608 (unique to a particular client/job occurrence). The container code indicates it is the first container ("A") of Sample #1.

If the primary container goes through a prep step that creates a "new" container, then the new container is considered secondary and gets another ID. An example of this being a client sample in a 1-Liter amber bottle is sent through a Liquid/Liquid Extraction and an extraction vial is created from this step. The vial would be a SECONDARY container. The secondary ID has 5 components.

Example: 180 - 9608 - A - 1 - **A** ←——**Secondary Container Occurrence**

Example: 180-9608-A-1-A, would indicate the PRIMARY container listed above that went through a step that created the 1st occurrence of a Secondary container.

With this system, a client sample can literally be tracked throughout the laboratory in every step from receipt to disposal.

23.3 Sample Acceptance Policy

The laboratory has a written sample acceptance policy (Figure 23-2) that clearly outlines the circumstances under which samples shall be accepted or rejected. These include:

- a COC must filled out completely
- samples must be properly labeled
- proper sample containers with adequate volume for the analysis and necessary QC

- samples must be preserved according to the requirements of the requested analytical method
- sample holding times must be adhered to
- Samples that require chilling must be received proper temperature
- the project manager will be notified if any sample is received in damaged condition

Data from samples which do not meet these criteria are flagged and the nature of the variation from policy is defined.

23.3.1.1 After inspecting the samples, the sample receiving personnel sign and date the COC form, make any necessary notes of the samples' conditions and store them in appropriate refrigerators or storage locations.

23.3.1.2 Any deviations from these checks that question the suitability of the sample for analysis, or incomplete documentation on the chain-of-custody will be resolved by consultation with the client. If the sample acceptance policy criteria are not met, the laboratory shall either:

- Retain all correspondence and/or records of communications with the client regarding the disposition of rejected samples, or
- Fully document any decision to proceed with sample analysis that does not meet sample acceptance criteria.
- If the conditions listed on the Acceptance Policy are not satisfactory and when lacking direction or agreement with the client, the sample may be rejected by the laboratory.

Note: North Carolina requires that they be notified when samples are processed that do not meet sample acceptance criteria.

Once sample acceptance is verified, the samples are logged into the LIMS according to laboratory SOP No. PT-SR-001.

23.4 Sample Storage

In order to avoid deterioration, contamination or damage to a sample during storage and handling, from the time of receipt until all analyses are complete, samples are stored in refrigerators, freezers, or protected locations suitable for the sample matrix. In addition, samples to be analyzed for volatile organic parameters are stored in separate refrigerators designated for volatile organic parameters only. Samples are never to be stored with reagents, standards or materials that may create contamination.

To ensure the integrity of the samples during storage, refrigerator blanks are maintained in the volatile sample refrigerators and analyzed at least every two weeks. See laboratory SOP PT-MS-005, *Volatile Holding Blanks*.

Analysts and technicians retrieve the sample container allocated to their analysis from the designated storage location and place them on carts, analyze the sample, and return the remaining sample or empty container to the storage location from which it originally came. All

unused portions of samples, including empty sample containers, are returned to the secure sample control area. Raw samples requiring cold storage are kept in the cold room for approximately 30 days after reported. Volatile samples are stored in the VOA refrigerator. All sample extracts are kept in the refrigerators for approximately two to four weeks after analysis, which meets or exceeds most sample holding times. After the cold storage time, the sample are moved to dry room-temperature sample archive area, where they are stored for an additional four weeks before they are disposed of. This holding period allows samples to be checked if a discrepancy or question arises. Special arrangements may be made to store samples for longer periods of time. This extended holding period allows additional metal analyses to be performed on the archived sample and assists clients in dealing with legal matters or regulatory issues.

Access to the laboratory is controlled such that sample storage need not be locked at all times unless a project specifically demands it. Samples are accessible to laboratory personnel only. Visitors to the laboratory are prohibited from entering the refrigerator and laboratory areas unless accompanied by an employee of TestAmerica.

23.5 Hazardous Samples And Foreign Soils

To minimize exposure to personnel and to avoid potential accidents, hazardous, for any sample that is known to be hazardous at the time of receipt a cautionary email communication should be sent to all applicable laboratory personnel by the project manager or designee. All hazardous samples are disposed of appropriately through a hazardous waste disposal process. Foreign soil samples are sent out for incineration by an USDA-approved waste disposal facility. Analysts will notify Sample Control of any sample determined to be hazardous after completion of analysis by sending an email. All hazardous samples are either returned to the client or disposed of appropriately through a hazardous waste disposal firm that lab-packs all hazardous samples and removes them from the laboratory. Foreign soil samples are sent out for incineration by a USDA-approved waste disposal facility.

23.6 Sample Shipping

In the event that the laboratory needs to ship samples, the samples are placed in a cooler with enough ice to ensure the samples remain just above freezing and at or below 6.0°C during transit. The samples are carefully surrounded by packing material to avoid breakage (yet maintain appropriate temperature). A trip blank is enclosed for those samples requiring water/solid volatile organic analyses. The chain-of-custody form is signed by the sample control technician and attached to the shipping paperwork. Samples are generally shipped overnight express or hand-delivered by a TestAmerica courier to maintain sample integrity. All personnel involved with shipping and receiving samples must be trained to maintain the proper chain-of-custody documentation and to keep the samples intact and on ice. The Environmental, Health and Safety Manual contains additional shipping requirements.

Note: If a client does not request trip blank analysis on the COC or other paperwork, the laboratory will not analyze the trip blanks that were supplied. However, in the interest of good client service, the laboratory will advise the client at the time of sample receipt that it was noted that they did not request analysis of the trip blank; and that the laboratory is providing the notification to verify that they are not inadvertently omitting a key part of regulatory compliance testing.

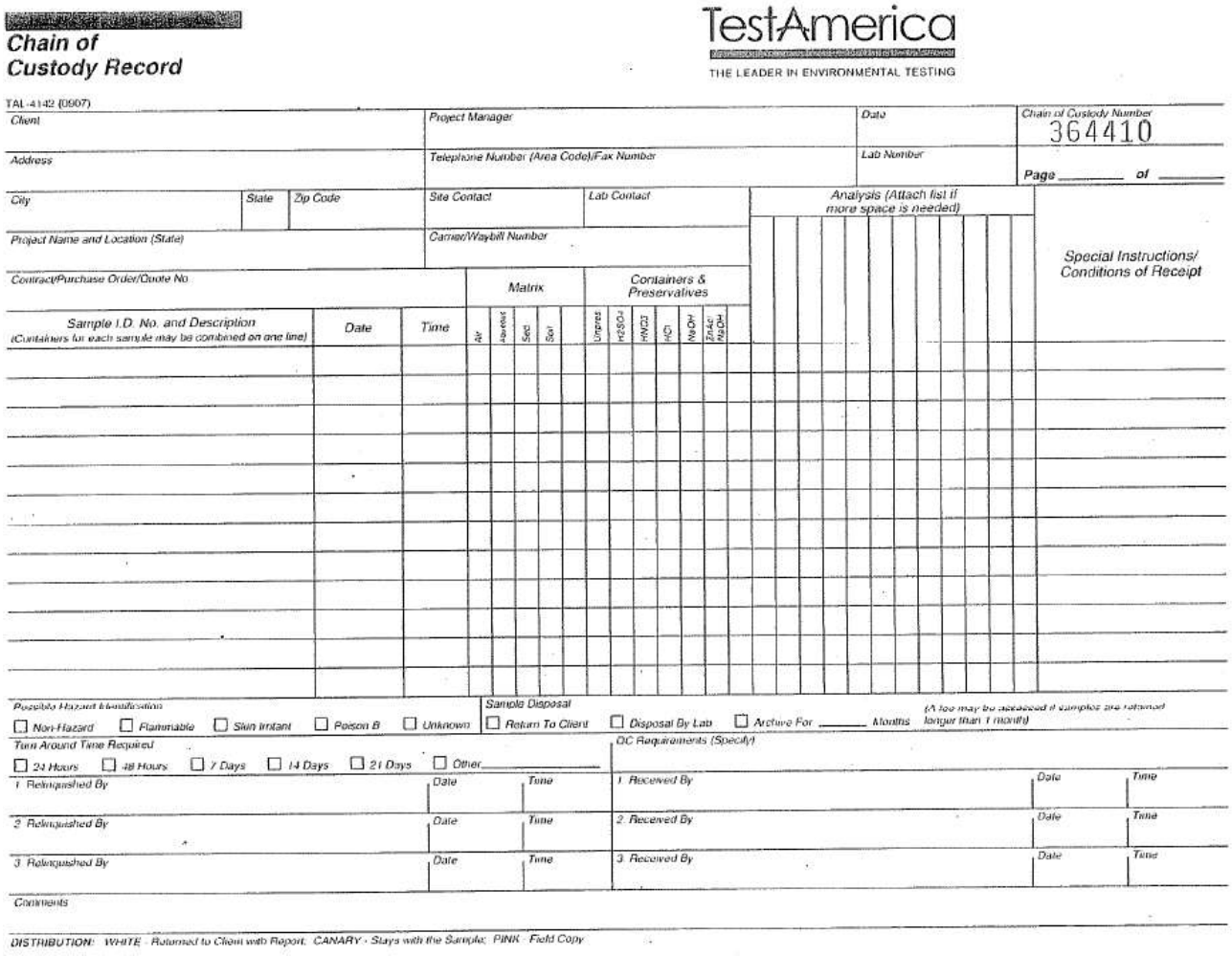
23.7 Sample Disposal

Samples should be retained for a minimum of 30 days after the project report is sent, however, provisions may be made for earlier disposal of samples once the holding time is exceeded. Some samples are required to be held for longer periods based on regulatory or client requirements (e.g., 60 days after project report is sent). The laboratory must follow the longer sample retention requirements where required by regulation or client agreement. Several possibilities for sample disposal exist: the sample may be consumed completely during analysis, the sample may be returned to the customer or location of sampling for disposal, or the sample may be disposed of in accordance with the laboratory's waste disposal procedures (SOP No. PT-HS-001). All procedures in the laboratory Environmental, Health and Safety Manual are followed during disposal. Samples are normally maintained in the laboratory no longer than two months from receipt unless otherwise requested. Unused portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work.

If a sample is part of a known litigation, the affected legal authority, sample data user, and/or submitter of the sample must participate in the decision about the sample's disposal. All documentation and correspondence concerning the disposal decision process must be kept on file. Pertinent information includes the date of disposal, nature of disposal (such as sample depletion, hazardous waste facility disposal, return to client), names of individuals who conducted the arrangements and physically completed the task. The laboratory will remove or deface sample labels prior to disposal unless this is accomplished through the disposal method (e.g., samples are incinerated). A Waste Disposal Record should be completed.

Figure 23-1

Example: Chain of Custody (COC)



Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TAL-4142 (0907)

Client	Project Manager	Date	Chain of Custody Number 364410
Address	Telephone Number (Area Code)/Fax Number	Lab Number	Page ____ of ____
City / State / Zip Code	Site Contact	Lab Contact	Analysis (Attach list if more space is needed)
Project Name and Location (State)	Carrier/Waybill Number		Special Instructions/ Conditions of Receipt
Contract/Purchase Order/Quote No.	Matrix / Containers & Preservatives		

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Air	Aqueous	Sed.	Soil	Unpres.	H_2SO_4	HNO_3	HCl	NaOH	ZnAc/ NaOH

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal
☐ Return To Client ☐ Disposal By Lab ☐ Archive For ____ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required
☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☐ Other ____

QC Requirements (Specify)

1. Relinquished By	Date	Time	1. Received By	Date	Time
2. Relinquished By	Date	Time	2. Received By	Date	Time
3. Relinquished By	Date	Time	3. Received By	Date	Time

Comments

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

Figure 23-2

Sample Acceptance Policy

All incoming work will be evaluated against the criteria listed below. Where applicable, data from any samples that do not meet the criteria listed below will be noted on the laboratory report defining the nature and substance of the variation. In addition the client will be notified either by telephone, fax or e-mail ASAP after the receipt of the samples.

1) Samples must arrive with labels intact with a Chain of Custody filled out completely. The following information must be recorded.
   - *Client name, address, phone number and fax number (if available)*
   - *Project name and/or number*
   - *Unique sample identification*
   - *Date, time and location of sampling*
   - *The collectors name*
   - *The matrix description*
   - *The container description*
   - *The total number of each type of container*
   - *Preservatives used*
   - *Analysis requested*
   - *Requested turnaround time (TAT)*
   - *Any special instructions*
   - *Purchase Order number or billing information (e.g. quote number) if available*
   - *The date and time that each person received or relinquished the sample(s), including their signed name.*
   - **Information must be legible**

2) Samples must be properly labeled.
   - Use durable labels (labels provided by TestAmerica are preferred)
   - Include a unique identification number
   - Include sampling date and time & sampler ID
   - Include preservative used.
   - Use indelible ink
   - **Information must be legible**

3) Proper sample containers with adequate volume for the analysis and necessary QC are required for each analysis requested.

4) Samples must be preserved according to the requirements of the requested analytical method. (See Sampling Guide)

5) Most analytical methods require chilling samples to 4° C (other than water samples for metals analysis). For these methods, the criteria are met if the samples are chilled to below 6° C and above freezing (0°C). For methods with other temperature criteria (e.g. some bacteriological methods require $\leq$ 10 ^{o}C), the samples must arrive within $\pm$ 2° C of the required temperature or within the method specified range. **Note:** Samples that are hand delivered to the laboratory immediately after

collection may not have had time to cool sufficiently. In this case the samples will be considered acceptable as long as there is evidence that the chilling process has begun (arrival on ice).

5i.) Samples that are delivered to the laboratory on the same day they are collected may not meet the requirements of Section 5. In these cases, the samples shall be considered acceptable if the samples were received on ice.

5ii.) If sample analysis is begun within fifteen (15) minutes of collection, thermal preservation is not required.

5iii.)Thermal preservation is not required in the field if the laboratory receives and refrigerates the sample within fifteen (15) minutes of collection.

- Chemical preservation (pH) will be verified prior to analysis and documented, either in sample control or at the analyst's level. The project manager will be notified immediately if there is a discrepancy. If analyses will still be performed, all affected results will be flagged to indicate improper preservation.

- **FOR WATER SAMPLES TESTED FOR CYANIDE (Method OIA-1677)**
  - In the Field: Samples are to be tested for Sulfide using lead acetate paper prior to the addition of Sodium Hydroxide (NaOH). If sulfide is present, the sample is treated in the field with lead carbonate or if the client requests the sample to be treated at the lab it will be filtered and treated at the lab with Cadmium Chloride.

  - If the sulfide test and treatment is not performed in the field, the lab will test the samples for sulfide using lead acetate paper at the time of receipt and if sulfide is present in the sample, the client will be notified and given the option of retaking the sample and treating in the field per the method requirements or the laboratory can analyze the samples as delivered and qualify the results in the final report.

- It is the responsibility of the client to notify the laboratory if thiosulfate, sulfite, or thiocyanate are known or suspected to be present in the sample. This notification may be on the chain of custody. The samples may need to be subcontracted to a laboratory that performs a UV digestion. If the lab does not perform the UV digestion on samples that contain these compounds, the results must be qualified in the final report.

- The laboratory must test the sample for oxidizing agents (e.g. Chlorine) prior to analysis and treat according to the methods prior to distillation. (ascorbic acid or sodium arsenite are the preferred choice).

- Water samples that require ortho-phosphorus must be filtered in the field within 15 minutes of sampling. Samples received without indication of filtration in the field will have results flagged for improper preservation.

- Samples for coliform analysis must be in sterile containers and must be free of residual chlorine. The bottle must be filled to <u>above</u> the 100mL mark.

6) *Matrix Spikes* are required for your project, separate sample volumes must be available for the requested analyses.

7) For Volatile Organic analyses: Efforts should be made to minimize any air bubbles in aqueous volatile samples. Air bubbles also the escape of volatile organics. This is especially important because air bubbles tend to form in iced samples. Volatile vials containing air bubbles larger than a pea will be treated as non-conformances.

8) All samples submitted for Volatile Organic analyses must have a Trip Blank submitted at the same time. TestAmerica will supply a blank with the bottle order.

9) Sample Holding Times

- TestAmerica will make every effort to analyze samples within the regulatory holding time. Samples must be received in the laboratory with enough time to perform the sample analysis. Except for short holding time samples (< 48hr HT) sample must be received with at least 48 hrs (working days) remaining on the holding time for us to ensure analysis.

- Analyses that are designated as "field" analyses (Odor, pH, Dissolved Oxygen, Disinfectant Residual; a.k.a. Residual Chlorine, and Redox Potential) should be analyzed ASAP by the field sampler prior to delivering to the lab (within 15 minutes). However, if the analyses are to be performed in the laboratory, TestAmerica will make every effort to analyze the samples within 24 hours from receipt of the samples in the testing laboratory. Samples for "field" analyses received after 4:00 pm on Friday or on the weekend will be analyzed no later than the next business day after receipt (Monday unless a holiday). Samples will remain refrigerated and sealed until the time of analysis. Samples analyzed in the laboratory will be qualified on the final report to indicate holding time exceedance.

10) The project manager will be notified if any sample is received in damaged condition. TestAmerica will request that a sample be resubmitted for analysis. The laboratory will notify the client upon sample receipt if the samples exhibit obvious signs of damage, contamination or inadequate preservation.

11) Recommendations for packing samples for shipment.

- Pack samples in Ice rather than "Blue" ice packs.

- Soil samples should be placed in plastic zip-lock bags. The containers often have dirt around the top and do not seal very well and are prone to intrusion from the water from melted ice.

- Water samples would be best if wrapped with bubble-wrap or paper (newspaper, or paper towels work) and then placed in plastic zip-lock bags.

- Fill extra cooler space with bubble wrap.

12) If the conditions listed on the Acceptance Policy are not satisfactory and when lacking direction or agreement with the client, the sample will be rejected by the laboratory.

Figure 23-3

Example: Sample Receipt Checklist

Login Sample Receipt Checklist

Client: Cardno ENTRIX

Job Number: 180-264-1

Login Number: 264
List Number: 1
Creator: Gamber, Tom

List Source: TestAmerica Pittsburgh

Question	Answer	Comment
Radioactivity either was not measured or, if measured, is at or below background	True	
The cooler's custody seal, if present, is intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the sample IDs on the containers and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
VOA sample vials do not have headspace or bubble is <6mm (1/4") in diameter.	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

SECTION 24

ASSURING THE QUALITY OF TEST RESULTS

24.1 Overview

In order to assure our clients of the validity of their data, the laboratory continuously evaluates the quality of the analytical process. The analytical process is controlled not only by instrument calibration as discussed in Section 20, but also by routine process quality control measurements (e.g. Blanks, Laboratory Control Samples (LCS), Matrix Spikes (MS), duplicates (DUP), surrogates, Internal Standards (IS)). These quality control checks are performed as required by the method or regulations to assess precision and accuracy. Quality control samples are to be treated in the exact same manner as the associated field samples being tested. In addition to the routine process quality control samples, Proficiency Testing (PT) Samples (concentrations unknown to laboratory) are analyzed to help ensure laboratory performance.

24.2 Controls

Sample preparation or pre-treatment is commonly required before analysis. Typical preparation steps include homogenization, solvent extraction, sonication, acid digestion, filtration, distillation, reflux, evaporation, drying and ashing. During these pre-treatment steps, samples are arranged into discreet manageable groups referred to as preparation (prep) batches. Prep batches provide a means to control variability in sample treatment. Control samples are added to each prep batch to monitor method performance and are processed through the entire analytical procedure with investigative/field samples.

24.3 Negative Controls

Table 24-1. Negative Controls

Control Type	Details
Method Blank (MB)	are used to assess preparation and analysis for possible contamination during the preparation and processing steps.
	The specific frequency of use for method blanks during the analytical sequence is defined in the specific standard operating procedure for each analysis. Generally it is 1 for each batch of samples; not to exceed 20 environmental samples.
	The method blank is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (e.g., Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The method blank goes through all of the steps of the process (including as necessary: filtration, clean-ups, etc.).
	Reanalyze or qualify associated sample results when the concentration of a targeted analyte in the blank is at or above the reporting limit as established by the method or by regulation, AND is greater than 1/10 of the amount measured in the sample.
Calibration Blanks	are prepared and analyzed along with calibration standards where applicable. They are prepared using the same reagents that are used to prepare the standards. In some analyses the calibration blank may be included in the calibration curve.

Table 24-1. Negative Controls

Control Type	Details
Instrument Blanks	are blank reagents or reagent water that may be processed during an analytical sequence in order to assess contamination in the analytical system. In general, instrument blanks are used to differentiate between contamination caused by the analytical system and that caused by the sample handling or sample prep process. Instrument blanks may also be inserted throughout the analytical sequence to minimize the effect of carryover from samples with high analyte content.
Trip Blank [1]	are required to be submitted by the client with each shipment of samples requiring aqueous and solid volatiles analyses (or as specified in the client's project plan). Additionally, trip blanks may be prepared and analyzed for volatile analysis of air samples, when required by the client. A trip blank may be purchased (certified clean) or is prepared by the laboratory by filling a clean container with pure deionized water that has been purged to remove any volatile compounds. Appropriate preservatives are also added to the container. The trip blank is sent with the bottle order and is intended to reflect the environment that the containers are subjected to throughout shipping and handling and help identify possible sources if contamination is found. The field sampler returns the trip blank in the cooler with the field samples.
Field Blanks [1]	are sometimes used for specific projects by the field samplers. A field blank prepared in the field by filling a clean container with pure reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken. (EPA OSWER)
Equipment Blanks [1]	are also sometimes created in the field for specific projects. An equipment blank is a sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (TNI)
Holding Blanks	also referred to as refrigerator or freezer blanks, are used to monitor the sample storage units for volatile organic compounds during the storage of VOA samples in the laboratory

[1] When known, these field QC samples should not be selected for matrix QC as it does not provide information on the behavior of the target compounds in the field samples. Usually, the client sample ID will provide information to identify the field blanks with labels such as "FB", "EB", or "TB."

Evaluation criteria and corrective action for these controls are defined in the specific standard operating procedure for each analysis. Also further detail is provided in SOP No. PT-QA-021.

24.3.1 Negative Controls for Microbiological Methods – Microbiological Methods utilize a variety of negative controls throughout the process to ensure that false positive results are not obtained. These controls are critical to the validity of the microbiological analyses. Some of these negative controls are:

Table 24-2. Negative Controls for Microbiology

Control Type	Details
Sterility Checks (Media)	are analyzed for each lot of pre-prepared media, ready-to-use media and for each batch of medium prepared by the laboratory.
Filtration Blanks	blanks are run at the beginning and end for each sterilized filtration unit used in a filtration series. For pre-sterilized single use funnels a sterility check is performed on at least one funnel per lot.
Sterility checks (Sample Containers)	are performed on at least one container per lot of purchased, pre-sterilized containers. If containers are prepared and sterilized by the laboratory, one container per sterilization batch is checked. Container sterility checks are performed using non-selective growth media.

Sterility Checks (Dilution Water)	are performed on each batch of dilution water prepared by the laboratory and on each batch of pre-prepared dilution water. All checks are performed using non-selective growth media.
Sterility Checks (Filters)	are also performed on at least one filter from each new lot of membrane filters using non-selective growth media.

Negative culture controls demonstrate that a media does not support the growth of non-target organisms and ensures that there is not an atypical positive reaction from the target organisms. Prior to the first use of the media, each lot of pre-prepared selective media or batch of laboratory prepared selective media is analyzed with at least one known negative culture control as appropriate to the method.

24.4 Positive Controls

Control samples (e.g., QC indicators) are analyzed with each batch of samples to evaluate data based upon (1) Method Performance (Laboratory Control Sample (LCS) or Blank Spike (BS)), which entails both the preparation and measurement steps; and (2) Matrix Effects (Matrix Spike (MS) or Sample Duplicate (MD, DUP), which evaluates field sampling accuracy, precision, representativeness, interferences, and the effect of the matrix on the method performed. Each regulatory program and each method within those programs specify the control samples that are prepared and/or analyzed with a specific batch

Note that frequency of control samples vary with specific regulatory, methodology and project specific criteria. Complete details on method control samples are as listed in each analytical SOP.

24.4.1 Method Performance Control - Laboratory Control Sample (LCS)

The LCS measures the accuracy of the method in a blank matrix and assesses method performance independent of potential field sample matrix affects in a laboratory batch.

The LCS is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (for example: Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The LCS is spiked with verified known amounts of analytes or is made of a material containing known and verified amounts of analytes, taken through all preparation and analysis steps along with the field samples. Where there is no preparation taken for an analysis (such as in aqueous volatiles), or when all samples and standards undergo the same preparation and analysis process (such as Phosphorus), a calibration verification standard may be reported as the LCS. In some instances where there is no practical clean solid matrix available, aqueous LCS's may be processed for solid matrices; final results may be calculated as mg/kg or ug/kg, assuming 100% solids and a weight equivalent to the aliquot used for the corresponding field samples, to facilitate comparison with the field samples.

Certified pre-made reference material purchased from a NIST/A2LA accredited vendor may also be used for the LCS when the material represents the sample matrix or the analyte is not easily spiked (e.g. solid matrix LCS for metals, TDS, etc.).

The specific frequency of use for LCS during the analytical sequence is defined in the specific standard operating procedure for each analysis. It is generally 1 for each batch of samples; not to exceed 20 environmental samples.

If the mandated or requested test method, or project requirements, do not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample (and Matrix Spike) where applicable (e.g. no spike of pH). However, in cases where the components interfere with accurate assessment (such as simultaneously spiking chlordane, toxaphene and PCBs in Method 608), the test method has an extremely long list of components or components are incompatible, at a minimum, a representative number of the listed components (see below) shall be used to control the test method. The selected components of each spiking mix shall represent all chemistries, elution patterns and masses, permit specified analytes and other client requested components. However, the laboratory shall ensure that all reported components are used in the spike mixture within a two-year time period.

- For methods that have 1-10 target analytes, spike all components.
- For methods that include 11-20 target analytes, spike at least 10 or 80%, whichever is greater.
- For methods with more than 20 target analytes, spike at least 16 components.
- Exception: Due to analyte incompatibility in pesticides, Toxaphene and Chlordane are only spiked at client request based on specific project needs.
- Exception: Due to analyte incompatibility between the various PCB aroclors, aroclors 1016 and 1260 are used for spiking as they cover the range of all of the aroclors. Specific aroclors may be used by request on a project specific basis.

24.4.2 Positive Controls for Microbiological Methods

- Each lot of pre-prepared media (including chromofluorogenic reagent) and each batch of laboratory prepared media is tested with a pure culture of known positive reaction.

- In addition, every analytical batch also contains a pure culture of known positive reaction.

  A pure culture of known negative reaction is also tested with each analytical batch to ensure specificity of the procedure.

24.5 Sample Matrix Controls

Table 24-3 Sample Matrix Control

Control Type	Details	
Matrix Spikes (MS)	Use	used to assess the effect sample matrix of the spiked sample has on the precision and accuracy of the results generated by the method used;
	Typical Frequency [1]	At a minimum, with each matrix-specific batch of samples processed, an MS is carried through the complete analytical procedure. Unless specified by the client, samples used for spiking are randomly selected and rotated between different client projects. If the mandated or requested test method does not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample and Matrix Spike. Refer to the method SOP for complete details
	Description	essentially a sample fortified with a known amount of the test analyte(s).
Surrogate	Use	Measures method performance to sample matrix (organics only).
	Typical Frequency [1]	Are added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. The recovery of the surrogates is compared to the acceptance limits for the specific method. Poor surrogate recovery may indicate a problem with sample composition and shall be reported, with data qualifiers, to the client whose sample produced poor recovery.
	Description	Are similar to matrix spikes except the analytes are compounds with properties that mimic the analyte of interest and are unlikely to be found in environment samples.
Duplicates[2]	Use	For a measure of analytical precision, with each matrix-specific batch of samples processed, a matrix duplicate (MD or DUP) sample, matrix spike duplicate (MSD), or LCS duplicate (LCSD) is carried through the complete analytical procedure.
	Typical Frequency [1]	Duplicate samples are usually analyzed with methods that do not require matrix spike analysis.
	Description	Performed by analyzing two aliquots of the same field sample independently or an additional LCS.
Internal Standards	Use	Are spiked into all environmental and quality control samples (including the initial calibration standards) to monitor the qualitative aspect of organic and some inorganic analytical measurements.
	Typical Frequency [1]	All organic and ICP methods as required by the analytical method.
	Description	Used to correct for matrix effects and to help troubleshoot variability in analytical response and are assessed after data acquisition. Possible sources of poor internal standard response are sample matrix, poor analytical technique or instrument performance.

[1] See the specific analytical SOP for type and frequency of sample matrix control samples.

[2] LCSD's are normally not performed except when regulatory agencies or client specifications require them. The recoveries for the spiked duplicate samples must meet the same laboratory established recovery limits as the accuracy QC samples. If an LCSD is analyzed both the LCS and LCSD must meet the same recovery criteria and be included in the final report. The precision measurement is reported as "Relative Percent Difference" (RPD). Poor precision between duplicates (except LCS/LCSD) may indicate non-homogeneous matrix or sampling.

24.6 Acceptance Criteria (Control Limits)

As mandated by the test method and regulation, each individual analyte in the LCS, MS, or Surrogate Spike is evaluated against the control limits published in the test method. Where there are no established acceptance criteria, the laboratory calculates in-house control limits

with the use of control charts or, in some cases, utilizes client project specific control limits. When this occurs, the regulatory or project limits will supersede the laboratory's in-house limits.

Note: For methods, analytes and matrices with very limited data (e.g., unusual matrices not analyzed often), interim limits are established using available data or by analogy to similar methods or matrices.

Once control limits have been established, they are verified, reviewed, and updated if necessary on an annual basis unless the method requires more frequent updating. Control limits are established per method (as opposed to per instrument) regardless of the number of instruments utilized.

Laboratory generated % Recovery acceptance (control) limits are generally established by taking ± 3 Standard Deviations (99% confidence level) from the average recovery of a minimum of 20-30 data points (more points are preferred).

- Regardless of the calculated limit, the limit should be no tighter than the Calibration Verification (ICV/CCV) (Unless the analytical method specifies a tighter limit).

- In-house limits cannot be any wider than those mandated in a regulated analytical method. Client or contract required control limits are evaluated against the laboratory's statistically derived control limits to determine if the data quality objectives (DQOs) can be achieved. If laboratory control limits are not consistent with DQOs, then alternatives must be considered, such as method improvements or use of an alternate analytical method.

- The lowest acceptable recovery limit will be 10% (the analyte must be detectable and identifiable). Exception: The lowest acceptable recovery limit for Benzidine will be 5% and the analyte must be detectable and identifiable.

- The maximum acceptable recovery limit will be 150%.

- The maximum acceptable RPD limit will be 35% for waters and 40% for soils. The minimum RPD limit is 10%.

- If either the high or low end of the control limit changes by ≤ 5% from previous, the control chart is visually inspected and, using professional judgment, they may be left unchanged if there is no effect on laboratory ability to meet the existing limits.

24.6.1 The lab must be able to generate a current listing of their control limits and track when the updates are performed. Current and historical limits are maintained in the LIMS, along with the effective dates. In addition, the laboratory must be able to recreate historical control limits. Refer to laboratory SOP No. PT-QA-021, *Quality Control Program*, for details on the creation, evaluation and application of statistical control limits.

24.6.2 A LCS that is within the acceptance criteria establishes that the analytical system is in control and is used to validate the process. Samples that are analyzed with an LCS with recoveries outside of the acceptance limits may be determined as out of control and should be reanalyzed if possible. If reanalysis is not possible, then the results for all affected analytes for samples within the same batch must be qualified when reported. The internal corrective action

process (see Section 12) is also initiated if an LCS exceeds the acceptance limits. Sample results may be qualified and reported without reanalysis if:

- The analyte results are below the reporting limit and the LCS is above the upper control limit.
- If the analytical results are above the relevant regulatory limit and the LCS is below the lower control limit. For further detail refer to laboratory SOP PT-QA-021 and method specific SOPs.
- For TNI work, there are an allowable number of Marginal Exceedances (ME):

<11 analytes	0 marginal exceedances are allowed
11 – 30 Analytes	1 marginal exceedance is allowed
31-50 Analytes	2 marginal exceedances are allowed
51-70 Analytes	3 marginal exceedances are allowed
71-90 Analytes	4 marginal exceedances are allowed
> 90 Analytes	5 marginal exceedances are allowed

  - Marginal exceedances are recovery exceedances between 3 SD and 4 SD from the mean recovery limit (TNI).
  - Marginal exceedances must be random. If the same analyte exceeds the LCS control limit repeatedly, it is an indication of a systematic problem. The source of the error must be located and corrective action taken. The laboratory has a system to monitor marginal exceedances to ensure that they are random.
  - Though marginal exceedances may be allowed, the data must still be qualified to indicate it is outside of the normal limits.

24.6.3 If the MS/MSDs do not meet acceptance limits, the MS/MSD and the associated parent sample are reported with a qualifier for those analytes that do not meet limits. If obvious preparation errors are suspected, or if requested by the client, unacceptable MS/MSDs are reprocessed and reanalyzed to prove matrix interference. A more detailed discussion of acceptance criteria and corrective action can be found in SOP No. PT-QA-021 – Laboratory Quality Control Program, analytical method SOPs and in Section 12 of this document.

24.6.4 If a surrogate standard falls outside the acceptance limits, if there is not obvious chromatographic matrix interference, reanalyze the sample to confirm a possible matrix effect. If the recoveries confirm or there was obvious chromatographic interference, results are reported from the original analysis and a qualifier is added. If the reanalysis meets surrogate recovery criteria, the second run is reported (or both are reported if requested by the client). Under certain circumstances, where all of the samples are from the same location and share similar chromatography, the reanalysis may be performed on a single sample rather than all of the samples and if the surrogate meets the recovery criteria in the reanalysis, all of the affected samples would require reanalysis.

24.7 Additional Procedures to Assure Quality Control

The laboratory has written and approved method SOPs to assure the accuracy of the test method including calibration (see Section 20), use of certified reference materials (see Section 21) and use of PT samples (see Section 15).

A discussion regarding MDLs, Limit of Detection (LOD) and Limit of Quantitation (LOQ) can be found in Section 19.

Use of formulae to reduce data is discussed in the method SOPs and in Section 20.

Selection of appropriate reagents and standards is included in Section 9 and 21.

A discussion on selectivity of the test is included in Section 5.

Constant and consistent test conditions are discussed in Section 18.

The laboratories sample acceptance policy is included in Section 23.

SECTION 25

REPORTING RESULTS

25.1 Overview

The results of each test are reported accurately, clearly, unambiguously, and objectively in accordance with State and Federal regulations as well as client requirements. Analytical results are issued in a format that is intended to satisfy customer and laboratory accreditation requirements as well as provide the end user with the information needed to properly evaluate the results. Where there is conflict between client requests and laboratory ethics or regulatory requirements, the laboratory's ethical and legal requirements are paramount, and the laboratory will work with the client during project set up to develop an acceptable solution. Refer to Section 7.

A variety of report formats are available to meet specific needs.

In cases where a client asks for simplified reports, there must be a written request from the client. There still must be enough information that would show any analyses that were out of conformance (QC out of limits) and there should be a reference to a full report that is made available to the client. Review of reported data is included in Section 19.

25.2 Test Reports

Analytical results are reported in a format that is satisfactory to the client and meets all requirements of applicable accrediting authorities and agencies. A variety of report formats are available to meet specific needs. The report is printed on laboratory letterhead, reviewed, and signed by the appropriate project manager. At a minimum, the standard laboratory report shall contain the following information:

25.2.1 A report title (e.g. Analytical Report) on the cover page with a "Result" column header on the sample result page

25.2.2 Each report cover page printed on company letterhead, which includes the laboratory name, address and telephone number

25.2.3 A unique identification of the report (e.g. job Number) and on each page an identification in order to ensure the page is recognized as part of the report and a clear identification of the end

Note: Page numbers of report are represented as page # of ## at the bottom of the page. Where the first number is the page number and the second is the total number of pages

25.2.4 A copy of the chain of custody (COC)

- Any COCs involved with Subcontracting are included

25.2.5 The name and address of client and a project name/number, if applicable

25.2.6 Client project manager or other contact

25.2.7 Description and unambiguous identification of the tested sample(s) including the client identification code

25.2.8 Date of receipt of sample, date and time of collection, and date(s) and time of test preparation and performance, and time of preparation or analysis if the required holding time for either activity is less than or equal to 72 hours

25.2.9 Date reported or date of revision, if applicable

25.2.10 Method of analysis including method code (EPA, Standard Methods, etc)

25.2.11 Reporting Limit.

25.2.12 Method detection limits (if requested)

25.2.13 Definition of Data qualifiers and reporting acronyms (e.g. ND)

25.2.14 Sample results

25.2.15 QC data consisting of method blank, surrogate, LCS, and MS/MSD recoveries and control limits are included unless the client specifies they do not require reporting the QC

25.2.16 Condition of samples at receipt including temperature. This may be accomplished in the case narrative or by attaching sample login sheets. The temperature is documented on the sample receipt checklist and noted in the report case narrative.

25.2.17 A statement expressing the validity of the results, that the source methodology was followed and all results were reviewed for error

25.2.18 A statement to the effect that the results relate only to the items tested and the sample as received by the laboratory

25.2.19 A statement that the report shall not be reproduced except in full, without prior express written approval by the laboratory coordinator

25.2.20 A signature and title of the person(s) accepting responsibility for the content of the report and date of issue (Signatories are appointed by the Lab Director)

25.2.21 When TNI accreditation is required, the lab shall certify that the test results meet all requirements of TNI or provide reasons and/or justification if they do not

25.2.22 If applicable, the laboratory includes a cover letter

25.2.23 Where applicable, a narrative to the report that explains the issue(s) and corrective action(s) taken in the event that a specific accreditation or certification requirement was not met

25.2.24 When soil samples are analyzed, a specific identification as to whether soils are reported on a “wet weight” or “dry weight” basis

25.2.25 Appropriate laboratory certification number for the state of origin of the sample, if applicable

25.2.26 If only part of the report is provided to the client (client requests some results before all of it is complete), it must be clearly indicated on the report (e.g., preliminary report). A complete report must be sent once all of the work has been completed.

25.2.27 Any non-TestAmerica subcontracted analysis results are provided as a separate report on the official letterhead of the subcontractor. All TestAmerica subcontracting is clearly identified on the report as to which laboratory performed a specific analysis.

25.2.28 A clear statement notifying the client that non-accredited tests were performed and directing the client to the laboratory’s accreditation certificates of approval shall be provided when non-accredited tests are included in the report

Note: It is required by the PA DEP that non-accredited parameters be clearly identified on the sample results.

Note: Refer to the Corporate SOP on Electronic Reporting and Signature Policy (No. CA-I-P-002) for details on internally applying electronic signatures of approval.

25.3 Reporting Level Or Report Type

The laboratory offers four levels of quality control reporting. Each level, in addition to its own specific requirements, contains all the information provided in the preceding level. The packages provide the following information in addition to the information described above:

- Level I is a report with the features described in Section 25.2 above.
- Level II is a Level I report plus summary information, including results for the method blank reported to the laboratory MDL, percent recovery for laboratory control samples and matrix spike samples, and the RPD values for all MSD and sample duplicate analyses.
- Level III contains all the information supplied in Level II, but presented on the CLP-like summary forms, and relevant calibration information. A Level II report is not included, unless specifically requested. No raw data is provided.
- Level IV is the same as Level III with the addition of all raw supporting data.

In addition to the various levels of QC packaging, the laboratory also provides reports in diskette deliverable form. Initial reports may be provided to clients by facsimile. Procedures used to ensure client confidentiality are outlined in Section 25.6.

25.3.1 Electronic Data Deliverables (EDDs)

EDDs are routinely offered as part of TestAmerica's services in addition to the test report as described in section 25.2. When NELAP accreditation is required and both a test report and EDD are provided to the client, the official version of the test report will be the combined information of the report and the EDD. Data qualifiers appearing on the test report must be included in the EDD.

Pittsburgh offers a variety of EDD formats including Environmental Restoration Information Management System (ERPIMS), Staged Electronic Data Deliverable (SEDD) Environmental Quality Information System (EQuIS), Electronic Deliverable Format (EDF), Excel and custom files as requested by the client.

EDD specifications are submitted to the IT department by the PM for review and undergo the contract review process. Once the facility has committed to providing data in a specific electronic format, the coding of the format may need to be performed. This coding is documented and validated. The validation of the code is retained by the IT staff coding the EDD.

EDDs shall be subject to a review to ensure their accuracy and completeness. If EDD generation is automated, review may be reduced to periodic screening if the laboratory can demonstrate that it can routinely generate that EDD without errors. Any revisions to the EDD format must be reviewed until it is demonstrated that it can routinely be generated without errors. If the EDD can be reproduced accurately and if all subsequent EDDs can be produced error-free, each EDD does not necessarily require a review.

25.4 Supplemental Information For Test

The lab identifies any unacceptable QC analyses or any other unusual circumstances or observations such as environmental conditions and any non-standard conditions that may have

affected the quality of a result. This is typically in the form of a footnote or a qualifier and/or a narrative explaining the discrepancy in the front of the report.

Numeric results with values outside of the calibration range, either high or low are qualified as 'estimated'.

Where quality system requirements are not met, a statement of compliance/non-compliance with requirements and/or specifications is required, including identification of test results derived from any sample that did not meet TNI sample acceptance requirements such as improper container, holding time, or temperature.

Where applicable, a statement on the estimated uncertainty of measurements; information on uncertainty is needed when a client's instructions so require.

Opinions and Interpretations - The test report contains objective information, and generally does not contain subjective information such as opinions and interpretations. If such information is required by the client, the Laboratory Director will determine if a response can be prepared. If so, the Laboratory Director will designate the appropriate member of the management team to prepare a response. The response will be fully documented, and reviewed by the Laboratory Director, before release to the client. There may be additional fees charged to the client at this time, as this is a non-routine function of the laboratory.

Note: Review of data deliverable packages for submittal to regulatory authorities requires responses to non-conforming data concerning potential impact on data quality. This necessitates a limited scope of interpretation, and this work is performed by the Manager(s)/Team Leaders or as assigned by the lab Director. This is the only form of "interpretation" of data that is routinely performed by the laboratory.

When opinions or interpretations are included in the report, the laboratory provides an explanation as to the basis upon which the opinions and interpretations have been made. Opinions and interpretations are clearly noted as such and where applicable, a comment should be added suggesting that the client verify the opinion or interpretation with their regulator.

25.5 Environmental Testing Obtained From Subcontractors

If the laboratory is not able to provide the client the requested analysis, the samples would be subcontracted following the procedures outlined in the Corporate SOP on Subcontracting (SOP # CA-L-S-002).

Data reported from analyses performed by a subcontractor laboratory are clearly identified as such on the analytical report provided to the client. Results from a subcontract laboratory outside of TestAmerica are reported to the client on the subcontract laboratory's original report stationary and the report includes any accompanying documentation.

25.6 Client Confidentiality

In situations involving the transmission of environmental test results by telephone, facsimile or other electronic means, client confidentiality must be maintained.

TestAmerica will not intentionally divulge to any person (other than the Client or any other person designated by the Client in writing) any information regarding the services provided by TestAmerica or any information disclosed to TestAmerica by the Client. Furthermore, information known to be potentially endangering to national security or an entity's proprietary rights will not be released.

Note: This shall not apply to the extent that the information is required to be disclosed by TestAmerica under the compulsion of legal process. TestAmerica will, to the extent feasible, provide reasonable notice to the client before disclosing the information.

Note: Authorized representatives of an accrediting authority are permitted to make copies of any analyses or records relevant to the accreditation process, and copies may be removed from the laboratory for purposes of assessment.

25.6.1 Report deliverable formats are discussed with each new client. If a client requests that reports be faxed or e-mailed, the reports are to meet all requirements of this document, including a cover letter.

25.7 Format Of Reports

The format of reports is designed to accommodate each type of environmental test carried out and to minimize the possibility of misunderstanding or misuse.

25.8 Amendments To Test Reports

Corrections, additions, or deletions to reports are only made when justification arises through supplemental documentation. Justification is documented using the laboratory's corrective action system (refer to Section 12).

The revised report is retained on the data server, as is the original report. The revised report is stored in the data server under the job number followed by "Rev (n)" where 'n' is the revision number. The revised report will have the words "Revision (n)" on the report cover page beneath the report date.

When the report is re-issued, a notation of "report re-issue" is placed on the cover/signature page of the report or at the top of the narrative page with a brief explanation of reason for the re-issue and a reference back to the last final report generated.

25.9 Policies On Client Requests For Amendments

25.9.1 Policy on Data Omissions or Reporting Limit Increases

Fundamentally, our policy is simply to not omit previously reported results (including data qualifiers) or to not raise reporting limits and report sample results as ND. This policy has few exceptions. Exceptions are:

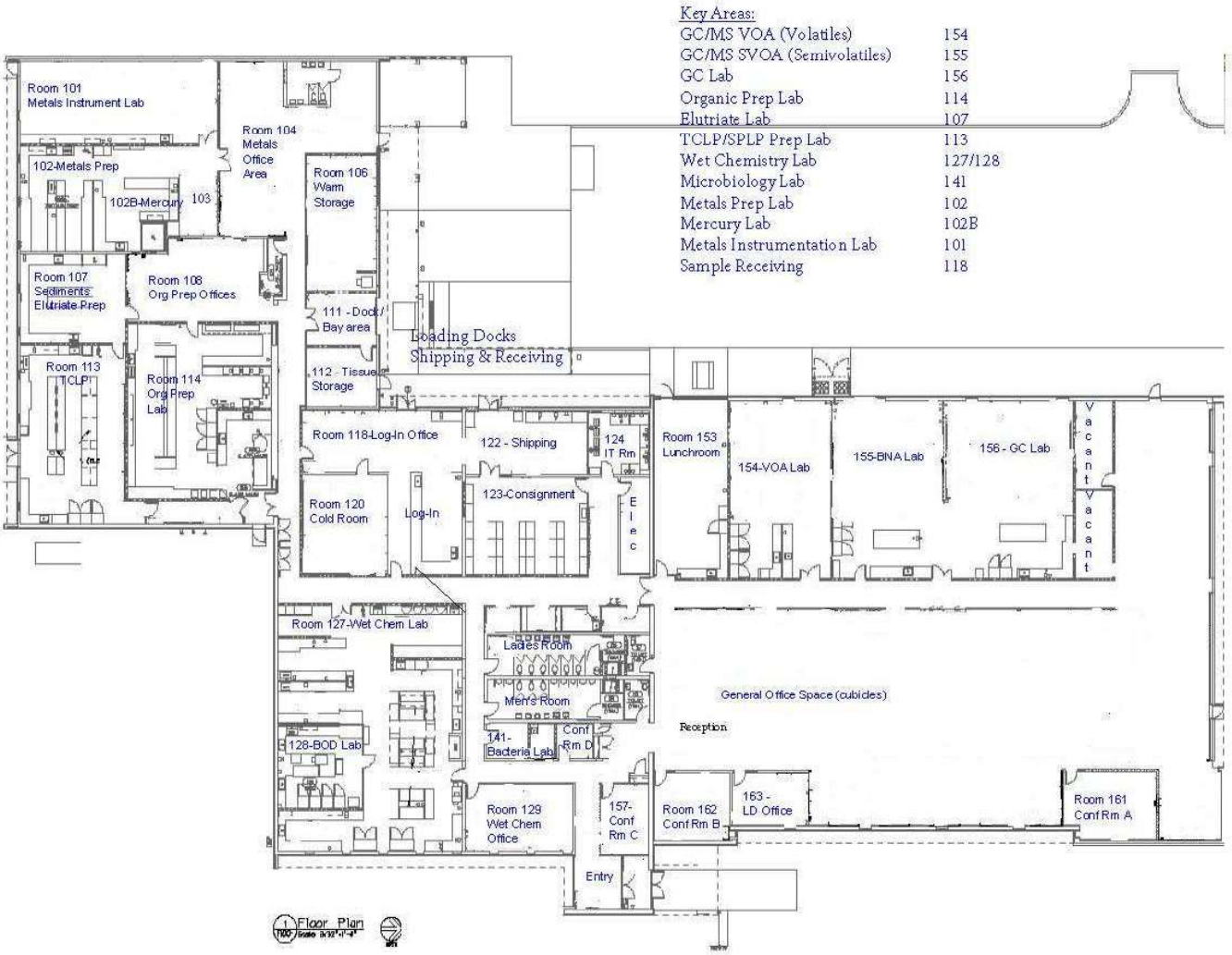
- Laboratory error
- Sample identification is indeterminate (confusion between COC and sample labels)

- An incorrect analysis (not analyte) was requested (e.g., COC lists 8315 but client wanted 8310). A written request for the change is required.
- Incorrect limits reported based on regulatory requirements
- The requested change has absolutely *no possible* impact on the interpretation of the analytical results and there is *no possibility* of the change being interpreted as misrepresentation by anyone inside or outside of our company.

25.9.2 Multiple Reports

TestAmerica does not issue multiple reports for the same job number where there is different information on each report (this does not refer to copies of the same report) unless required to meet regulatory needs and approved by QA.

Appendix 1
Laboratory Floor Plan



Appendix 2
Glossary/Acronyms

Glossary:

Acceptance Criteria: Specified limits placed on characteristics of an item, process, or service defined in requirement documents. (ASQC)

Accreditation: The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory.

Accuracy: The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (QAMS)

Analyst: The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality. (TNI)

Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis. (TNI)

Anomaly: A condition or event, other than a deficiency, that may affect the quality of the data, whether in the laboratory's control or not.

Assessment: The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of laboratory accreditation). (TNI)

Audit: A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives. (TNI)

Batch: Environmental samples which are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one to 20 environmental samples of the same matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An **analytical batch** is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various quality system matrices and can exceed twenty (20) samples. (TNI)

Bias: The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value). (TNI)

Blank: A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. (ASQC)

Calibration: A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. (TNI)

1) In calibration of support equipment the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI).

2) In calibration according to methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications.

Calibration Curve: The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (TNI)

Calibration Standard: A substance or reference material used to calibrate an instrument (QAMS)

Certified Reference Material (CRM): A reference material, accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute. (TNI)

Chain of Custody (COC) Form: Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; the collector; time of collection; preservation; and requested analyses. (TNI)

Compromised Samples: Those samples which are improperly sampled, insufficiently documented (chain of custody and other sample records and/or labels), improperly preserved, collected in improper containers, or exceeding holding times when delivered to a laboratory. Under normal conditions, compromised samples are not analyzed. If emergency situation require analysis, the results must be appropriately qualified.

Confidential Business Information (CBI): Information that an organization designates as having the potential of providing a competitor with inappropriate insight into its management, operation or products. TNI and its representatives agree to safeguarding identified CBI and to maintain all information identified as such in full confidentiality.

Confirmation: Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to Second Column Confirmation; Alternate wavelength; Derivatization; Mass spectral interpretation; Alternative detectors or Additional Cleanup procedures. (TNI)

Conformance: An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements. (ANSI/ASQC E4-1994)

Correction: Actions necessary to correct or repair analysis specific non-conformances. The acceptance criteria for method specific QC and protocols as well as the associated corrective actions. The analyst will most frequently be the one to identify the need for this action as a result of calibration checks and QC sample analysis. No significant action is taken to change behavior, process or procedure.

Corrective Action: The action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO 8402)

Data Audit: A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data re of acceptable quality (i.e., that they meet specified acceptance criteria). (TNI)

Data Reduction: The process of transforming the number of data items by arithmetic or statistical calculations, standard curves, and concentration factors, and collation into a more useable form. (TNI)

Data Review Checker: Automated data review feature in TALS that compares data entered to list of control and preventative review requirements and presents all findings to the first level data reviewer for response or correction.

Deficiency: An unauthorized deviation from acceptable procedures or practices, or a defect in an item. (ASQC), whether in the laboratory's control or not.

Demonstration of Capability: A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision. (TNI)

Document Control: The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly, and controlled to ensure use of the correct version at the location where the prescribed activity if performed. (ASQC)

Duplicate Analyses: The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. (EPA-QAD)

Equipment Blank: Sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures.

External Standard Calibration: Calibrations for methods that do not utilize internal standards to compensate for changes in instrument conditions.

Field Blank: Blank prepared in the field by filing a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken (EPA OSWER)

Field of Accreditation: Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.

Holding Times : The maximum times that samples may be held prior to analyses and still be considered valid or not compromised. (40 CFR Part 136)

Internal Standard: A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical test method. (TNI)

Internal Standard Calibration: Calibrations for methods that utilize internal standards to compensate for changes in instrument conditions.

Instrument Blank: A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. (EPA-QAD)

Instrument Detection Limit (IDL): The minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific instrument. The IDL is associated with the instrumental portion of a specific method only, and sample preparation steps are not considered in its derivation. The IDL is a statistical estimation at a specified confidence interval of the concentration at which the relative uncertainty is ± 100%. The IDL represents a range where qualitative detection occurs on a specific instrument. Quantitative results are not produced in this range.

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes, taken through all preparation

and analysis steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

An LCS shall be prepared at a minimum of 1 per batch of 20 or less samples per matrix type per sample extraction or preparation method, or more frequently if so required by the reference method, except for analytes for which spiking solutions are not available such as, total volatile solids, odor, temperature, or dissolved oxygen. The results of these samples shall be used to determine batch acceptance.

Least Squares Regression (1st Order Curve): The least squares regression is a mathematical calculation of a straight line over two axes. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The regression calculation will generate a correlation coefficient (r) that is a measure of the "goodness of fit" of the regression line to the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r must be greater than or equal to 0.99 for organics and 0.995 for inorganics.

Limit of Detection (LOD): [a.k.a., Method Detection Limit (MDL]: A laboratory's estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect in their facility. (TNI)

LOD Verification [a.k.a., MDL Verification]: A processed QC sample in the matrix of interest, spiked with the analyte at no more than 3X the LOD for single analyte tests and 4X the LOD for multiple analyte tests and processed through the entire analytical procedure.

Limit(s) of Quantitation (LOQ) [a.k.a., Reporting Limit]: The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. (TNI)

(QS) Matrix: The component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions shall be used:

Aqueous: Any aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine. Includes surface water, groundwater, effluents, and TCLP or other extracts.

Drinking Water: any aqueous sample that has been designated as a potable or potential potable water source.

Saline/Estuarine: any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.

Non-aqueous Liquid: any organic liquid with <15% settleable solids.

Biological Tissue: any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Solids: includes soils, sediments, sludges, and other matrices with >15% settleable solids.

Chemical Waste: a product or by-product of an industrial process that results in a matrix not previously defined.

Air & *Emissions*: whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device. (TNI)

Matrix Spike (spiked sample or fortified sample): A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by

adding a known amount of target analyte to a specified amount of sample for which an independent test result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Matrix Spike Duplicate (spiked sample or fortified sample duplicate): A replicate matrix spike prepared and analyzed to obtain a measure of the precision of the recovery for each analyte.
Method Blank: A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.

Method Detection Limit: The minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40 CFR Part 136, Appendix B)

Negative Control: Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results.

Non-conformance: An indication, judgment, or state of not having met the requirements of the relevant specifications, contract, or regulation.

Observation: A record of phenomena that (1) may assist in evaluation of the sample data; (2) may be of importance to the project manager and/or the client, and yet not at the time of the observation have any known effect on quality.

Performance Audit: The routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory.

Positive Control: Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects.

Precision: The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms.

Preservation: Any conditions under which a sample must be kept in order to maintain chemical and/or biological integrity prior to analysis. (TNI)

Proficiency Testing: A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (TNI)

Proficiency Testing Program: The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories. (TNI)

Proficiency Test Sample (PT): A sample, the composition of which is unknown to the laboratory and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria. (TNIS)

Quality Assurance: An integrated system of management activities involving planning, implementation, assessment,~~,~~ reporting and quality improvement to ensure that a process, item, ~~product~~ or service is of the type of quality needed and expected by the client. (TNI)

Quality Assurance [Project] Plan (QAPP): A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. (EAP-QAD)

Quality Control: The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality. (TNI)

Quality Control Sample: A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control. (TNI)

Quality Manual: A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. (TNI)

Quality System: A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC activities. (TNI)

Raw Data: The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records. (TNI)

Record Retention: The systematic collection, indexing and storing of documented information under secure conditions.

Reference Material: Material or substance one or more properties of which are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (ISO Guide 30-2.1)

Reference Standard: Standard used for the calibration of working measurement standards in a given organization or a given location. (TNI)

Sampling: Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.

Second Order Polynomial Curve (Quadratic): The 2nd order curves are a mathematical calculation of a slightly curved line over two axis. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The 2nd order regression will generate a coefficient of determination (COD or r^2) that is a measure of the "goodness of fit" of the quadratic curvature the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r^2 must be greater than or equal to 0.99.

Selectivity: The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system. (TNI)

Sensitivity: The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (TNI)

Spike: A known mass of target analyte added to a blank, sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.

Standard: The document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of standard setting NELAC and meets the approval requirements of standard adoption organizations procedures and policies. (TNI)

Standard Operating Procedures (SOPs): A written document which details the method for an operation, analysis, or action, with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks. (TNI)

Storage Blank: A blank matrix stored with field samples of a similar matrix (volatiles only) that measures storage contribution to any source of contamination.

Surrogate: A substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes.

Surrogate compounds must be added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. Poor surrogate recovery may indicate a problem with sample composition and shall be reported to the client whose sample produced poor recovery. (QAMS)

Systems Audit (also Technical Systems Audit): A thorough, systematic, qualitative on-site assessment of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system. (EPA-QAD)

Technical Manager: A member of the staff of an environmental laboratory who exercises actual day-to-day supervision of laboratory operations for the appropriate fields of accreditation and reporting of results

Technology: A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.

Traceability: The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project. (TNI)

Trip Blank:
A blank matrix placed in a sealed container at the laboratory that is shipped, held unopened in the field, and returned to the laboratory in the shipping container with the field samples.

Uncertainty:
A parameter associated with the result of a measurement that characterizes the dispersion of the value that could reasonably be attributed to the measured value.

Acronyms:

CAR – Corrective Action Report
CCV – Continuing Calibration Verification
CF – Calibration Factor
CFR – Code of Federal Regulations
COC – Chain of Custody
DOC – Demonstration of Capability
DQO – Data Quality Objectives
DUP - Duplicate
EHS – Environment, Health and Safety
EPA – Environmental Protection Agency
GC - Gas Chromatography
GC/MS - Gas Chromatography/Mass Spectrometry
HPLC - High Performance Liquid Chromatography
ICP - Inductively Coupled Plasma Atomic Emission Spectroscopy
ICP/MS – ICP/Mass Spectrometry
ICV – Initial Calibration Verification
IDL – Instrument Detection Limit
IH – Industrial Hygiene
IS – Internal Standard
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
LIMS – Laboratory Information Management System
LOD – Limit of Detection
LOQ – Limit of Quantitation
MDL – Method Detection Limit
MDLCK – MDL Check Standard
MDLV – MDL Verification Check Standard
MRL – Method Reporting Limit Check Standard
MS – Matrix Spike
MSD – Matrix Spike Duplicate
MSDS - Material Safety Data Sheet
NELAP - National Environmental Laboratory Accreditation Program
PT – Performance Testing
TNI – The NELAC Institute
QAM – Quality Assurance Manual
QA/QC – Quality Assurance / Quality Control
QAPP – Quality Assurance Project Plan
RF – Response Factor
RPD – Relative Percent Difference
RSD – Relative Standard Deviation
SD – Standard Deviation
SOP: Standard Operating Procedure
TAT – Turn-Around-Time
VOA – Volatiles
VOC – Volatile Organic Compound

Appendix 3

Laboratory Certifications, Accreditations, Validations

Pittsburgh maintains certifications, accreditations, certifications, and validations with numerous state and national entities. Programs vary but may include on-site audits, reciprocal agreements with another entity, performance testing evaluations, review of the QA Manual, Standard Operating Procedures, Method Detection Limits, training records, etc. At the time of this QA Manual revision, the laboratory has accreditation / certification / licensing with the following organizations:

Organization	Certificate Number Or Laboratory ID Number
Arkansas	88-0690
California ELAP	2891
Connecticut	PH-0688
Florida	E871008
Illinois	002602
Kansas	E-10350
Louisiana	04041
New Hampshire	203010
New Jersey	PA005
New York	11182
North Carolina	434
Pennsylvania	02-00416
South Carolina	89014002
Texas	T104704528
Utah	STLP
USDA	P330-10-00139
USDA	P-Soil -01
Virginia VELAP	460189
West Virginia	142
Wisconsin	998027800

The certificates and parameter lists (which may differ) are available, upon request, from a laboratory representative. They may be found on the Corporate web site, the laboratory's public server and in the QA web page.

Appendix 4

Pittsburgh Laboratory SOP List

Document No.	Title
PT-FS-001	Field Measurement of Dissolved Oxygen (DO) Method: SM 4500-O G
PT-FS-002	Field Measurement of Total Residual Chlorine Method: SM 4500-Cl G
PT-FS-003	Field Measurement of pH Method: SM 4500 H+B
PT-GC-001	Gas Chromatographic Analysis of Herbicides, SW-846 Method 8151A
PT-GC-002	Analysis of Organochlorine Pesticides and PCBs by Method 608
PT-GC-004	1,2-Dibromoethane(EDB) and 1,2-Dibromo-3-Chloropropane(DBCP) in Water by Microextraction and Gas Chromatography, Method 8011
PT-GC-005	Polychlorinated Biphenyls (PCBs) and PCBs as Congeners by GC/ECD - Method: SW-846 8082 and 8082A
PT-GC-006	Chlorinated Pesticides - Method: SW-846 8081A/B
PT-GC-007	Organophosphorus Pesticides by Gas Chromatography - Method: SW-846 8141A and 8141B
PT-GC-009	Determination of Inorganic Anions by Ion Chromatography EPA Method 300 SW-846 Method 9056A
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Quality Assurance Manual

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SOP/Policy Reference	Title
CA-I-P-002	Electronic Reporting and Signature Policy
CA-L-P-002	Contract Compliance Policy
CW-L-S-004	Subcontracting Procedures
CA-Q-M-002	Corporate Quality Management Plan
CA-Q-S-001	Acid and Solvent Lot Testing and Approval
CA-Q-S-002	Acceptable Manual Integration Practices
CA-Q-S-006	Detection Limits
CA-Q-S-009	Root Cause Analysis
CA-T-P-001	Qualified Products List
CW-E-M-001	Corporate Environmental Health and Safety Manual
CW-F-P-002	Company Wide Authorization Matrix
CW-F-P-004	Procurement and Contracts Policy
CW-F-S-007	Capital Expenditure Controlled Purchases
CW-L-P-001	Record Retention
CW-L-P-004	Company Wide Ethics Policy
CW-L-S-002	Internal Investigations
CW-Q-S-001	Corporate Document Control and Archiving
CW-Q-S-002	Writing a Standard Operating Procedure (SOPs)
CW-Q-S-003	Internal Auditing
CW-Q-S-004	Management Systems Review
CW-Q-S-005	Data Recall Process
CA-C-S-001	Work Sharing Process

REFERENCED LABORATORY SOPs

SOP Reference	Title
KNOX-QA-0001	Standard/Reagent Labeling and Documentation (Sec. 9.3.2, 9.3.3, 21.4, 21.4.3)
KNOX-QA-0004	Control Limits and Control Charting (Sec. 5.5, 5.6.1, 24.6.4.1)
KNOX-QA-0005	Balance Calibration and Weight Verification (Sec. 9.5, 20.3.1)
KNOX-QA-0006	Subsampling (Sec. 22.5)
KNOX-QA-0008	Nonconformance and Corrective Action System (Sec. 10.1)
KNOX-QA-0009	Personnel Orientation and Training (Sec. 17.3, 19.4.2, 19.4.3.8)
KNOX-QA-0010	Temperature Monitoring and Thermometer Calibration (Sec. 20.3.3.)
KNOX-QA-0011	Document Control & Distribution (Sec. 3.4.1, 6.1, 19.2)
KNOX-QA-0012	Pipette and Volumetric Labware Calibration Verification (Sec. 20.3.5)
KNOX-QA-0018	Preparation and Management of Standard Operating Procedures (Sec. 6.3, 19.2)
KNOX-QA-0019	Estimation of Measurement Uncertainty (Sec. 19.12.4)
KNOX-QA-0021	Department of Defense Quality Systems Manual Program Requirements (Sec 24.6.5.3.1, 24.6.5.3.2, 25.2.8)
KNOX-QA0023	Detection Limits (Sec. 19.7.1)
KNOX-AD-0003	Documenting Project Requirements (Sec. 7.3.1)
KNOX-AD-0004	Data Reporting (Sec. 14.1.1, 25.3)
KNOX-IT-0001	Good Automated Laboratory Practices (Sec. 9.4, 19.13.1)
KNOX-IT-0002	Electronic Data And Software Backup (Sec. 19.13.1)
KNOX-MS-0014	Tentatively Identified Compounds (TICS) (Sec. 20.5)
KNOX-SC-0003	Sample Receipt and Login (Sec. 23.2.1)
KNOX-SC-0005	Sample Disposal, Return and Archive (Sec. 23.7)

SECTION 3

INTRODUCTION, SCOPE AND APPLICABILITY

3.1 INTRODUCTION AND COMPLIANCE REFERENCES

TestAmerica Knoxville's Quality Assurance Manual (QAM) is a document prepared to define the overall policies, organization objectives and functional responsibilities for achieving TestAmerica's data quality goals. The laboratory maintains a local perspective in its scope of services and client relations and maintains a national perspective in terms of quality.

The QAM has been prepared to assure compliance the NELAC Institute (TNI) Standard dated 2009, Volume 1 Modules 2 and 4, and ISO/IEC Guide 17025:2005(E). In addition, the policies and procedures outlined in this manual are compliant with TestAmerica's Corporate Quality Management Plan (CA-Q-M-002; CQMP) and the various accreditation and certification programs listed in Appendix 3. The CQMP provides a summary of TestAmerica's quality and data integrity system. It contains requirements and general guidelines under which all TestAmerica facilities conduct their operations.

The QAM has been prepared to be consistent with the requirements of the following documents:

- ANSI/ASQC, E4-1994, "Specifications and Guidelines for Quality Management Systems for Environmental Data Collection and Environmental Technology Programs" (American National Standard, January 5, 1995, or most recent version)
- "EPA Requirements for Quality Management Programs" (QA/R-2) (EPA/240/B-01/002, May 31, 2006).
- EPA 600/4-79-019, *Handbook for Analytical Quality Control in Water and Wastewater Laboratories,* EPA, March 1979.
- Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008. Final Update V, August 2015.
- Federal Register, 40 CFR Parts 136, 141, and 261.
- Manual for the Certification of Laboratories Analyzing Drinking Water (EPA 815-R-05-004, January 2005).
- APHA, *Standard Methods for the Examination of Water and Wastewater,* 18th Edition, 19th, 20th , 21st , and on-line Editions.
- *U.S. Department of Energy* Order 414.1B, *Quality Assurance*, Approved April 29, 2004, and/or 414.1C, *Quality Assurance*, Approved June 17, 2005; and/or *U.S. Department of Energy* Order 414.1D, *Quality Assurance,* Approved April 25, 2011.
- U.S. Department of Defense, Quality Systems Manual for Environmental Laboratories, Version 4.2, October 2010.
- U.S. Department of Defense (DoD)/Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0, July 2013.

3.2 TERMS AND DEFINITIONS

A Quality Assurance Program is a company-wide system designed to ensure that data produced by the laboratory conforms to the standards set by state and/or federal regulations. The program functions at the management level through company goals and management policies, and at the analytical level through Standard Operating Procedures (SOPs) and quality control. The TestAmerica program is designed to minimize systematic error, encourage constructive, documented problem solving, and provide a framework for continuous improvement within the organization.

Refer to Appendix 2 for the Glossary/Acronyms.

3.3 SCOPE / FIELDS OF TESTING

The laboratory analyzes a broad range of environmental and industrial samples every month. Sample matrices vary among air (source and ambient), drinking water, effluent water, groundwater, soils, sediment, biological, hazardous waste, and sludge. The Quality Assurance Program contains specific procedures and methods to test samples of differing matrices for chemical and physical parameters. The Program also contains guidelines on maintaining documentation of analytical processes, reviewing results, servicing clients and tracking samples through the laboratory. The technical and service requirements of all analytical requests are thoroughly evaluated before commitments are made to accept the work. Measurements are made using published reference methods or methods developed and validated by the laboratory.

The methods covered by this manual include the most frequently requested methodologies needed to provide analytical services in the United States and its territories. The specific list of test methods used by the laboratory can be found in Table 19-1. The approach of this QAM is to define the minimum level of quality assurance and quality control necessary to meet these requirements. All methods performed by the laboratory meet these criteria as appropriate. In some instances, quality assurance project plans (QAPPs), project specific data quality objectives (DQOs) or local regulations may require criteria other than those contained in this QAM. In these cases, the laboratory abides by the requested criteria following review and acceptance of the requirements by the Laboratory Director and the Quality Assurance (QA) Manager. In some cases, QAPPs and DQOs may specify less stringent requirements. The Laboratory Director and the QA Manager must determine if it is in the lab's best interest to follow the less stringent requirements.
Note: TestAmerica Knoxville must comply with the information provided in its VAP approved QA Manual and SOPs.

3.4 MANAGEMENT OF THE MANUAL

3.4.1 Review Process

The template on which this manual is based is reviewed annually by Corporate Quality Management Personnel to assure that it remains in compliance with Section3.1. This QAM itself is reviewed annually by the senior laboratory management to assure that it reflects current practices and meets the requirements of the laboratory's clients and regulators as well as the CQMP. Occasionally, the manual may need changes in order to meet new or changing regulations and operations. The QA Manager reviews the changes in the normal course of

business and incorporates changes into revised sections of the document. All updates are reviewed by the senior laboratory management staff. The laboratory updates and approves such changes according to our document control and distribution procedures (refer to SOP No. KNOX-QA-0011).

Laboratory-specific QAM changes are initiated through the TestAmerica Knoxville Quality Assurance Manager. Each revision to the QAM is approved by the same authorized signatories as shown on the cover page of the QAM. Changes to the Laboratory Specific QAM must also be reviewed and approved by Ohio EPA VAP prior to implementation.

SECTION 4

MANAGEMENT REQUIREMENTS

4.1 OVERVIEW

TestAmerica Knoxville is a local operating unit of TestAmerica Laboratories, Inc. The organizational structure, responsibilities and authorities of the corporate staff of TestAmerica Laboratories, Inc. are presented in the CQMP. The laboratory has day-to-day independent operational authority overseen by corporate officers (e.g., President and Chief Executive Officer, Chief Operating Officer (COO), Executive VP Operations, Corporate Quality Assurance, etc.). The TestAmerica Knoxville laboratory operational and support staff work under the direction of the Laboratory Director. The organizational structure for both Corporate & TestAmerica Knoxville is presented in Figure 4-1.

4.2 ROLES AND RESPONSIBILITIES

In order for the Quality Assurance Program to function properly, all members of the staff must clearly understand and meet their individual responsibilities as they relate to the quality program. The following descriptions briefly define each role in its relationship to the Quality Assurance Program. More detailed laboratory job descriptions are maintained by management and human resources on the company intranet.

4.2.1 Additional Requirements for Laboratories

The responsibility for quality resides with every employee of the laboratory. All employees have access to the QAM, are trained to this QAM, and are responsible for upholding the standards therein. Each person carries out his/her daily tasks in a manner consistent with the goals and in accordance with the procedures in this manual and the laboratory's SOPs. Role descriptions for Corporate personnel are defined in the CQMP. This manual is specific to the operations of TestAmerica's Knoxville laboratory.

4.2.2 Laboratory Director

TestAmerica Knoxville's Laboratory Director is responsible for the overall quality, safety, financial, technical, human resource and service performance of the laboratory and reports directly to the General Manager. The Laboratory Director provides the resources necessary to implement and maintain an effective and comprehensive Quality Assurance and Data Integrity Program.

Specific responsibilities include, but are not limited to:

- Implementing and ensuring adherence to the Quality System as described in this QAM and in the supporting laboratory policies and procedures.
- Providing one or more technical managers for the appropriate fields of testing. If the Technical Manager is absent for a period of time exceeding 15 consecutive calendar days, the Laboratory Director must designate another full time staff member meeting the qualifications of the Technical Manager to temporarily perform this function. If the absence

exceeds 65 consecutive calendar days, the primary accrediting authority must be notified in writing.

- Ensuring that all laboratory analysts and group leaders have the appropriate education and training to properly carry out the duties assigned to them and ensuring that this training has been documented.
- Ensuring that personnel are free from any undue pressures, including inappropriate commercial or financial concerns which may adversely affect the quality of their work.
- Annually assessing the effectiveness of the Quality System within the operation.
- Maintaining adequate trained staff to supervise and perform the work of the laboratory.
- Ensuring that appropriate corrective actions are taken to address analyses identified as requiring such actions by internal and external performance or procedural audits. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs may be temporarily suspended by the Laboratory Director.
- Having signature authority for the QAM, laboratory policies, SOPs, and contracts.
- Having the authority and responsibility to halt work, withhold final reports, or suspend an analysis for due cause as well as authorize the resumption of work

4.2.3 Quality Assurance (QA) Manager or Designee

The QA Manager is able to evaluate data objectively and perform assessments without outside (i.e., managerial) influence. Authorities and responsibilities include:

- Reporting directly to the Laboratory Director and to the Quality Director to maintain independence of QA oversight.
- Maintaining, approving, communicating and implementing the QAM.
- Having joint signature authority, with the Laboratory Director and Technical Manager for approval of quality documents.
- Directing controlled distribution of laboratory quality documents.
- Monitoring and communicating regulatory changes that may affect the laboratory to management.
- Having documented training and/or experience in QA/QC procedures and the laboratory's Quality System.
- Training and advising the laboratory staff on quality assurance/quality control procedures that are pertinent to their daily activities.
- Conducting Ethics and Data Integrity Training and conducting new employee Ethics and QA orientation.
- Ensuring that all personnel understand their contribution to the quality system.
- Evaluating the thoroughness and effectiveness of training.
- Reviewing and approving documentation of analyst training records.
- Serving as a focal point for QA and QC issues, reviewing corrective actions and recommending resolution for recurring nonconformances within the laboratory.

- Notifying laboratory management of deficiencies in the quality system and ensuring corrective actions are implemented and effective. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs shall be investigated following the procedures outlined in Section 12 and if deemed necessary may be temporarily suspended during the investigation.
- Assisting the laboratory in maintaining regulatory analytical compliance, including maintaining certifications.
- Having a general knowledge of the analytical test methods for which data audit/review is performed.
- Monitoring data quality measures via statistical methods to verify that the laboratory routinely meets stated quality goals.
- Using available tools, such as audit results, control charts, proficiency testing results, data analysis, corrective and preventive actions, customer feedback, and management reviews in efforts to monitor trends and continually improve the quality system.
- Scheduling proficiency test samples.
- Performing annual quality systems audits, and periodic data audits.
- Hosting external audits conducted by outside agencies.
- Approving quality control reference data changes in the LIMS.
- Preparing monthly QA Reports to management providing Quality System Metrics.
- Having the final authority to accept or reject data and to stop work in progress in the event that procedures or practices compromise the validity and integrity of analytical data. The QA Manager also has the responsibility to authorize the resumption of work if a stop work order was issued.
- Having responsibility and authority to ensure the continuous implementation of the quality system based on ISO 17025.
- Ensuring communication & monitoring standards of performance to ensure that systems are in place to produce the level of quality as defined in this document.
- Ensuring compliance with ISO 17025.
- Ensuring compliance with the DoD/ DOE Consolidated Quality Systems Manual (QSM).

4.2.4 Technical Manager or Designee

The Technical Manager is responsible for the technical operation of the laboratory and reports directly to the Laboratory Director. The Technical Manager is responsible for compliance with the ISO 17025 Standard. Specific responsibilities include, but are not limited to:

- Monitoring standards of performance in quality control and quality assurance.
- Monitoring the validity of the analyses performed and the data generated in the laboratory to assure reliable data.
- Exercising day to day supervision of laboratory operations and data reporting.
- Coordinating the development and implementation of SOPs.

- Having joint signature authority for QAM, SOPs, and training records.
- Performing technical training in area(s) of expertise.
- Interfacing with management on technical needs and solving day-to-day technical issues.
- Determining qualifications required for technical positions and evaluating job candidates against those requirements.
- Investigating technical issues related to projects as directed by QA.
- Evaluating new methods, technical proposals, and statements of work.
- Certifying technical laboratory personnel based on education and background to ensure that staff has demonstrated capability in the activities for which they are responsible.
- Meeting the requirements specified in the Section 4.1.1.1 of the NELAC standards.
- Ensuring compliance with ISO 17025.
- Ensuring compliance with the DoD/DOE QSM.

4.2.5 Operations Manager

The Operations Manager reports directly to the Laboratory Director and supervises the daily activities of the analytical groups. Responsibilities include, but are not limited to:

- Scheduling analytical operations.
- Supervising QC activities performed as a part of routine analytical operations.
- Implementing data review procedures.
- Supervising the preparation and maintenance of laboratory records.
- Supervising maintenance of instruments and scheduling of repairs.
- Supervising the daily activities of the Report Production Group.
- Working with the Project Managers and Group Leaders to assure the requirements of projects are met in a timely manner.
- Ensuring that corrective actions are implemented and effective.

4.2.6 Report Production Staff

The Report Production Staff reports to the Operations Manager. Responsibilities include, but are not limited to:

- Accurately generating and compiling analytical reports and associated deliverables for delivery to the client.
- Producing deliverables that meet NELAC requirements, as required.

4.2.7 Environmental Health and Safety Coordinator and Radiation Safety Officer

The Environmental Health and Safety Coordinator reports directly to the Laboratory Director. Responsibilities include, but are not limited to:

- Staying current with the hazardous waste regulations.
- Continuing training on hazardous waste issues.
- Reviewing and updating annually the Hazardous Waste Contingency Plan.
- Auditing the staff with regard to compliance with the TestAmerica Knoxville Specific Emergency Contingency Plan and the Corporate Environmental Health and Safety Manual (CW-E-M-001).
- Contacting the hazardous waste subcontractors for review of procedures and opportunities for minimization of waste.
- Conducting ongoing, necessary safety training and conduct new employee safety orientation.
- Assisting in developing and maintaining the Chemical Hygiene/Safety Manual.
- Administering dispersal of all Material Safety Data Sheet (MSDS) information.
- Performing regular chemical hygiene and housekeeping instruction.
- Giving instruction on proper labeling and practice; Serving as chairman of the laboratory safety committee.
- Overseeing the inspection and maintenance of general safety equipment – fire extinguishers, safety showers, eyewash fountains, etc. and ensure prompt repairs as needed.
- Supervising and scheduling fire drills and emergency evacuation drills.

As Radiation Safety Officer (RSO), responsibilities include but are not limited to:

- Ensuring that all uses of radioactive materials and radiation sources are conducted safely, in accordance with the conditions of the license and applicable regulations, and result in exposures to personnel which are as low as reasonably achievable (ALARA).

- Apprising and informing management of the radiation safety status of the facility and for keeping them aware of their responsibility in maintaining an adequate radiation protection program.

4.2.8 Group (Area) Leader, Team Leader or Laboratory Supervisor

Laboratory Supervisors report directly to the Operations Manager or the Laboratory Director. Responsibilities include, but are not limited to:

- Supervising daily activities of analyses within the group ensuring that the laboratory analysts adhere to the appropriate SOPs and the QAM.
- Supervising QC activities performed as a part of routine analytical operations.
- Implementing data review procedures.
- Supervising the preparation and maintenance of laboratory records.
- Evaluating instrument performance and supervising the calibration, preventive maintenance, and scheduling of repairs.

- Overseeing or performing review and approval of all analytical data.
- Reporting nonconformances to the appropriate managers.
- Ensuring that corrective actions are implemented and effective
- Providing written corrective action responses to audit findings
- Generating and reviewing SOPs for their section.

4.2.9 Laboratory Analysts

Laboratory analysts are responsible for conducting analysis and performing all tasks assigned to them by the group leader. Responsibilities include, but are not limited to:

- Performing analytical methods and data recording in accordance with documented procedures.
- Performing and documenting calibration and preventive maintenance.
- Performing data processing and data review procedures.
- Reporting nonconformances to the Group Leader, Technical Manager and QA Manager.
- Ensuring sample and data integrity by adhering to internal chain-of-custody procedures.

4.2.10 Data Reviewer

Laboratory Data Reviewers are responsible for review of analytical data. Laboratory Analysts also perform data reviews as noted above. Responsibilities include, but are not limited to:

- Performing data review procedures.
- Reporting nonconformances to the Group Leader, Technical Manager and QA Manager.

4.2.11 Sample Receiving Group Leader

The Sample Receiving Group Leader reports to the Customer Service Manager. Responsibilities include, but are not limited to:

- Ensuring implementation of proper sample receipt procedures, including maintenance of chain-of-custody.
- Reporting variances associated with condition-upon-receipt of samples.
- Logging samples into the LIMS.
- Ensuring that all samples are stored in the proper environment.
- Assisting Environmental Health and Safety staff with sample disposal.

4.2.12 Laboratory Client Relations Manager

The Client Relations Manager reports directly to the Laboratory Director and serves as the interface between the laboratory's technical departments and the laboratory's clients. The staff consists of the Project Management team. Responsibilities include, but are not limited to:

- Supervising the daily activities of the Project Management and Sample Control groups.
- Working with the Operations Manager and/or Group Leaders to ensure the requirements of projects are met in a timely manner.
- Having signature authority for laboratory reports.
- Defining customer requirements through project definition.
- Assessing and assuring customer satisfaction.
- Providing feedback to management on changing customer needs.
- Bringing together resources necessary to ensure customer satisfaction.

4.2.13 Project Manager

The Project Manager reports directly to the Customer Service Manager. Responsibilities include, but are not limited to:

- Monitoring analytical and quality assurance project requirements for a specified project.
- Acting as a liaison between the client and the laboratory staff.
- Preparing Quality Assurance Summary (QAS) or equivalent summary form and communicates project-specific requirements to all parties involved.
- Assisting the laboratory staff with interpretation of work plans, contracts, and QAPP requirements.
- Reviewing project data packages for completeness and compliance to client needs.
- Having signature authority for final report.
- Keeping the laboratory and client informed of project status.
- Together with the QA Manager, approving customer requested variances to methods and to standard laboratory protocols.
- Monitoring, reviewing, and evaluating the progress and performance of projects.
- Reporting client inquiries involving data quality issues or data acceptability to the facility QA Manager and to the operations staff.
- Preparing reissue requests for project data.

4.3 DEPUTIES

The following table defines who assumes the responsibilities of key personnel in their absence:

Key Personnel	Deputy
Laboratory Director: Christopher Rigell	Robyn Wagner
QA Manager: Kevin McGee	Annette Ribet
Technical Manager: Robyn Wagner	David Wiles
Technical Manager: Bruce Wagner	Melissa Davidson
Client Relations Manager: John Reynolds	Jamie McKinney

Key Personnel	Deputy
EHS Coordinator: Lewis Osborne	Mike Patty
Radiation Safety Officer (RSO): Lewis Osborne	James Cochran

The laboratory operational and support staff work under the direction of the Laboratory Director. The organizational structure for both Corporate & TestAmerica Knoxville is presented in Figure 4-1. Employee names are provided to demonstrate range and size of departments however the actual staff members may vary over time. The most current Organization Chart may be obtained from Quality Assurance Manager or Laboratory Director.

Figure 4-1.

Corporate and Laboratory Organization Charts

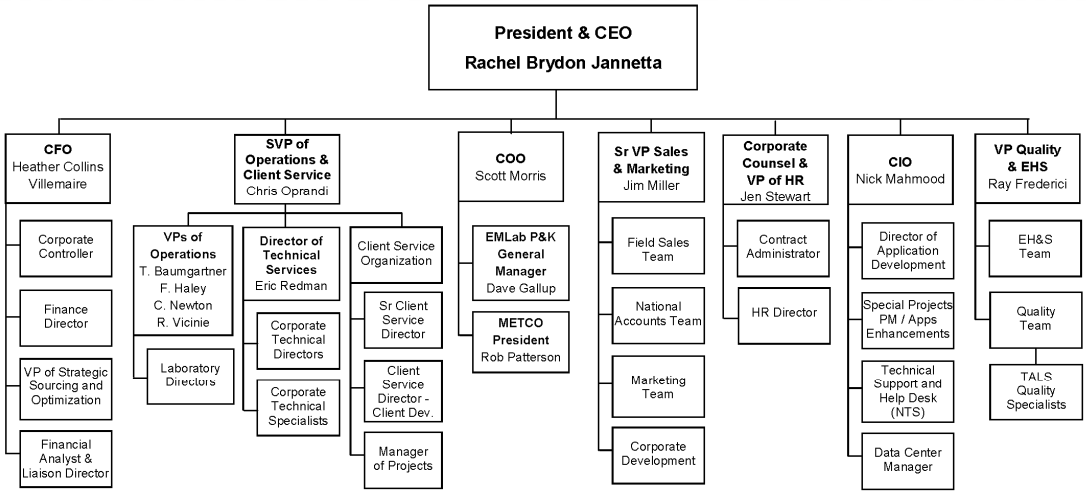

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Figure 4-1.

Corporate and Laboratory Organization Charts (continued)

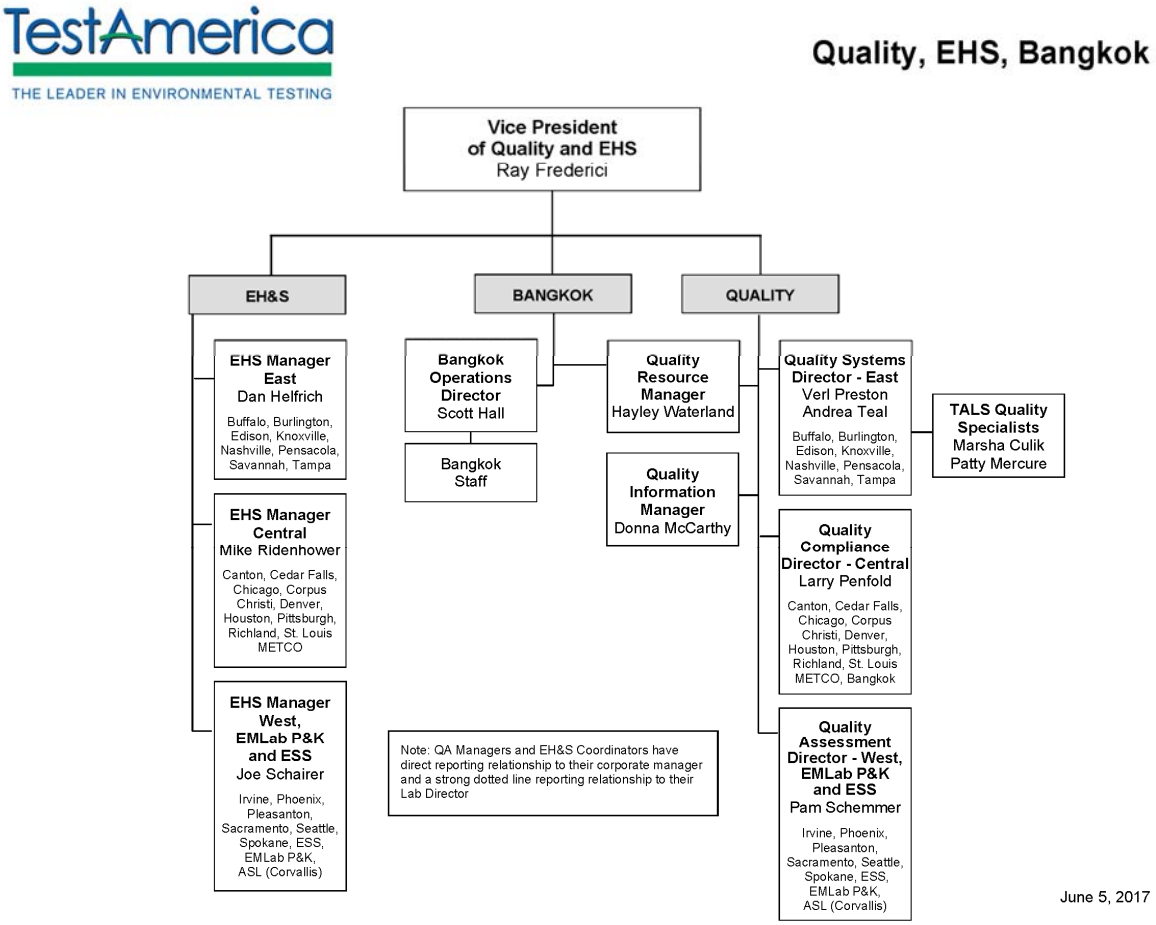
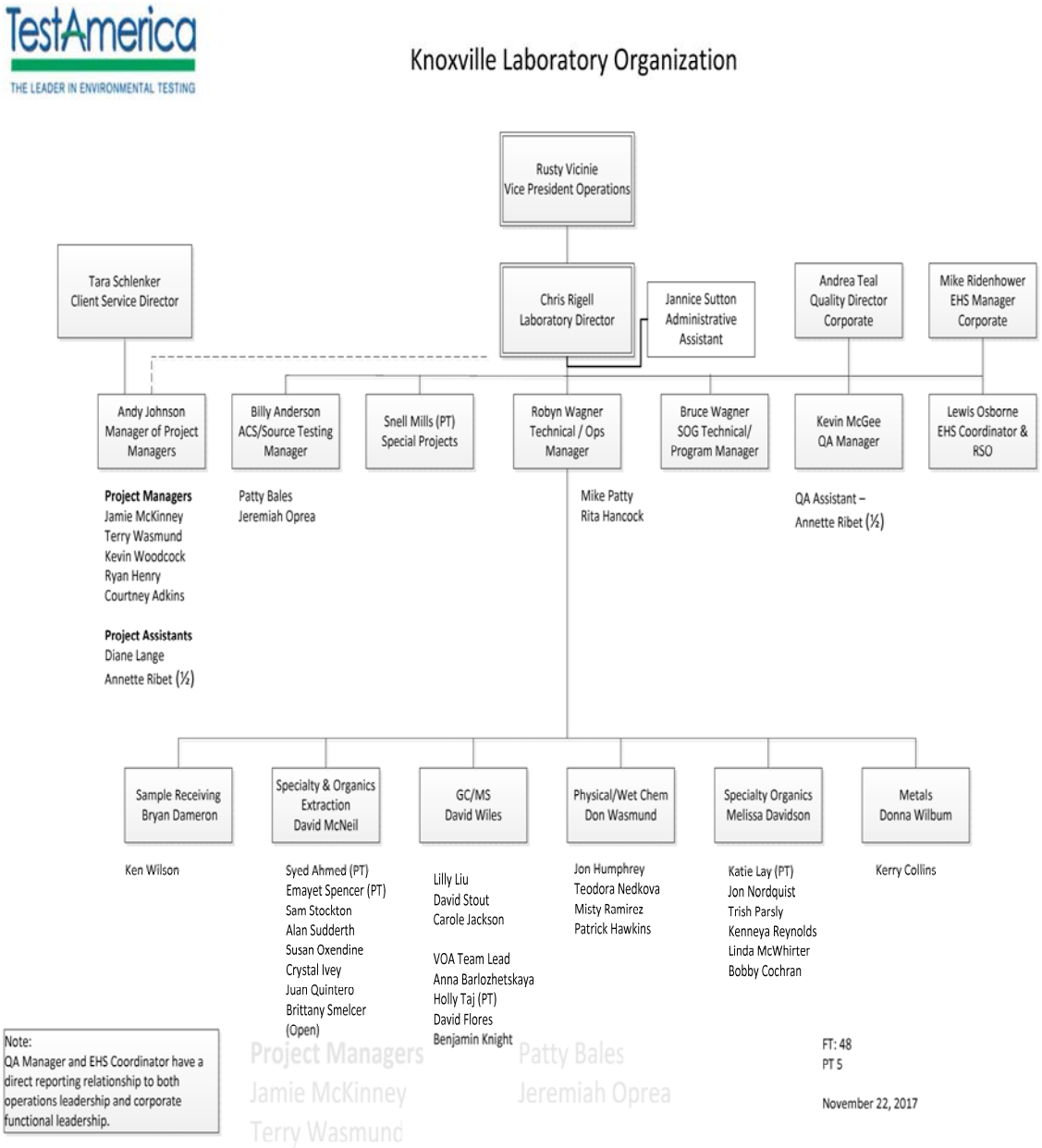


Figure 4-1.

Corporate and Laboratory Organization Charts (continued)



SECTION 5

QUALITY SYSTEM

5.1 QUALITY POLICY STATEMENT

It is TestAmerica's Policy to:

- ❖ Provide data of known quality to its clients by adhering to approved methodologies, regulatory requirements and the QA/QC protocols.
- ❖ Effectively manage all aspects of the laboratory and business operations by the highest ethical standards.
- ❖ Continually improve systems and provide support to quality improvement efforts in laboratory, administrative and managerial activities. TestAmerica recognizes that the implementation of a quality assurance program requires management's commitment and support as well as the involvement of the entire staff.
- ❖ Provide clients with the highest level of professionalism and the best service practices in the industry.
- ❖ To comply with the NELAC Standards (2003), ISO/IEC 17025:2005(E) International Standard, the 2009 TNI Standard and to continually improve the effectiveness of the management system.

Every staff member at the laboratory plays an integral part in quality assurance and is held responsible and accountable for the quality of their work. It is, therefore, required that all laboratory personnel are trained and agree to comply with applicable procedures and requirements established by this document.

5.2 ETHICS AND DATA INTEGRITY

TestAmerica is committed to ensuring the integrity of its data and meeting the quality needs of its clients. The elements of TestAmerica's Ethics and Data Integrity Program include:

- An Ethics Policy (Company-Wide Ethics Policy No. CW-L-P-004) and Employee Ethics Statements.
- Ethics and Compliance Officers (ECOs).
- A Training program.
- Self-governance through disciplinary action for violations.
- A Confidential mechanism for anonymously reporting alleged misconduct and a means for conducting internal investigations of all alleged misconduct (Corporate SOP No. CW-L-S-002).
- Procedures and guidance for recalling data if necessary (Corporate SOP No. CA-Q-S-005).
- Effective external and internal monitoring system that includes procedures for internal audits (Section 15).

Produce results which are accurate and include QA/QC information that meets client pre-defined Data Quality Objectives (DQOs).

- Present services in a confidential, honest and forthright manner.
- Provide employees with guidelines and an understanding of the Ethical and Quality Standards of our Industry.
- Operate our facilities in a manner that protects the environment and the health and safety of employees and the public.
- Obey all pertinent federal, state and local laws and regulations and encourage other members of our industry to do the same.
- Educate clients as to the extent and kinds of services available.
- Assert competency only for work for which adequate personnel and equipment are available and for which adequate preparation has been made.
- Promote the status of environmental laboratories, their employees, and the value of services rendered by them.

5.3 QUALITY SYSTEM SUPPORTING DOCUMENTATION

The laboratory's Quality System is communicated through a variety of documents.

- Quality Assurance Manual – Each laboratory has a lab specific quality assurance manual.
- Corporate SOPs and Policies - Corporate SOPs and Policies are developed for use by all relevant laboratories. They are incorporated into the laboratory's normal SOP distribution, training and tracking system. Corporate SOPs may be general or technical.
- Work Instructions - A subset of procedural steps, tasks or forms associated with an operation of a management system (e.g., checklists, preformatted bench sheets, forms).
- Laboratory SOPs – General and Technical.

5.3.1 Order of Precedence

In the event of a conflict or discrepancy between policies, the order of precedence is as follows:

- Corporate Quality Management Plan (CQMP)
- Corporate SOPs and Policies
- Laboratory QA/QC Policy Memorandum
- Laboratory Quality Assurance Manual (QAM)
- Laboratory SOPs and Policies
- Other (Work Instructions (WI), memos, flow charts, etc.)

Note: The laboratory has the responsibility and authority to operate in compliance with regulatory requirements of the jurisdiction in which the work is performed. Where the CQMP conflicts with those regulatory requirements, the regulatory requirements of the jurisdiction hold primacy. The laboratory's QAM takes precedence over the CQMP in those cases. Any regulatory requirements (e.g.; Ohio EPA VAP, CT RCP, etc) provided in the laboratory specific

documents (i.e., QAM and SOPs) take precedence over any policies provided in corporate documents.

5.4 QA/QC OBJECTIVES FOR THE MEASUREMENT OF DATA

Quality Assurance (QA) and Quality Control (QC) are activities undertaken to achieve the goal of producing data that accurately characterize the sites or materials that have been sampled. Quality Assurance is generally understood to be more comprehensive than Quality Control. Quality Assurance can be defined as the integrated system of activities that ensures that a product or service meets defined standards.

Quality Control is generally understood to be limited to the analyses of samples and to be synonymous with the term *"analytical quality control"*. QC refers to the routine application of statistically based procedures to evaluate and control the accuracy of results from analytical measurements. The QC program includes procedures for estimating and controlling precision and bias and for determining reporting limits.

Request for Proposals (RFPs) and Quality Assurance Project Plans (QAPP) provide a mechanism for the client and the laboratory to discuss the data quality objectives in order to ensure that analytical services closely correspond to client needs. The client is responsible for developing the QAPP. In order to ensure the ability of the laboratory to meet the Data Quality Objectives (DQOs) specified in the QAPP, clients are advised to allow time for the laboratory to review the QAPP before being finalized. Additionally, the laboratory provides support to the client for developing the sections of the QAPP that concern laboratory activities.

Note: TestAmerica Knoxville must comply with the information provided in its VAP approved QAM and SOPs.

Historically, laboratories have described their QC objectives in terms of precision, accuracy, representativeness, comparability, completeness, selectivity and sensitivity (PARCCSS). Equations to derive relevant QC objectives can be found in the method specific SOPs.

5.4.1 Precision

The laboratory objective for precision is to meet the performance for precision demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Precision is defined as the degree of reproducibility of measurements under a given set of analytical conditions (exclusive of field sampling variability). Precision is documented on the basis of replicate analysis, usually duplicate or matrix spike (MS) duplicate samples.

5.4.2 Accuracy

The laboratory objective for accuracy is to meet the performance for accuracy demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Accuracy is defined as the degree of bias in a measurement system. Accuracy may be documented through the use of laboratory control samples (LCS) and/or MS. A statement of accuracy is expressed as an interval of acceptance recovery about the mean recovery.

5.4.3 Representativeness

The laboratory objective for representativeness is to provide data which is representative of the sampled medium. Representativeness is defined as the degree to which data represent a characteristic of a population or set of samples and is a measurement of both analytical and field sampling precision. The representativeness of the analytical data is a function of the procedures used in procuring and processing the samples. The representativeness can be documented by the relative percent difference between separately procured, but otherwise identical samples or sample aliquots.

The representativeness of the data from the sampling sites depends on both the sampling procedures and the analytical procedures. The laboratory may provide guidance to the client regarding proper sampling and handling methods in order to assure the integrity of the samples.

5.4.4 Comparability

The comparability objective is to provide analytical data for which the accuracy, precision, representativeness and reporting limit statistics are similar to these quality indicators generated by other laboratories for similar samples, and data generated by the laboratory over time.

The comparability objective is documented by inter-laboratory studies carried out by regulatory agencies or carried out for specific projects or contracts, by comparison of periodically generated statements of accuracy, precision and reporting limits with those of other laboratories.

5.4.5 Completeness

The completeness objective for data is 90% (or as specified by a particular project), expressed as the ratio of the valid data to the total data over the course of the project. Data will be considered valid if they are adequate for their intended use. Data usability is defined in a QAPP, project scope or regulatory requirement. Data validation is the process for reviewing data to determine its usability and completeness. If the completeness objective is not met, actions will be taken internally and with the data user to improve performance. This may take the form of an audit to evaluate the methodology and procedures as possible sources for the difficulty or may result in a recommendation to use a different method.

5.4.6 Selectivity

Selectivity is defined as the capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. Target analytes are separated from non-target constituents and subsequently identified/detected through one or more of the following, depending on the analytical method: extractions (separation), digestions (separation), interelement corrections (separation), use of matrix modifiers (separation), specific retention times (separation and identification), confirmations with different columns or detectors (separation and identification), specific wavelengths (identification), specific mass spectra (identification), specific electrodes (separation and identification), etc..

5.4.7 Sensitivity

Sensitivity refers to the amount of analyte necessary to produce a detector response that can be reliably detected (Method Detection Limit, Estimated Detection Limit, or Limit of Detection) or quantified (Reporting Limit, Minimum Level, or Limit of Quantitation).

5.5 CRITERIA FOR QUALITY INDICATORS

The laboratory can prepare upon request a Quality Control Limit Summary from the Laboratory Information Management System (LIMS) that summarize the precision and accuracy acceptability limits for performed analyses. This summary includes an effective date, is updated each time new limits are generated and is located in the LIMS. Current limits are controlled through the LIMS. The limits in effect for a given date are archived in the LIMS with the associated sample data. Unless otherwise noted, limits within these tables are laboratory generated. Some acceptability limits are derived from US EPA methods when they are required. Where US EPA method limits are not required, the laboratory has developed limits from evaluation of data from similar matrices. Criteria for development of control limits is contained in SOP KNOX-QA-0004.

5.6 STATISTICAL QUALITY CONTROL

Statistically-derived precision and accuracy limits are required by selected methods (such as SW-846). The laboratory routinely utilizes statistically-derived limits to evaluate method performance and determine when corrective action is appropriate. The laboratory analysts are instructed to use the current limits in the laboratory (dated and approved by the Technical Manager/Group Leader and QA Manager) and entered into the LIMS. The Quality Assurance department maintains an archive of all limits used within the laboratory. These limits are maintained in the LIMS as part of the analytical historical record. If a method defines the QC limits, the method limits are used.

If a method requires the generation of historical limits, the lab develops such limits from recent data in the QC database of the LIMS following the guidelines described in Section 25. All calculations and limits are documented and dated when approved and effective. On occasion, a client requests contract-specified limits for a specific project.

Current QC limits are entered and maintained in the LIMS analyte database. As sample results and the related QC are entered into LIMS, the sample QC values are compared with the limits in LIMS to determine if they are within the acceptable range. The laboratory analyst then evaluates if the sample needs to be rerun or re-extracted/rerun or if a comment should be added to the report explaining the reason for the QC outlier.

5.6.1 QC Charts

The generation and use of QC Charts (Control Charts) are described in the laboratory SOP KNOX-QA-0004.

5.7 QUALITY SYSTEM METRICS

In addition to the QC parameters discussed above, the entire Quality System is evaluated on a monthly basis through the use of specific metrics (refer to Section 16). These metrics are used to drive continuous improvement in the laboratory's Quality System.

SECTION 6

DOCUMENT CONTROL

6.1 OVERVIEW

The QA Department is responsible for the control of documents used in the laboratory to ensure that approved, up-to-date documents are in circulation and out-of-date (obsolete) documents are archived or destroyed. The following documents, at a minimum, must be controlled at each laboratory Facility:

- Laboratory Quality Assurance Manual
- Laboratory Standard Operating Procedures (SOP)
- Laboratory Policies
- Work Instructions and Forms
- Corporate Policies and Procedures distributed outside the intranet

The Corporate Quality staff posts Corporate Manuals, SOPs, Policies, Work Instructions, White Papers and Training Materials on the company intranet site. These Corporate documents are only considered controlled when they are read on the intranet site. Printed copies are considered uncontrolled unless the laboratory physically distributes them as controlled documents. A detailed description of the procedure for issuing, authorizing, controlling, distributing, and archiving Corporate documents is found in Corporate SOP No. CW-Q-S-001, Corporate Document Control and Archiving. The laboratory's internal document control procedure is defined in KNOX-QA-0011, Document Control and Distribution.

The laboratory QA Department also maintains access to various references and document sources integral to the operation of the laboratory. This includes reference methods and regulations. Instrument manuals (hard or electronic copies) are also maintained by the laboratory.

The laboratory maintains control of records for raw analytical data and supporting records such as audit reports and responses, logbooks, standard logs, training files, MDL studies, Proficiency Testing (PT) studies, certifications and related correspondence, and nonconformance memos (NCMs). Raw analytical data consists of bound logbooks, instrument printouts, any other notes, magnetic media, electronic data and final reports.

6.2 DOCUMENT APPROVAL AND ISSUE

The pertinent elements of a document control system for each document include a unique document title and number, pagination, the total number of pages of the item or an 'end of document' page, the effective date, revision number and the laboratory's name. The QA personnel are responsible for the maintenance of this system.

Controlled documents are authorized by the QA Department and other laboratory management. In order to develop a new document, an employee submits a draft to the QA Department by way of the group leader/Technical Manager. Upon approval, QA personnel add the identifying version information to the document and retains that document as the official document on file.

That document is then provided to all applicable operational units (may include electronic access). Controlled documents are identified as such and records of their distribution are kept by the QA Department. Document control may be achieved by either electronic or hardcopy distribution.

The QA Department maintains a list of the official versions of controlled documents.

Quality System Policies and Procedures are reviewed at a minimum of every two years and revised as appropriate. Technical procedures used in support of work done for the Department of Defense (DOD) and Department of Energy (DOE), and the TestAmerica Knoxville Quality Assurance Manual must be reviewed at a one year frequency. Changes to documents occur when a procedural change warrants a revision of the document.

6.3 PROCEDURES FOR DOCUMENT CONTROL POLICY

For changes to the QAM, requests for change or revision may be made to the TestAmerica QA Manager. Changes affecting the text of the Corporate Quality Management Plan are forwarded to the Corporate QA Director for review and approval. If the proposed changes are accepted, they are incorporated into the next revision of the appropriate section of the QAM. Each revision to the QAM is approved by the same authorized signatories as shown on the cover page of the QAM. Uncontrolled copies must not be used within the laboratory. Previous revisions are archived by the QA department.

For changes to SOPs, refer to SOP No. KNOX-QA-0018, Preparation and Management of Standard Operating Procedures.

Forms, worksheets, work instructions and information are organized by form number and revision number on the QAQC shared directory on a local area network server.

6.4 OBSOLETE DOCUMENTS

All invalid or obsolete documents are removed, or otherwise prevented from unintended use. The laboratory has specific procedures as described above to accomplish this. In general, obsolete documents are collected from employees according to distribution lists and are marked obsolete on the cover or destroyed. At least one copy of the obsolete document is archived as described in Section 14.

SECTION 7

SERVICE TO THE CLIENT

7.1 OVERVIEW

The laboratory has established procedures for the review of work requests and contracts, oral or written. The procedures include evaluation of the laboratory's capability and resources to meet the contract's requirements within the requested time period. All requirements, including the methods to be used, must be adequately defined, documented and understood. For many environmental sampling and analysis programs, testing design is site or program specific and does not necessarily "fit" into a standard laboratory service or product. It is the laboratory's intent to provide both standard and customized environmental laboratory services to our clients.

A thorough review of technical and QC requirements contained in contracts is performed to ensure project success. The appropriateness of requested methods, and the lab's capability to perform them must be established. Projects, proposals and contracts are reviewed for adequately defined requirements and the laboratory's capability to meet those requirements. Alternate test methods that are capable of meeting the clients' requirements may be proposed by the lab. A review of the lab's capability to analyze non-routine analytes is also part of this review process.

All projects, proposals and contracts are reviewed for the client's requirements in terms of compound lists, test methodology requested, sensitivity (detection and reporting levels), accuracy, and precision requirements (% Recovery and RPD). The reviewer ensures that the laboratory's test methods are suitable to achieve these requirements and that the laboratory holds the appropriate certifications and approvals to perform the work. The laboratory and any potential subcontract laboratories must be certified, as required, for all proposed tests.

The laboratory must determine if it has the necessary physical, personnel and information resources to meet the contract, and if the personnel have the expertise needed to perform the testing requested. Each proposal is checked for its impact on the capacity of the laboratory's equipment and personnel. As part of the review, the proposed turnaround time is checked for feasibility.

Electronic or hard copy deliverable requirements are evaluated against the laboratory's capacity for production of the documentation.

If the laboratory cannot provide all services but intends to subcontract such services, whether to another TestAmerica facility or to an outside firm, this is documented and discussed with the client prior to contract approval. (Refer to Section 8 for Subcontracting Procedures.)

The laboratory informs the client of the results of the review if it indicates any potential conflict, deficiency, lack of accreditation, or inability of the lab to complete the work satisfactorily. Any discrepancy between the client's requirements and the laboratory's capability to meet those requirements is resolved in writing before acceptance of the contract. It is necessary that the contract be acceptable to both the laboratory and the client. Amendments initiated by the client and/or TestAmerica, are documented in writing.

All contracts, QAPPs, Sampling and Analysis Plans (SAPs), contract amendments, and documented communications become part of the project record.

The same contract review process used for the initial review is repeated when there are amendments to the original contract by the client, and the participating personnel are informed of the changes.

7.2 REVIEW SEQUENCE AND KEY PERSONNEL

The contract review process is outlined in SOP No. CA-L-P-002**,** Contract Compliance Policy.

This review encompasses all facets of the operation. The scope of work is distributed to the appropriate personnel, as needed based on scope of contract, to evaluate all of the requirements. Appropriate personnel may include:

- Contract Administrator
- VP of Operations
- Laboratory Manager of Project Managers
- The Laboratory Operations Manager
- Laboratory and/or Corporate Technical Managers / Directors
- Laboratory and/or Corporate Information Technology Managers/Directors
- Account Executives
- Laboratory and/or Corporate Quality
- Laboratory and/or Corporate Environmental Health and Safety Managers/Directors
- The Laboratory Director reviews the formal laboratory quote and makes final acceptance for their facility.

For routine projects and other simple tasks, a review by the Project Manager (PM) is considered adequate. The PM confirms that the laboratory has any required certifications, that it can meet the clients' data quality and reporting requirements and that the lab has the capacity to meet the clients turn around needs.

The Sales Director, Contract Administrator, Account Executive, or local account representative then submits the final proposal to the client.

In the event that one of the above personnel is not available to review the contract, his or her back-up fulfills the review requirements.

The Contracts Department maintains copies of all signed contracts*.* The Project Manager also maintains a copy.

7.3 DOCUMENTATION

Appropriate records are maintained for every contract or work request. All stages of the contract review process are documented and include records of any significant changes. This information is archived in the project files.

The contract is distributed to and maintained by the appropriate sales/marketing personnel and the Regional Account Manager. A copy of the contract and formal quote is filed with the Laboratory Project Manager and/or the Laboratory Director.

Records are maintained of pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract. The PM keeps a phone log of conversations with the client. This information is archived in the project file or in the lot folder as appropriate.

7.3.1 Project-Specific Quality Planning

Communication of contract specific technical and QC criteria is an essential activity in ensuring the success of site specific testing programs. To achieve this goal, the laboratory assigns a PM to each client. The PM is the first point of contact for the client. It is the PMs responsibility to ensure that project specific technical and QC requirements are effectively evaluated and communicated to the laboratory personnel before and during the project. QA department involvement may be needed to assist in the evaluation of custom QC requirements.

PMs are the primary client contact and they ensure resources are available to meet project requirements. Although PMs do not have direct reports or staff in production, they coordinate opportunities and work with laboratory management and supervisory staff to ensure available resources sufficient to perform work for the client's project. Project management is positioned between the client and laboratory resources.

Project specific instructions are communicated to the laboratory through the use of the Client Requirements Checklist in the LIMS or by a Quality Assurance Summary. Further details regarding the communication and documentation of project requirements are found in SOP KNOX-AD-0003, Documenting Project Requirements.

The laboratory strongly encourages client visits to the laboratory and for formal/informal information sharing session with employees in order to effectively communicate ongoing client needs as well as project specific details for customized testing programs.

7.4 SPECIAL SERVICES

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. It is the laboratory's goal to meet all client requirements in addition to statutory and regulatory requirements. The laboratory has procedures to ensure confidentiality to clients (Section 15 and 25).

The laboratory's standard procedures for reporting data are described in Section 25. Special services are also available and provided upon request. These services include:

- Reasonable access for our clients or their representatives to the relevant areas of the laboratory for the witnessing of tests performed for the client.
- Assist client-specified third party data validators as specified in the client's contract.

- Supplemental information pertaining to the analysis of their samples. Note: An additional charge may apply for additional data/information that was not requested prior to the time of sample analysis or previously agreed upon.

7.5 CLIENT COMMUNICATION

PMs are the primary communication link to the clients. They inform their clients of any delays in project completion as well as any non-conformances in either sample receipt or sample analysis. Project management maintains ongoing client communication throughout the entire client project.

Technical Managers are available to discuss any technical questions or concerns that the client may have.

7.6 REPORTING

The laboratory works with our clients to produce any special communication reports required by the contract.

7.7 CLIENT SURVEYS

The laboratory assesses both positive and negative client feedback. The results are used to improve overall laboratory quality, client service, and testing activities.

TestAmerica's Sales and Marketing teams periodically develops lab and client specific surveys to assess client satisfaction.

SECTION 8

SUBCONTRACTING OF TESTS

8.1 OVERVIEW

For the purpose of this quality manual, the phrase subcontract laboratory refers to a laboratory external to the TestAmerica laboratories. The phrase "work sharing" refers to internal transfers of samples between the TestAmerica laboratories. The term outsourcing refers to the act of subcontracting tests.

When contracting with our clients, the laboratory makes commitments regarding the services to be performed and the data quality for the results to be generated. When the need arises to outsource testing for our clients because project scope, changes in laboratory capabilities, capacity or unforeseen circumstances, we must be assured that the subcontractors or work sharing laboratories understand the requirements and meet the same commitments we have made to the client. Refer to TestAmerica's Corporate SOPs on Subcontracting Procedures (CW-L-S-004) and the Work Sharing Process (CA-C-S-001).

When outsourcing analytical services, the laboratory assures, to the extent necessary, that the subcontract or work sharing laboratory maintains a program consistent with the requirements of this document, the requirements specified in TNI/ISO 17025 and/or the client's Quality Assurance Project Plan (QAPP). All QC guidelines specific to the client's analytical program are transmitted to the subcontractor and agreed upon before sending the samples to the subcontract facility. Additionally, work requiring accreditation is placed with an appropriately accredited laboratory. The laboratory performing the subcontracted work is identified in the final report, as is non-TNI accredited work where required.

Project Managers (PMs), Client Relations Managers, or Account Executives for the Export Lab are responsible for obtaining client approval prior to subcontracting any samples. The laboratory advises the client of a subcontract arrangement in writing and when possible approval from the client is retained in the project folder. Standard TestAmerica Terms & Conditions include the flexibility to subcontract samples within the TestAmerica laboratories. Therefore, additional advance notification to clients for intra-laboratory subcontracting is not necessary unless specifically required by a client contract.

Note: In addition to the client, some regulating agencies (e.g., USDA) or contracts (e.g., DoD and DOE projects) require notification prior to placing such work. Unless the work is done directly for the USDA, this notification is made to the client who is responsible for ensuring notification of the regulating agency.

8.2 QUALIFYING AND MONITORING SUBCONTRACTORS

Whenever a PM, Account Executive (AE) or Client Relations Manager (CSM) becomes aware of a client requirement or laboratory need where samples must be outsourced to another laboratory, the other laboratory(s) are selected based on the following:

- Subcontractors specified by the client - In these circumstances, the client assumes responsibility for the quality of the data generated from the use of a subcontractor.

- Subcontractors reviewed by TestAmerica – Firms which have been reviewed by the company and are known to meet standards for accreditations (e.g., State, TNI and DoD/DOE); technical specifications; legal and financial information.

A listing of vendors is available on the TestAmerica intranet site.

All TestAmerica laboratories are pre-qualified for work sharing provided they hold the appropriate accreditations, can adhere to the project/program requirements, and the client approved sending samples to that laboratory. The client must provide acknowledgement that the samples can be sent to that facility (an e-mail is sufficient documentation or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented). The originating laboratory is responsible for communicating all technical, quality, and deliverable requirements as well as other contract needs. (Corporate SOP No. CA-C-S-001, Work Sharing Process).

8.2.1 When the potential subcontract laboratory has not been previously approved, PMs may nominate a laboratory as a subcontractor based on need. The decision to nominate a laboratory must be approved by the Laboratory Director. The Laboratory Director requests that the PM begin the process of approving the subcontract laboratory as outlined in Corporate SOP No. CW-L-S-004, Subcontracting Procedures.

Once the appropriate accreditation and legal information is received by the laboratory, it is evaluated for acceptability (where applicable) and forwarded to the Corporate Quality Information Manager (QIM) for review. After the Corporate QIM reviews the documents for completeness, the Corporate QIM will forward the documents to the Finance Department for formal signature and contracting with the laboratory. The approved vendor will be added to the approved subcontractor list on the intranet site and the finance group is concurrently notified for JD Edwards.

The client will assume responsibility for the quality of the data generated from the use of a subcontractor they have requested the lab to use. The qualified subcontractors on the intranet site are known to meet minimal standards. TestAmerica does not certify laboratories. The subcontractor is on our approved list and can only be recommended to the extent that we would use them.

8.3 OVERSIGHT AND REPORTING

8.3.1 The status and performance of qualified subcontractors will be monitored by the Corporate Quality department. Any problems identified will be brought to the attention of TestAmerica's Corporate Finance, Legal and Corporate Quality personnel.

- Complaints shall be investigated. Documentation of the complaint, investigation and corrective action will be maintained in the subcontractor's file on the intranet site. Complaints are posted using the Vendor Performance Report.
- Information shall be updated on the intranet when new information is received from the subcontracted laboratories.
- Subcontractors in good standing will be retained on the intranet listing. CSO personnel will notify all TestAmerica laboratories, Corporate Quality and Corporate Contracts if any laboratory requires removal from the intranet site. This notification will be posted on the

intranet site and e-mailed to all CSO Personnel, Laboratory Directors, QA Managers and Sales Personnel.

Prior to initially sending samples to the subcontracted laboratory, the PM confirms their certification status to determine if it's current and scope-inclusive. The information is documented within the project records.

8.3.2 For continued use of a subcontractor, verification of certification is placed upon the subcontractor for the defined project. Samples are subcontracted under Chain of Custody with the program defined as 'Accreditation Required' and the following statement for verification upon sample receipt:

Note: Since laboratory accreditations are subject to change, TestAmerica Laboratories, Inc. places the ownership of method, analyte & accreditation compliance upon our subcontract laboratories. This sample shipment is forwarded under Chain of Custody. If the laboratory does not currently maintain accreditation in the State of Origin listed above for analytes/tests/matrix being analyzed, the samples must be shipped back to the TestAmerica laboratory or other instructions will be provided. Any changes to accreditation status should be brought to TestAmerica Laboratories, Inc. attention immediately. If all requested accreditations are current to date, return the signed Chain of Custody attesting to said compliance to TestAmerica Laboratories, Inc.

For TestAmerica laboratories, certifications can be viewed on the company's TotalAccess Database.

8.3.3 All subcontracted samples must be accompanied by a TestAmerica Chain of Custody (COC). A copy of the original COC sent by the client must be available in TALS for all samples workshared within TestAmerica. Client COCs are only forwarded to external subcontractors when samples are shipped directly from the project site to the subcontractor lab. Under routine circumstances, client COCs are not provided to external subcontractors.

Through communication with the subcontracted laboratory, the PM monitors the status of the subcontracted analyses, facilitates successful execution of the work, and ensures the timeliness and completeness of the analytical report.

Non-TNI accredited work must be identified in the subcontractor's report as appropriate. If TNI accreditation is not required, the report does not need to include this information.

Reports submitted from subcontractor laboratories are not altered and are included in their original form in the final project report. This clearly identifies the data as being produced by a subcontractor facility. If subcontract laboratory data is incorporated into the laboratories EDD (i.e., imported), the report must explicitly indicate which lab produced the data for which methods and samples.

Note: The results submitted by a TestAmerica work sharing laboratory may be transferred electronically and the results reported by the TestAmerica work sharing lab are identified on the final report. The report must explicitly indicate which lab produced the data for which methods and samples. The final report must include a copy of the completed COC for all work sharing reports.

8.4 CONTINGENCY PLANNING

The full qualification of a subcontractor may be waived to meet emergency needs; however, this decision & justification must be documented in the project files, and the 'Purchase Order Terms And Conditions For Subcontracted Laboratory Services' must be sent with the samples and Chain-of-Custody.

In the event this provision is utilized, the laboratory (e.g., PM) will be required to verify and document the applicable accreditations of the subcontractor. All other quality and accreditation requirements will still be applicable, but the subcontractor need not have signed a subcontract with TestAmerica at this time.

The use of any emergency subcontractor will require the PM to complete a JDE New Vendor Add Form in order to process payment to the vendor and add them to TALS. This form requires the user to define the subcontractor's category/s of testing and the reason for testing.

SECTION 9

PURCHASING SERVICES AND SUPPLIES

9.1 OVERVIEW

Evaluation and selection of suppliers and vendors is performed, in part, on the basis of the quality of their products, their ability to meet the demand for their products on a continuous and short term basis, the overall quality of their services, their past history, and competitive pricing. This is achieved through evaluation of objective evidence of quality furnished by the supplier, which can include certificates of analysis, recommendations, and proof of historical compliance with similar programs for other clients. To ensure that quality critical consumables and equipment conform to specified requirements, all purchases from specific vendors are approved by a member of the supervisory or management staff. Capital expenditures are made in accordance with the TestAmerica's Capital Expenditure, Controlled Purchase Requests and Fixed Asset Capitalization, SOP No. CW-F-S-007.

Contracts are signed in accordance with the TestAmerica's Company Wide Authorization Policy, CW-F-P-002. (RFP's) are issued where more information is required from the potential vendors than just price. Process details are available in TestAmerica's Corporate Procurement and Contracts Policy (Policy No. CW-F-P-004). RFP's allow TestAmerica to determine if a vendor is capable of meeting requirements such as supplying all of the TestAmerica facilities, meeting required quality standards and adhering to necessary ethical and environmental standards. The RFP process also allows potential vendors to outline any additional capabilities they may offer.

Records for services and supplies that may affect the quality of environmental tests must include the following where applicable: date of receipt, expiration date, source, lot or serial number, calibration and verification records and certifications. See the SOPs referenced in Sections 9.3.3, and 9.5, and Section 22.2 for more details.

9.2 GLASSWARE

Glassware used for volumetric measurements must be Class A or verified for accuracy according to laboratory procedure. Pyrex (or equivalent) glass is used where possible. For safety purposes, thick-wall glassware is used where available and appropriate.

9.3 REAGENTS, STANDARDS & SUPPLIES

Purchasing guidelines for equipment, consumables and reagents must meet with the requirements of the specific method and testing procedures for which they are being purchased. Solvents and acids are pre-tested in accordance with TestAmerica's Corporate SOP on Solvent & Acid Lot Testing & Approval, SOP No. CA-Q-S-001. Approval information for the solvents and acids tested under SOP CA-Q-S-001 is stored on the TestAmerica Sharepoint, under Solvent Approvals. A master list of all tested materials, as well as the certificates of analysis for the materials, is stored in the same location.

9.3.1 Purchasing

Chemical reagents, solvents, glassware, and general supplies are ordered as needed to maintain sufficient quantities on hand. Materials used in the analytical process must be of a known quality. The wide variety of materials and reagents available makes it advisable to specify recommendations for the name, brand, and grade of materials to be used in any determination. This information is contained in the method SOP.

Many consumable items are maintained in an on-site consignment system, where the items in inventory have been pre-approved for laboratory use. On-site consignment is an inventory of commonly used items maintained at the laboratory by a laboratory supply company where they track the supply of items and restock as needed. If an item is not included in the on-site consignment system but is needed for laboratory operations, the group leader or designee enters the request into the JD Edwards system. The vendor item catalogue number is entered into the system to specify the required quality. Each request is reviewed and approved by the Laboratory Director or the Technical Manager (or designee) prior to purchase.

9.3.2 Receiving

It is the responsibility of the laboratory associate (typically sample receiving personnel) to receive the shipment. Once the ordered reagents or materials are received, the analyst compares the information on the label or packaging to the original order to ensure that the purchase meets the quality level specified and documents the date the materials were received. Refer to SOP KNOX-QA-0001 for further details.

The laboratory associate verifies the lot numbers of received solvents and acids against the pre-approval lists. If a received material is listed as unapproved, or is not listed, it is sequestered and returned to the vendor. Alternatively, the laboratory may test the material for the intended use, and if it is acceptable, document the approval on the approval list. Records of any testing performed locally are maintained on the shared “public” folder on the computer network.

Materials may not be released for use in the laboratory until they have been inspected, verified as suitable for use, and the inspection/verification has been documented

Safety Data Sheets (SDSs) are available online through the Company’s intranet website. Anyone may review these for relevant information on the safe handling and emergency precautions of on-site chemicals.

9.3.3 Specifications

Methods in use in the laboratory specify the grade of reagent that must be used in the procedure. If the quality of the reagent is not specified, analytical reagent grade will be used. It is the responsibility of the laboratory analyst to check the procedure carefully for the suitability of grade of reagent.

Chemicals are not to be used past the manufacturer’s expiration date and must not be used past the expiration time noted in a method SOP. If expiration dates are not provided, the laboratory may contact the manufacturer to determine an expiration date.

The laboratory assumes a five year expiration date on inorganic dry chemicals and solvents unless noted otherwise by the manufacturer or by the reference source method.

Chemicals/solvents are not to be used past the manufacturer's or SOPs expiration date unless 'verified' (refer to item 3 listed below).

- An expiration date cannot be extended if the dry chemical/solvent is discolored or appears otherwise physically degraded; the dry chemical must be discarded.

- Expiration dates can be extended if the dry chemical/solvent is found to be satisfactory based on acceptable performance of quality control samples (Continuing Calibration Verification (CCV), Method Blanks, Laboratory Control Sample (LCS), etc.).

- If the dry chemical/solvent is used for the preparation of standards, the expiration dates can be extended 6 months if the dry chemical/solvent is compared to an unexpired independent source in performing the method and the performance of the dry chemical/solvent is found to be satisfactory. The comparison must show that the dry chemical/solvent meets CCV limits. The comparison studies are maintained electronically in the group share on the local area network with the associated scanned calibration files.

Wherever possible, standards must be traceable to national or international standards of measurement or to national or international reference materials. Records to that effect are available to the user.

Compressed gases in use are checked for pressure and secure positioning daily. To prevent a tank from going to dryness or introducing potential impurities, the pressure should be closely watched as it decreases to approximately 15% of the original reading, at which point it should be replaced. For example, a standard sized laboratory gas cylinder containing 3,000 psig of gas should be replaced when it drops to approximately 500 psig. The quality of the gases must meet method or manufacturer specification or be of a grade that does not cause any analytical interference.

Water used in the preparation of standards or reagents must have a specific conductivity of less than 1μmho/cm (or resistivity of greater than 1.0 megaohm-cm) at 25°C. The specific conductivity is checked and recorded daily. If the water's conductivity is greater than the specified limit, the Technical Manager must be notified immediately in order to notify all departments, decide on cessation (based on intended use) of activities, and make arrangements for correction.

The laboratory may purchase reagent grade (or other similar quality) water for use in the laboratory. This water must be certified "clean" by the supplier for all target analytes or otherwise verified by the laboratory prior to use. This verification is documented.

Standard lots are verified before first time use if the laboratory switches manufacturers or has historically had a problem with the type of standard. Spiking standards are verified before use and instrument calibration standards are verified with a second source calibration verification standard. (Note: For Ohio EPA VAP, the continuing calibration verification standard must be from the same source used to prepare the standards used for the calibration curve, unless the analytical method states otherwise.)

Purchased bottleware used for sampling must be certified clean and the certificates must be maintained. If uncertified sampling bottleware is purchased, all lots must be verified clean prior

to use. For trace level analyses where vendors do not provide certification of cleanliness, periodic monitoring of uncertified bottleware is conducted with QA Manager approval instead of checking all bottleware lots. This verification must be maintained.

Tedlar bags purchased by the laboratory must be certified clean and the certificates must be maintained. Tedlar bags are not recommended for trace level analyses as the lab default reporting limits are 20x higher for Tedlar bags than for Summa Canisters.

Required records for solvents and standards are specified in the laboratory SOP KNOX-QA-0001, "Standard/Reagent Labeling and Documentation."

9.3.4 Storage

Reagent and chemical storage is important from the aspects of both integrity and safety. Light-sensitive reagents may be stored in brown-glass containers. Storage conditions are per the Corporate Environmental Health & Safety Manual (Corp. Doc. No. CW-E-M-001) and method SOPs or manufacturer instructions.

9.4 PURCHASE OF EQUIPMENT/INSTRUMENTS/SOFTWARE

When a new piece of equipment is needed, either for additional capacity or for replacing inoperable equipment, the analyst or supervisor makes a supply request to the Technical Manager and/or the Laboratory Director. If they agree with the request the procedures outlined in TestAmerica's Corporate Policy No. CA-T-P-001, Qualified Products List, are followed. A decision is made as to which piece of equipment can best satisfy the requirements. The appropriate written requests are completed and purchasing places the order.

Upon receipt of a new or used piece of equipment, it is given an instrument name in the LIMS, (e.g. MX), and added to the equipment list described in Section 20 maintained by the QA Department. Its capability is assessed to determine if it is adequate or not for the specific application. For instruments, a calibration curve is generated, followed by MDLs, Demonstration of Capabilities (DOCs), and other relevant criteria (refer to Section 19). For software, its operation must be deemed reliable and evidence of instrument verification must be retained by the IT Department as specified in the laboratory's procedure for software verification KNOX-IT-0001. Software certificates supplied by the vendors are filed with IT Department. The manufacturer's operation manual is retained at or near the bench.

9.5 SERVICES

Service to analytical instruments (except analytical balances) is performed on an as needed basis. Routine preventative maintenance is discussed in Section 20. The need for service is determined by laboratory analysts and/or Group Leaders. The service providers that perform the services are approved by the Group Leaders/Technical Manager.

Analytical balances are serviced and calibrated annually in accordance with SOP KNOX-QA-0005, "Balance Calibration and Weight Verification." The calibration and maintenance services are performed on-site, and the balances are returned to use immediately following successful calibration. When the calibration certificates are received (usually within two weeks of the service), they are reviewed, and documentation of the review is filed with the certificates. If the

calibration was unsuccessful, the balance is immediately removed from service and segregated pending either further maintenance or disposal.

Calibration services for support equipment such as thermometers, weight sets, autopipettors, etc, are obtained from vendors with current and valid ISO 17025 accreditation for calibration of the specific piece of equipment. Prior to utilizing the vendor's services, the vendor's accreditation status is verified. Once the equipment has been calibrated, the calibration certificates are reviewed by the QA department, and documentation of the review is filed with the calibration certificates. The equipment is then returned to service within the laboratory

9.6 SUPPLIERS

TestAmerica selects vendors through a competitive proposal / bid process, strategic business alliances or negotiated vendor partnerships (contracts). This process is defined in the Procurement & Contracts Policy (Policy No. CW-F-P-004). The level of control used in the selection process is dependent on the anticipated spending amount and the potential impact on TestAmerica business. Vendors that provide test and measuring equipment, solvents, standards, certified containers, instrument related service contracts or subcontract laboratory services are subject to more rigorous controls than vendors that provide off-the-shelf items of defined quality that meet the end use requirements. The JD Edwards purchasing system includes all suppliers/vendors that have been approved for use.

Evaluation of suppliers is accomplished by ensuring the supplier ships the product or material ordered and that the material is of the appropriate quality. This is documented by signing off on packing slips or other supply receipt documents. The purchasing documents contain the data that adequately describe the services and supplies ordered.

Any issues of vendor performance are to be reported immediately by the laboratory staff to the Corporate Purchasing Group by completing a Vendor Performance Report.

The Corporate Purchasing Group works through the appropriate channels to gather the information required to clearly identify the problem and contacts the vendor to report the problem and to make any necessary arrangements for exchange, return authorization, credit, etc.

As deemed appropriate, the Vendor Performance Reports are summarized and reviewed to determine corrective action necessary, or service improvements required by vendors

The laboratory has access to a listing of all approved suppliers of critical consumables, supplies and services. This information is provided through the JD Edwards purchasing system.

9.6.1 New Vendor Procedure

TestAmerica employees who wish to request the addition of a new vendor must complete a J.D. Edwards Vendor Add Request Form.

New vendors are evaluated based upon criteria appropriate to the products or services provided as well as their ability to provide those products and services at a competitive cost. Vendors are

also evaluated to determine if there are ethical reasons or potential conflicts of interest with TestAmerica employees that would make it prohibitive to do business with them as well as their financial stability. The QA Department and/or the Technical Manager are consulted with vendor and product selection that have an impact on quality.

SECTION 10

COMPLAINTS

10.1 OVERVIEW

The laboratory considers an effective client complaint handling process to be of significant business and strategic value. Listening to and documenting client concerns captures 'client knowledge' that enables our operations to continually improve processes and improve client satisfaction. An effective client complaint handling process also provides assurance to the data user that the laboratory will stand behind its data, service obligations and products.

A client complaint is any expression of dissatisfaction with any aspect of our business services, (e.g., communications, responsiveness, data, reports, invoicing and other functions) expressed by any party, whether received verbally or in written form. Client inquiries, complaints or noted discrepancies are documented, communicated to management, and addressed promptly and thoroughly.

The laboratory has procedures for addressing both external and internal complaints with the goal of providing satisfactory resolution to complaints in a timely and professional manner.

The nature of the complaint is identified, documented and investigated, and an appropriate action is determined and taken. In cases where a client complaint indicates that an established policy or procedure was not followed, the QA Department must evaluate whether a special audit must be conducted to assist in resolving the issue. A written confirmation or letter to the client, outlining the issue and response taken is recommended as part of the overall action taken.

The process of complaint resolution and documentation utilizes the procedures outlined in Section 12 (Corrective Actions) and is documented following the procedure for Nonconformance and Corrective Action System (SOP KNOX-QA-0008). Client complaints are recorded as a type of nonconformance memo (NCM) in TestAmerica LIMS (i.e., TALS), and are summarized in the monthly QA Reports to Management. It is the laboratory's goal to provide a satisfactory resolution to complaints in a timely and professional manner.

10.2 EXTERNAL COMPLAINTS

An employee that receives a complaint initiates the complaint resolution process and the documentation of the complaint.

Complaints fall into two categories: correctable and non-correctable. An example of a correctable complaint would be one where a report re-issue would resolve the complaint. An example of a non-correctable complaint would be one where a client complains that their data was repeatedly late. Non-correctable complaints are reviewed for preventive action measures to reduce the likelihood of future occurrence and mitigation of client impact.

The general steps in the complaint handling process are:

- Receiving and Documenting Complaints
- Complaint Investigation and Service Recovery

- Process Improvement

The laboratory informs the initiator of the complaint of the results of the investigation and the corrective action taken, if any.

10.3 INTERNAL COMPLAINTS

Internal complaints include, but are not limited to: errors and non-conformances, training issues, internal audit findings, and deviations from methods. Corrective actions may be initiated by any staff member who observes a nonconformance and follow the procedures outlined in Section 12. In addition, Corporate Management, Sales and Marketing and Information Technology (IT) may initiate a complaint by contacting the laboratory or through the corrective action system described in Section 12.

10.4 MANAGEMENT REVIEW

The number and nature of client complaints is reported by the QA Manager to the laboratory and QA Director in the QA Monthly report. Monitoring and addressing the overall level and nature of client complaints and the effectiveness of the solutions is part of the Annual Management Review (Section 16).

SECTION 11

CONTROL OF NON-CONFORMING WORK

11.1 OVERVIEW

When data discrepancies are discovered or deviations and departures from laboratory standard procedures, policies and/or client requests have occurred, corrective action is taken immediately. First, the laboratory evaluates the significance of the nonconforming work. Then, a corrective action plan is initiated based on the outcome of the evaluation. If it is determined that the nonconforming work is an isolated incident, the plan could be as simple as adding a qualifier to the final results and/or making a notation in the case narrative. If it is determined that the nonconforming work is a systematic or improper practices issue, the corrective action plan could include a more in depth investigation and a possible suspension of an analytical method. In all cases, the actions taken are documented using the laboratory's corrective action system (refer to Section 12).

Due to the frequently unique nature of environmental samples, sometimes departures from documented policies and procedures are needed. When a laboratory analyst encounters such a situation, the problem is typically discussed with the group leader. The group leader or laboratory analyst may elect to discuss it with the Technical Manager or have the Project Manager contact the client to decide on a logical course of action. Once an approach is agreed upon, the laboratory analyst documents it using the laboratory's corrective action system described in Section 12. This information is supplied to the client in the form of a case narrative with the report.

Note: For Ohio EPA VAP work, the laboratory must implement corrective action procedures to resolve the deviation and limit qualification of the final results. The laboratory is not permitted to deviate from its VAP approved SOP for nonconformances under the laboratory's control if it intends to attest under affidavit that the "results" are VAP certified. When all corrective actions listed in the SOP have been exhausted for nonconformances under the laboratory's control, data still considered qualified is noted as not VAP certified on the affidavit. The SOPs must include exceptions to taking corrective actions for situations outside the laboratory's control. For example, this includes but is not limited to samples prepared or analyzed outside holding times due to no fault of the laboratory and insufficient sample amount. The positive or negative bias associated with the situation outside the laboratory's control must be narrated as described in the SOP and the data is reported as VAP certified on the affidavit.

Project Managers may encounter situations where a client may request that a special procedure be applied to a sample that is not standard lab practice. Based on a technical evaluation, the lab may accept or opt to reject the request based on technical or ethical merit. If accepted, such a request is documented in project specific instructions to the laboratory.

11.2 RESPONSIBILITIES AND AUTHORITIES

Under certain circumstances the Laboratory Director, Technical Manager, Group Leader or the QA Manager may exceptionally authorize departures from documented procedures or policies depending on the nature and extent of the departure. The departures may be a result of

procedural changes due to the nature of the sample; a one-time procedure for a client; QC failures with insufficient sample to reanalyze, etc. In most cases, the client is informed of the departure prior to the reporting of the data. Any departures must be well documented using the laboratory's corrective action procedures. This information may also need to be documented on data review checklists as appropriate. Any impacted data must be referenced in a case narrative and/or flagged with an appropriate data qualifier.

Any misrepresentation or possible misrepresentation of analytical data discovered by any laboratory staff member must be reported to facility Senior Management within 24-hours. The Senior Management staff is comprised of the Laboratory Director, the QA Manager, the Client Relations Manager, the Technical Manager(s) and the Operations Manager. The Laboratory Director and QA Manager must be included in the notification. The reporting of issues involving alleged violations of the company's Data Integrity or Manual Integration procedures must be conveyed to an Ethics and Compliance Officer (ECO), (e.g., the VP QA/EHS) and the laboratory's Quality Director within 24 hours of discovery.

Whether an inaccurate result was reported due to calculation or quantitation errors, data entry errors, improper practices, or failure to follow SOPs, the data must be evaluated to determine the possible effect.

The Laboratory Director, QA Manager, ECOs, VP of Operations and the Quality Directors have the authority and responsibility to halt work, withhold final reports, or suspend an analysis for due cause as well as authorize the resumption of work.

11.3 EVALUATION OF SIGNIFICANCE AND ACTIONS TAKEN

For each nonconforming issue reported, an evaluation of its significance and the level of management involvement needed is made. This includes reviewing its impact on the final data, whether or not it is an isolated or systematic issue, and how it relates to any special client requirements.

Corporate SOP entitled Data Recalls (CW-Q-S-005) is the procedure to be followed when it is discovered that erroneous or biased data may have been reported to clients or regulatory agencies.

Corporate SOP entitled Internal Investigations (CW-L-S-002) is the procedure to be followed for investigation and correction of situations that involved alleged incidents of misconduct or violation of the company's ethics policy.

Laboratory level decisions are documented and approved using the laboratory's standard nonconformance/corrective action reporting (Section 13) in lieu of the data recall determination form contained in TestAmerica's Corporate SOP No. CW-Q-S-005.

11.4 PREVENTION OF NONCONFORMING WORK

If it is determined that the nonconforming work could recur, further corrective actions must be made following the laboratory's corrective action system. On a monthly basis, the QA Department evaluates non-conformances to determine if any nonconforming work has been repeated multiple times. If so, the laboratory's corrective action process may be followed.

11.5 METHOD SUSPENSION/RESTRICTION (STOP WORK PROCEDURES)

In some cases it may be necessary to suspend/restrict the use of a method or target compound which constitutes significant risk and/or liability to the laboratory. Suspension/restriction procedures can be initiated by any of the persons noted in Section 11.2, Paragraph 5.

Prior to suspension/restriction, confidentiality is respected, and the problem with the required corrective and preventive action is stated in writing and presented to the Laboratory Director.

The Laboratory Director arranges for the appropriate personnel to meet with the QA Manager as needed. This meeting is held to confirm that there is a problem, that suspension/restriction of the method is required and is concluded with a discussion of the steps necessary to bring the method/target or test fully back on line. In some cases that may not be necessary if all appropriate personnel have already agreed there is a problem and there is agreement on the steps needed to bring the method, target or test fully back on line. The QA Manager also initiates a corrective action report as described in Section 12 if one has not already been started. A copy of any meeting notes and agreed upon steps must be faxed or e-mailed by the laboratory to the appropriate General Manager and member of Corporate QA. This fax/e-mail acts as notification of the incident.

After suspension/restriction, the lab will hold all reports to clients pending review. No faxing, mailing or distributing through electronic means may occur. The report must not be posted for viewing on the internet. It is the responsibility of the Laboratory Director to hold all reporting and to notify all relevant laboratory personnel regarding the suspension/restriction (i.e., Project Management, Log-in, etc.). Clients are NOT generally be notified at this time. Analysis may proceed in some instances depending on the nonconformance issue.

Within 72 hours, the QA Manager determines if compliance is now met and reports can be released, OR determine the plan of action to bring work into compliance, and release work. A team, with all principals involved (Laboratory Director, Technical Manager, QA Manager, Project Manager, Group Leader) devises a start-up plan to cover all steps from client notification through compliance and release of reports. Project Management and the Directors of Client Services and Sales and Marketing must be notified if clients must be notified or if the suspension/restriction affects the laboratory's ability to accept work. The QA Manager must approve start-up or elimination of any restrictions after all corrective action is complete. This approval is given by final signature on the completed corrective action report.

SECTION 12

CORRECTIVE ACTION

12.1 OVERVIEW

A major component of TestAmerica's Quality Assurance (QA) Program is the problem investigation and feedback mechanism designed to keep the laboratory staff informed on quality related issues and to provide insight to problem resolution. When nonconforming work or departures from policies and procedures in the quality system or technical operations are identified, the corrective action procedure provides a systematic approach to assess the issues, restore the laboratory's system integrity, and prevent reoccurrence. Corrective actions are documented using Nonconformance Memos (NCMs) and Corrective Action Reports (CARs) (refer to Figure 12-1). Corrective actions for internal or external systems audit findings are documented using the corrective action responses to each audit.

12.2 GENERAL

Problems within the quality system or within analytical operations may be discovered in a variety of ways, such as QC sample failures, internal or external audits, proficiency testing (PT) performance, client complaints, staff observation, etc.

The purpose of a corrective action system is to:

- Identify non-conformance events and assign responsibility for investigation.
- Resolve non-conformance events and assign responsibility for any required corrective action.
- Identify systematic problems before they become serious.
- Identify and track Client complaints and provide resolution (see more on client complaints in Section 11).

12.2.1 Nonconformance Memo (NCM) - is used to document the following types of corrective actions:

- Deviations from an established procedure or SOP.
- QC outside of limits (non matrix related).
- Isolated Reporting / Calculation Errors.
- Client Complaints.
- Equipment Failures (Equipment Tag-out)
- Discrepancies in materials / goods received vs. manufacturer packing slips.

See SOP KNOX-QA-0008, Nonconformance and Corrective Action System, current revision, for details.

12.2.2 Corrective Action Report (CAR) - is used to document the following types of corrective actions:

- Questionable trends that are found in the review of NCMs.
- Issues found while reviewing NCMs that warrant further investigation.
- Internal and external audit findings.
- Failed or Unacceptable PT results.
- Corrective actions that cross multiple departments in the laboratory.
- Systematic Reporting / Calculation Errors.
- Excessive revised reports.
- Identified poor process or method performance trends.

This will provide background documentation to enable root cause analysis and preventive action. Data Recall Investigations, and Client Complaints are tracked as part of the laboratory's corrective action tracking system.

12.3 CLOSED LOOP CORRECTIVE ACTION PROCESS

Any employee in the company can initiate a corrective action. There are four main components to a closed-loop corrective action process once an issue has been identified: Cause Analysis, Selection and Implementation of Corrective Actions (both short and long term), Monitoring of the Corrective Actions, and Follow-up.

12.3.1 Cause Analysis

- Upon discovery of a non-conformance event, the event must be defined and documented. A CAR or NCM must be initiated, someone is assigned to investigate the issue and the event is investigated for cause. Table 12-1 provides some general guidelines on determining responsibility for assessment.
- The cause analysis step is the key to the process as a long term corrective action cannot be determined until the cause is determined.
- If the cause is not readily obvious, the Group Leader, Technical Manager, or QA Manager (or QA designee) is consulted.

12.3.2 Selection and Implementation of Corrective Actions

- Where corrective action is needed, the laboratory identifies potential corrective actions. The action(s) most likely to eliminate the problem and prevent recurrence are selected and implemented. Responsibility for implementation is assigned.
- Corrective actions are to a degree appropriate to the magnitude of the problem identified through the cause analysis.
- Whatever corrective action is determined to be appropriate, the laboratory documents and implements the changes. The CAR or NCM is used for this documentation.

12.3.3 Root Cause Analysis

Root Cause Analysis is a class of problem solving (investigative) methods aimed at identifying the basic or causal factor(s) that underlie variation in performance or the occurrence of a significant failure. At first glance, the immediate response is typically directed at a symptom and

not the cause. Typically, root cause analysis works best with three or more incidents to triangulate a weakness. Corporate SOP Root Cause Analysis (No. CA-Q-S-009) describes the procedure.

Systematically analyze and document the Root Causes of the more significant problems that are reported. Identify, track, and implement the corrective actions required to reduce the likelihood of recurrence of significant incidents. Trend the root cause data from these incidents to identify root causes that, when corrected, can lead to dramatic improvements in performance by eliminating entire classes of problems.

Identify the one event associated with problem and ask why this event occurred. Brainstorm the root causes of failures; for example, by asking why events occurred or conditions existed; and then why the cause occurred 5 consecutive times until you get to the root cause. For each of these sub events or causes, ask why it occurred. Repeat the process for the other events associated with the incident.

Root cause analysis does not mean the investigation is over. Look at technique, or other systems outside the normal indicators. Often creative thinking finds root causes that ordinarily would be missed, and continue to plague the laboratory or operation.

12.3.4 Monitoring of the Corrective Actions

- The Group Leaders, Operation Manager and QA Manager are responsible to ensure that the corrective action taken was effective.
- Ineffective actions are documented and re-evaluated until acceptable resolution is achieved. Group Leaders are accountable to the Laboratory Director to ensure final acceptable resolution is achieved and documented appropriately.
- Each NCM is entered into a database for tracking purposes and a monthly summary of all NCMs is printed out for review to aid in ensuring that the appropriate corrective actions have taken effect. CARs are also compiled and reviewed monthly.
- TestAmerica laboratories began using the Incident/Corrective Action Tracker (iCAT) database developed by the company in 2015. (Previously, a local database served this purpose.) An incident is an event triggering the need for one or more corrective actions as distinct from a corrective action, a potential deficiency stemming from an incident that requires investigation and possibly fixing. The database is independent of TALS, available to all local and corporate managers, and capable of notifying and tracking multiple corrective actions per event, dates, and personnel. iCAT allows associated document upload, categorization (such as, external/internal audit, client service concerns, data quality issues, proficiency testing, etc.), and trend analysis. Refer to Figure 12-1.
- The QA Manager reviews monthly NCMs for trends. Highlights are included in the QA monthly report (refer to Section 16). If a significant trend develops that adversely affects quality, an audit of the area is performed and corrective action implemented.
- Any out-of-control situations that are not addressed acceptably at the laboratory level may be reported to the Corporate Quality Director by the QA Manager, indicating the nature of the out-of-control situation and problems encountered in solving the situation.

12.3.5 Follow-up Audits

- Follow-up audits may be initiated by the QA Manager and are performed as soon as possible when the identification of a nonconformance casts doubt on the laboratory's compliance with its own policies and procedures, or on its compliance with state or federal requirements. (Section 15 includes additional information regarding internal audit procedures.)
- These audits often follow the implementation of the corrective actions to verify effectiveness. An additional audit would only be necessary when a critical issue or risk to business is discovered.

12.4 TECHNICAL CORRECTIVE ACTIONS

In addition to providing acceptance criteria and specific protocols for technical corrective actions in the method SOPs, the laboratory has general procedures to be followed to determine when departures from the documented policies and procedures and quality control have occurred (refer to Section 11 for information regarding the control of non-conforming work). The documentation of these procedures is through the use of an NCM.

Table 12-1 includes examples of general technical corrective actions. For specific criteria and corrective actions refer to specific method SOPs.

Table 12-1 provides some general guidelines for identifying the individual(s) responsible for assessing each QC type and initiating corrective action. The table also provides general guidance on corrective actions if associated QC measurements are unacceptable. Specific procedures are included in Method SOPs, and QAM Sections 19 and 20. All corrective actions are reviewed monthly, at a minimum, by the QA Manager and highlights are included in the QA monthly report.

To the extent possible, samples are reported only if all quality control measures are acceptable. If the deficiency does not impair the usability of the results, data are reported with an appropriate data qualifier and/or the deficiency is noted in the case narrative. Where sample results may be impaired, the Project Manager is notified by NCM and appropriate corrective action (e.g., reanalysis) is taken and documented**.**

12.5 BASIC CORRECTIONS

When mistakes occur in records, each mistake is crossed-out, [not obliterated (e.g. no white-out)], and the correct value entered alongside. All such corrections are initialed (or signed) and dated by the person making the correction. In the case of records stored electronically, the original "uncorrected" file must be maintained intact and a second "corrected" file is created.

This same process applies to adding additional information to a record. All additions made later than the initial must also be initialed (or signed) and dated.

When corrections are due to reasons other than obvious transcription errors, the reasons for the corrections (or additions) are also documented.

Figure 12-1.
Example – Corrective Action Report

TestAmerica Knoxville - Quality Assurance

Corrective Action 7035

Incident 2591: CAR 2017#1 SSAS failure for Hydrogen Chloride
Incident Status: Closed
Response Due to Client: Friday, Feb 17, 2017

Created By:	Kevin McGee	Created On:	Thursday, Feb 9, 2017
Laboratory Function:	Method Performance Studies and On-Going Cks	Date Follow-up Due:	Tuesday, Feb 28, 2017
Corrective Action Type:	Bias and precision studies	Date Follow-up Done:	Wednesday, Mar 1, 2017
Department:		Response Due to QA:	Friday, Feb 17, 2017
Finding Number:		Planned Closure Date:	Tuesday, Feb 28, 2017
Is Repeat Finding?:	No	Date Closed:	Wednesday, Mar 1, 2017
Finding Reference:			
Assigned To/Lead:	Donald Wasmund		
Priority:	3 (Normal Importance)		
Follow-up Assigned To:	Kevin McGee		
C.A. Status:	Closed		

Issue Requiring Corrective Action:
Hydrogen Chloride in impinger solution for lot # 120116P was outside of acceptance limits. The reported value for Hydrogen Chloride was 5.39 mg/L with an assigned value of 6.06 mg/L. The acceptance range was 5.45-6.67 mg/L.

Investigation/Response:
a) The acceptance limits of +/- 10% for the source air audit sample is narrow. b) The CCV for the original analysis was -5%.and c) the assigned value was approximately 7 to 8% lower than claimed by the manufacturer. The instrument was recalibrated and the results for CCV/LCS data were within 99-100%. The original run had CCVs at 94-95%. The retest result passed at 103% recovery. However, the retest of the original audit sample passed at 94%. The group leader believes the source air audit sample was 7 – 8 % lower than claimed by the manufacturer. The client's data was accepted within HT and there was no adverse effect except extra costs associated with the reanalysis with a new source air audit sample.

Root Cause:
a) The acceptance limits of +/- 10% for the source air audit sample is narrow. b) The CCV for the original analysis was -5%.and c) the assigned value was approximately 7 to 8% lower than claimed by the manufacturer. The instrument was recalibrated and the results for CCV/LCS data were within 99-100%. The original run had CCVs at 94-95%. The retest result passed at 103% recovery. However, the retest of the original audit sample passed at 94%. The group leader believes the source air audit sample was 7 – 8 % lower than claimed by the manufacturer. The client's data was accepted within HT and there was no adverse effect except extra costs associated with the reanalysis with a new source air audit sample.

Corrective Action Plan:
1. Recalibrate instrument. Reanalyze the original samples along with a new audit sample, within holding time. 2. Reissue deliverable including the new audit results. 3. Review audit results when received.

Corrective Action Documents (0)

No documents.

For QA Use Only

QA Comments	Follow Up
Enter a QA Comment	*Enter Follow Up*

Notifications

Location QA (notification required)

Name	Title
Kevin McGee	QA Manager
Annette Ribet	Project Management Assistant II
Hayley Waterland	

Additional Notifications

Name	Title
Annette Ribet	Project Management Assistant II
Donald Wasmund	Senior Analytical Consultant
Kevin McGee	QA Manager
Robyn Wagner	Operations Manager

Table 12-1.

Example – General Corrective Action Procedures

QC Activity ***(Individual Responsible for Initiation/Assessment)***	**Acceptance Criteria**	**Recommended Corrective Action**
Initial Instrument Blank *(Analyst)*	- Instrument response < Reporting Limit (RL)[1].	- Prepare another instrument blank. - If same response, determine cause of contamination: reagents, environment, instrument equipment failure, etc.
Initial Calibration Standards *(Analyst, Group Leader)*	- Correlation coefficient r≥0.990 for organics and r≥0.995 for inorganics or - %RSD within acceptance range. - See details in Method SOP.	- Reanalyze standards. - If still unacceptable, remake standards and recalibrate instrument.
Tuning (GC/MS Methods) (Analyst)	- Refer to Method SOP for specific ion criteria.	- Retune instrument and verify. (Samples may not be run without valid tune)
Independent Calibration Verification (Second Source) *(Analyst, Group Leader)*	- % Recovery within acceptance limits.	- Remake and reanalyze standard. - If still unacceptable, then remake calibration standards or use new primary standards and recalibrate instrument.
Continuing Calibration Standards *(Analyst, Data Reviewer)*	% Difference (or %Drift) within acceptance limits.	- Reanalyze standard. - If still unacceptable, then recalibrate and rerun affected samples.
Matrix Spike / Matrix Spike Duplicate (MS/MSD) *(Analyst, Data Reviewer)*	- % Recovery within limits documented in TALS.	- If the acceptance criteria for duplicates or matrix spikes are not met because of matrix interferences, the acceptance of the analytical batch is determined by the validity of the LCS. - If the LCS is within acceptable limits the batch is acceptable. - The results of the duplicates, matrix spikes and the LCS are reported with the data set. - For matrix spike or duplicate results outside criteria the data for that sample shall be reported with qualifiers.
Laboratory Control Sample (LCS) and LCSD (where applicable) *(Analyst, Data Reviewer)*	- % Recovery within limits specified in QuantIMS. This includes any allowable marginal exceedance (Marginal Exceedances are not allowed for Ohio VAP).	- Batch must be re-prepared and re-analyzed. **Note:** See Method SOPs for further details. For example, if there is insufficient sample or the holding time cannot be met, contact client and report with flags.

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Surrogates *(Analyst, Data Reviewer)*	- % Recovery within limits specified in TALS.	- Individual sample must be repeated. - Surrogate results outside criteria shall be reported with qualifiers. **Note:** See Method SOPs for further details. For example, if there is insufficient sample or the holding time cannot be met, contact client and report with flags.
Method Blank (MB) *(Analyst, Data Reviewer)*	< Reporting Limit [1]	- Reanalyze Method Blank. - If still positive, determine source of contamination. If necessary, reprocess (i.e. digest or extract) entire sample batch. Report Method blank results. - Qualify the result(s) if the concentration of a targeted analyte in the Method Blank is at or above the reporting limit AND is > 1/10 of the amount measured in the sample.

Note:
1. See specific method SOPs for acceptance criteria. Concentrations up to five times the reporting limit may be allowed for the common laboratory and reagent contaminants: methylene chloride, toluene, acetone, 2-butanone and phthalates. Some program requirements (e.g. DOD QSM and Ohio EPA VAP) have more stringent requirements that must be followed when performing work for those programs. For example, DOD QSM requires the Method Blanks < ½ Reporting Limit with common lab contaminants <Reporting Limit. (Note: Ohio EPA VAP requires all analytes of concern in Method Blanks to be less than the RL.)

SECTION 13

PREVENTIVE ACTION / IMPROVEMENT

13.1 OVERVIEW

The laboratory's preventive action programs improve or eliminate potential causes of nonconforming product and/or nonconformance to the quality system. This preventive action process is a proactive and continuous process of improvement activities that can be initiated through feedback from clients, employees, business providers, and affiliates. The QA Department has the overall responsibility to ensure that the preventive action process is in place, and that relevant information on actions is submitted for management review.

Dedicating resources to an effective preventive action system emphasizes the laboratory's commitment to its Quality Program. It is beneficial to identify and address negative trends before they develop into complaints, problems and corrective actions. Additionally, the laboratory continually strives to improve customer service and satisfaction through continuous improvements to laboratory systems.

Opportunities for improvement may be discovered through any of the following:

- review of the monthly QA Metrics Report,
- trending NCMs,
- review of control charts and QC results,
- trending proficiency testing (PT) results,
- performance of management system reviews,
- trending client complaints,
- review of processing operations, or
- staff observations.

The monthly QA Metrics Report shows performance indicators in all areas of the laboratory and quality system. These areas include revised reports, corrective actions, audit findings, internal auditing and data authenticity audits, client complaints, PT samples, holding time violations, SOPs, ethics training, etc. The metrics report is reviewed monthly by the laboratory management, Corporate QA and TestAmerica's Executive Committee. These metrics are used in evaluating the management and quality system performance on an ongoing basis and provide a tool for identifying areas for improvement.

Items identified as continuous improvement opportunities to the management system may be issued as goals from the annual management systems review, recommendations from internal audits, white papers, Lesson Learned, Technical Services audit report, Technical Best Practices, or as Corporate or management initiatives.

The laboratory's corrective action process is integral to implementation of preventive actions. A critical piece of the corrective action process is the implementation of actions to prevent further

occurrence of a non-compliance event. Historical review of corrective action and non-conformances provides a valuable mechanism for identifying preventive action opportunities.

13.1.1 The following elements are part of a preventive action/ process improvement system:

- Identification of an opportunity for preventive action or process improvement.
- Process for the preventive action or improvement.
- Define the measurements of the effectiveness of the process once undertaken.
- Execution of the preventive action or improvement.
- Evaluation of the plan using the defined measurements.
- Verification of the effectiveness of the preventive action or improvement.
- Close-Out by documenting any permanent changes to the Quality System as a result of the Preventive Action or Process Improvement. Documentation of Preventive Action/ process improvement is incorporated into the monthly QA reports, corrective action process, management review, and through the review and revision of the QAM and/or laboratory SOPs.

13.1.2 Any Preventive Actions/Process Improvements undertaken or attempted are taken into account during the Annual Management Systems Review (Section 16). A highly detailed report is not required; however, a summary of successes and failures within the preventive action program is sufficient to provide management with a measurement for evaluation.

13.2 MANAGEMENT OF CHANGE

The Management of Change process is designed to manage significant events and changes that occur within the laboratory. This is routinely managed by the Laboratory Director with input from the General Manager, the QA Manager, Operations Manager, Technical Managers, Group Leaders, and IT support staff. The laboratory manages change by documenting and maintaining a history of organization/staffing, equipment, certifications, and procedures.

Section 14

CONTROL OF RECORDS

The laboratory maintains a records management system appropriate to its needs and that complies with applicable standards or regulations as required. The system produces unequivocal, accurate records that document all laboratory activities. The laboratory retains all original observations, calculations and derived data, calibration records and a copy of the analytical report for a minimum of five years after it has been issued. Refer to SOP KNOX-AD-0001, Record Retention and Document Storage for further details.

14.1 OVERVIEW

The laboratory has established procedures for identification, collection, indexing, access, filing, storage, maintenance and disposal of quality and technical records. A record index is listed in Table 14-1. Quality records are maintained by the QA department in a database, which is backed up as part of the regular network backup. Hardcopy quality records are stored in fireproof filing cabinets. Records are of two types; either electronic or hard copy paper formats depending on whether the record is computer or hand generated (some records may be in both formats). Technical records are maintained by Group Leaders and the local IT staff.

Table 14-1. Record Index[1]

	Record Types [1]:	Retention Time:
Technical Records	- Raw Data - Logbooks[2] - Standards - Certificates - Analytical Records - MDLs/IDLs/DOCs - Lab Reports	5 Years from analytical report issue*
Official Documents	- Quality Assurance Manual (QAM) - Work Instructions - Policies - SOPs - Policy Memorandums - Manuals - Published Methods	Indefinitely*
QA Records	-Certifications -Method and Software Validation/Verification Data	Indefinitely*
QA Records	- Internal & External Audits/Response - Corrective/Preventive Actions - Management Reviews - Data Investigation	5 Years from archival* **Data Investigation:** 5 years or the life of the affected raw data storage whichever is greater (beyond 5 years if ongoing project or pending investigation)

	Record Types [1]:	Retention Time:
Project Records	- Sample Receipt & COC Documentation - Contracts and Amendments - Correspondence - QAPP -SAP - Telephone Logbooks - Lab Reports	5 Years from analytical report issue*
Administrative Records	Finance and Business Operations	Refer to CW-L-WI-001
	EH&S Manual, Permits	Indefinitely
	Disposal Records	Indefinitely
	Employee Handbook	Indefinitely
	Personnel files, Employee Signature & Initials, Administrative Training Records (e.g., Ethics)	Refer to HR Manual
	Administrative Policies	Indefinitely
	Technical Training Records	7 years
	Legal Records	Indefinitely
	HR Records	Refer to CW-L-WI-001
	IT Records	Refer to CW-L-WI-001
	Corporate Governance Records	Refer to CW-L-WI-001
	Sales & Marketing	5 years
	Real Estate	Indefinitely

[1] Record Types encompass hardcopy or electronic records.
[2] Examples of Logbook types: Maintenance, Instrument Run, Preparation (standard and samples), Standard and Reagent Receipt, Archiving, Balance Calibration, Temperature (hardcopy or electronic records).
* Exceptions listed in Table 14-2.

14.1.1 All records are stored and retained in such a way that they are secure and readily retrievable at the laboratory facility or the Iron Mountain data storage facility that provides a suitable environment to prevent damage or deterioration and to prevent loss. All records are protected against fire, theft, loss, environmental deterioration, and vermin. In the case of electronic records, storage media are protected from deterioration caused by magnetic fields and/or electronic deterioration.

Access to the data is limited to laboratory and company employees and shall be documented with an access log. Records are maintained for a minimum of five years unless otherwise specified by a client or regulatory requirement.

Note: For the Ohio EPA VAP program the laboratory is required to notify Ohio EPA of its intent to dispose of any records.

For raw data and project records, record retention is calculated from the date the project report is issued. For other records, such as Controlled Documents, QA, or Administrative Records, the retention time is calculated from the date the record is formally retired. Records related to the

programs listed in Table 14-2 have lengthier retention requirements and are subject to the requirements in Section 14.1.3.

14.1.2 Programs with Longer Retention Requirements

Some regulatory programs have longer record retention requirements than the standard record retention time. These are detailed in Table 14-2 with their retention requirements. In these cases, the longer retention requirement is enacted. If special instructions exist such that client data cannot be destroyed prior to notification of the client, the container or box containing that data is marked as to who to contact for authorization prior to destroying the data. Refer to SOP KNOX-AD-0001, Record Retention and Document Storage for details on how records are retained for these programs.

Table 14-2. Special Record Retention Requirements

Program	[1]Retention Requirement
Drinking Water – All States	10 years (lab reports and raw data) 10 years – Radiochemistry (project records)
FIFRA – 40 CFR Part 160	Retain for life of research or marketing permit for pesticides regulated by EPA
Housing and Urban Development (HUD) Environmental Lead Testing	10 years
Alaska	10 years
Louisiana – All	10 years
Michigan Department of Environmental Quality – all environmental data	10 years
NY Potable Water NYCRR Part 55-2	10 years
Ohio EPA VAP	10 years and state contacted prior to disposal
TSCA - 40 CFR Part 792	10 years after publication of final test rule or negotiated test agreement
OSHA	30 years

[1]Note: Extended retention requirements must be noted with the archive documents or addressed in facility-specific records retention procedures.

The laboratory has procedures to protect and back-up records stored electronically and to prevent unauthorized access to or amendment of these records. All analytical data is maintained as hard copy or in a secure readable electronic format. For analytical reports that are maintained as copies in PDF format, refer to section 19.14.1 for more information.

The record keeping system allows for historical reconstruction of all laboratory activities that produced the analytical data, as well as rapid recovery of historical data. The history of the sample from when the laboratory took possession of the samples must be readily understood through the documentation. This includes inter-laboratory transfers of samples and/or extracts.

- The records include the identity of personnel involved in sampling, sample receipt, preparation, or testing. All analytical work contains the initials (at least) of the personnel involved. A copy of the chain of custody is stored with the invoice, associated data review checklists, and other lot specific documents as described in SOP KNOX-AD-0001. The chain of custody would indicate the name of the sampler.

- All information relating to the laboratory facilities equipment, analytical test methods, and related laboratory activities, such as sample receipt, sample preparation, or data verification are documented.

- The record keeping system facilitates the retrieval of all working files and archived records for inspection and verification purposes (e.g., set format for naming electronic files, set format for what is included with a given analytical data set). Instrument data is stored electronically with the Lot raw data for samples and the associated quality control samples. Instrument calibration data is stored electronically by analytical group, method, instrument and date. Run logs are maintained for each instrument; a copy of each day's run log or instrument sequence is stored to aid in reconstructing an analytical sequence. Where an analysis is performed without an instrument, bound logbooks or bench sheets are used to record and file data. Standard and reagent information is recorded in logbooks.

- Changes to hardcopy records follow the procedures outlined in Section 12 and 19. Changes to electronic records in LIMS or instrument data are recorded in audit trails.

- The reason for a signature or initials on a document is clearly indicated in the records such as "sampled by," "prepared by," "reviewed by", or "analyzed by".

- All generated data except those that are generated by automated data collection systems, are recorded directly, promptly and legibly in permanent dark ink.

- Hard copy data may be scanned into PDF format for record storage as long as the scanning process can be verified in order to ensure that no data is lost and the data files and storage media must be tested to verify the laboratory's ability to retrieve the information prior to the destruction of the hard copy that was scanned. The procedure for scanning the records is discussed in SOP KNOX-AD-0004, Data Reporting, and KNOX-AD-0001, Record Retention and Document Storage.

- Also refer to Section 19.13.1 'Computer and Electronic Data Related Requirements'**.**

14.2 TECHNICAL AND ANALYTICAL RECORDS

14.2.1 The laboratory retains records of original observations, derived data and sufficient information to establish an audit trail, calibration records, staff records and a copy of each analytical report issued, for a minimum of five years unless otherwise specified by a client or regulatory requirement (refer to Table 14-2). The records for each analysis contain sufficient information to enable the analysis to be repeated under conditions as close as possible to the original. The records include the identity of laboratory personnel responsible for performance of each analysis and reviewing results.

14.2.2 Observations, data and calculations are recorded real-time they are made and are

identifiable to the specific task.

14.2.3 Changes to hardcopy records follow the procedures outlined in Section 12 and 19. Changes to electronic records in LIMS or instrument data are recorded in audit trails.
The essential information to be associated with analysis, such as strip charts, tabular printouts, computer data files, analytical notebooks, and run logs, include:

- Laboratory sample ID code**;**
- Date of analysis; Time of analysis is also required if the holding time is seventy-two (72) hours or less, or when time critical steps are included in the analysis (e.g., drying times, incubations, etc.); instrumental analyses have the date and time of analysis recorded as part of their general operations. The date and time may also be recorded in the associated logbook or benchsheet.
- Instrumentation identification and instrument operating conditions/parameters. Operating conditions/parameters are typically recorded in instrument maintenance logs.
- Analysis type**;**
- All manual calculations and manual integrations**;**
- Laboratory Analyst's or operator's initials/signature**;**
- Sample preparation including cleanup, separation protocols, lab sample ID codes, volumes, weights, instrument printouts, calculations, and reagents**;**
- Test results**;**
- Standard and reagent origin, receipt, preparation, and use**;**
- Calibration criteria, frequency and acceptance criteria**;**
- Data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions**;**
- Quality control protocols and assessment**;**
- Electronic data security, software documentation and verification, software and hardware audits, backups, and records of any changes to automated data entries; and
- Method performance criteria including expected quality control requirements. These are indicated in the LIMS or in the associated analytical SOPs

14.2.4 All logbooks used during receipt, preparation, storage, analysis, and reporting of samples or monitoring of support equipment shall undergo a documented supervisory or peer review on a periodic basis.

14.3 LABORATORY SUPPORT ACTIVITIES

In addition to documenting all the above-mentioned activities, the following are retained QA records and project records (previous discussions in this section relate where and how these data are stored):

- All original raw data, whether hard copy or electronic, for calibrations, samples and quality control measures, including analysts' work sheets and data output records (chromatograms, strip charts, and other instrument response readout records)**;**

- A written description or reference to the specific test method used which includes a description of the specific computational steps used to translate parametric observations into a reportable analytical value**;**
- Copies of final reports**;**
- Archived SOPs**;**
- Correspondence relating to laboratory activities for a specific project**;**
- All corrective action reports, audits and audit responses**;**
- Proficiency test results and raw data; and
- Results of data review, verification, and crosschecking procedures.

14.3.1 Sample Handling Records

Records of all procedures to which a sample is subjected while in the possession of the laboratory are maintained. These include but are not limited to records pertaining to:

- Sample preservation including appropriateness of sample container and compliance with holding time requirement;
- Sample identification, receipt, acceptance or rejection and login;
- Sample storage and tracking including shipping receipts, sample transmittal / COC forms; and
- Procedures for the receipt and retention of samples, including all provisions necessary to protect the integrity of samples.

14.4 ADMINISTRATIVE RECORDS

The laboratory also maintains the administrative records in either electronic or hard copy form. See Table 14-1.

14.5 RECORDS MANAGEMENT, STORAGE AND DISPOSAL

14.5.1 All records (including those pertaining to test equipment), certificates and reports are safely stored, held secure and in confidence to the client. Certification related records are available upon request.

14.5.2 All information necessary for the historical reconstruction of data is maintained by the laboratory. Records that are stored only on electronic media must be supported by the hardware and software necessary for their retrieval.

14.5.3 Records that are stored or generated by computers or personal computers have hard copy, write-protected backup copies, or an electronic audit trail controlling access**.**

14.5.4 The laboratory has a record management system for control of laboratory notebooks, instrument logbooks, standards logbooks, and project records. Laboratory notebooks are sequentially numbered by QA and issued to the analytical group as needed. Bench sheets are

filed and archived with the project raw data. Completed logbooks are returned to QA for archive storage. Records are considered archived when moved to the archive server on the local area network or when logbooks are turned in to QA for storage. Access to archived hard-copy information is documented with in/out cards.

14.5.5 Transfer of Ownership

In the event that the laboratory transfers ownership or goes out of business, the laboratory ensures that the records are maintained or transferred according to client's instructions. Upon ownership transfer, record retention requirements must be addressed in the ownership transfer agreement and the responsibility for maintaining archives is clearly established. In addition, in cases of bankruptcy, appropriate regulatory and state legal requirements concerning laboratory records must be followed. In the event of the closure of the laboratory, all records will revert to the control of the corporate headquarters. Should the entire company cease to exist, as much notice as possible will be given to clients and the accrediting bodies who have worked with the laboratory during the previous 5 years of such action.

14.5.6 Records Disposal

14.5.6.1 Records are removed from the archive and destroyed after 5 years unless otherwise specified by a client or regulatory requirement. On a project specific or program basis, clients may need to be notified prior to record destruction. Records are destroyed in a manner that ensures their confidentiality such as shredding, mutilation or incineration.

14.5.6.2 Electronic copies of records must be destroyed by erasure or physically damaging off-line storage media so no records can be read.

14.5.6.3 If a third party records management company is hired to dispose of records, a "Certificate of Destruction" is required. [Refer to Policy No. CW-L-P-001 (Records Retention).]

SECTION 15

AUDITS

15.1 INTERNAL AUDITS

Internal audits are performed to verify that laboratory operations comply with the requirements of the lab's quality system and with the external quality programs under which the laboratory operates. Audits are planned and organized by the QA staff. Personnel conducting the audits should be independent of the area being evaluated. Auditors will have sufficient authority, access to work areas, and organizational freedom necessary to observe all activities affecting quality and to report the assessments to laboratory management and when requested to corporate management.

Audits are conducted and documented as described in the TestAmerica Corporate SOP on Internal Auditing, SOP No. CW-Q-S-003. The types and frequency of routine internal audits are described in Table 15-1. Special or ad hoc assessments may be conducted as needed under the direction of the QA staff.

Table 15-1. Types of Internal Audits and Frequency

Description	Performed by	Frequency
Quality Systems Audits	QA Department, QA approved designee, or Corporate QA	All areas of the laboratory annually
QA Technical Audits	Joint responsibility: a) QA Manager or designee b) Technical Manager or Designee (Refer to CW-Q-S-003)	Technical Audits Frequency: 50% of methods annually
SOP Method Compliance	Joint responsibility: a) QA Manager or designee b) Technical Manager or Designee (Refer to CW-Q-S-003)	SOP Compliance Review Frequency: • Every 2 years • 100% of SOPs annually (DoD/DOE Labs)
Special	QA Department or Designee	Surveillance or spot checks performed as needed, e.g., to confirm corrective actions from other audits.
Performance Testing	Laboratory Analysts with QA oversight	Two successful per year for each TNINELAC field of testing or as dictated by regulatory requirements

15.1.1 Annual Quality Systems Audit

An annual quality systems audit is required to ensure compliance to analytical methods and SOPs, TestAmerica's Data Integrity and Ethics Policies, TNI quality systems, client and state requirements, and the effectiveness of the internal controls of the analytical process, including

but not limited to data review, quality controls, preventive action and corrective action. The completeness of earlier corrective actions is assessed for effectiveness and sustainability. The audit is divided into sections for each operating or support area of the lab, and each section is comprehensive for a given area. The area audits may be performed on a rotating schedule throughout the year to ensure adequate coverage of all areas. This schedule may change as situations in the laboratory warrant

Note: Part of the quality systems audit relates to regulatory compliance. An assessment of the laboratory's compliance to regulatory requirements is performed by Corporate QA through monthly management reports, review of client and regulatory concerns and also through periodic on-site evaluations.

The annual quality systems audit must include a review of logbooks and benchsheets used in laboratory areas as well as the items listed in the Internal Audit Checklists as described in SOP CW-Q-S-003.

15.1.2 QA Technical Audits

QA technical audits assess data authenticity and analyst integrity. These audits are based on client projects, associated sample delivery groups, and the methods performed. Reported results are compared to raw data to verify the authenticity of results. The validity of calibrations and QC results are compared to data qualifiers, footnotes, and case narratives. Documentation is assessed by examining run logs and records of manual integrations. Manual calculations are checked. Where possible, electronic audit miner programs (e.g., MintMiner and Chrom AuditMiner) are used to identify unusual manipulations of the data deserving closer scrutiny. QA technical audits include all methods within a two-year period. All analysts should be reviewed over the course of a two year period through at least one QA Technical Audit.

The QA Technical Audits must include a review of raw sample data, calibration data and QC data records.

15.1.3 SOP Method Compliance

Compliance of all SOPs with the source methods and compliance of the operational groups with the SOPs are assessed by the Technical Manager or qualified designee at least every two years. (Annually for methods and administrative SOPs related to DoD and DOE programs.) It is also recommended that the work of each newly hired laboratory analyst is assessed within 3 months of working independently, (e.g., completion of method IDOC). In addition, as laboratory analysts add methods to their capabilities, (new IDOC) reviews of the laboratory analyst work products are performed within 3 months of completing the documented training.

15.1.4 Special Audits

Special audits are conducted on an as needed basis, generally as a follow up to specific issues such as client complaints, corrective actions, PT results, data audits, system audits, validation comments, regulatory audits or suspected ethical improprieties. Special audits are focused on a specific issue, and report format, distribution, and timeframes are designed to address the nature of the issue.

15.1.5 Performance Testing

The laboratory participates semi-annually in performance audits conducted through the analysis of PT samples provided by a third party. The laboratory generally participates in the following types of PT studies: Drinking Water, Nonpotable Water, Soil, and Air.

It is TestAmerica's policy that PT samples be treated as typical samples in the production process. Furthermore, where PT samples present special or unique problems, in the regular production process they may need to be treated differently, as would any special or unique request submitted by any client. The QA Manager must be consulted and in agreement with any decisions made to treat a PT sample differently due to some special circumstance.

Written responses to unacceptable PT results are required. In some cases it may be necessary for blind QC samples to be submitted to the laboratory to show a return to control.

15.2 EXTERNAL AUDITS

External audits are performed when certifying agencies or clients conduct on-site inspections or submit performance testing samples for analysis. It is TestAmerica's policy to cooperate fully with regulatory authorities and clients. The laboratory makes every effort to provide the auditors with access to personnel, documentation, and assistance. Group Leaders are responsible for providing corrective actions to the QA Manager who coordinates the response for any deficiencies discovered during an external audit. Audit responses are due in the time allotted by the client or agency performing the audit. When requested, a copy of the audit report and the lab's corrective action plan are forwarded to Corporate Quality.

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. The client may only view data and systems related directly to the client's work. All efforts are made to keep other client information confidential.

15.2.1 Confidential Business Information (CBI) Considerations

During on-site audits, on-site auditors may come into possession of information claimed as business confidential. A business confidentiality claim is defined as "a claim or allegation that business information is entitled to confidential treatment for reasons of business confidentiality or a request for a determination that such information is entitled to such treatment." When information is claimed as business confidential, the laboratory must place on (or attach to) the information at the time it is submitted to the auditor, a cover sheet, stamped or typed legend or other suitable form of notice, employing language such as "trade secret", "proprietary" or "company confidential". Confidential portions of documents otherwise non-confidential must be clearly identified. CBI may be purged of references to client identity by the responsible laboratory official at the time of removal from the laboratory. However, sample identifiers may not be obscured from the information. Additional information regarding CBI can be found in within the 2009 TNI standards.

15.3 AUDIT FINDINGS

Audits are documented in summary report(s) providing the findings for each laboratory area and recommended corrective actions to the appropriate Group Leader. The laboratory corrective action is compiled by QA and responses to external audits are signed by the QA Manager and the Laboratory Director. The laboratory's corrective action responses may include action plans

that could not be completed within a predefined timeframe. In these instances, a completion date must be set and agreed to by operations management and the QA Manager.

Developing and implementing corrective actions to findings is the responsibility of the Group Leader where the finding originated. Findings that are not corrected by specified due dates are reported monthly to management in the QA monthly report. When requested, a copy of the audit report and the labs corrective action is forwarded to Corporate Quality.

If any audit finding casts doubt on the effectiveness of the operations or on the correctness or validity of the laboratory's test results, the laboratory takes timely corrective action, and notifies clients in writing if the investigations show that the laboratory results have been affected. Once corrective action is implemented, a follow-up audit is scheduled to ensure that the problem has been corrected.

Clients must be notified promptly in writing, of any event such as the identification of defective measuring or test equipment that casts doubt on the validity of results given in any test report or amendment to a test report. The investigation must begin within 24-hours of discovery of the problem and all efforts are made to notify the client within two weeks after the completion of the investigation.

SECTION 16

MANAGEMENT REVIEWS

16.1 QUALITY ASSURANCE REPORT

A comprehensive QA Report is prepared each month by the laboratory's QA Department and forwarded to the Laboratory Director, Technical Managers, their Quality Director as well as the VP of Operations. All aspects of the QA system are reviewed to evaluate the suitability of policies and procedures. During the course of the year, the Laboratory Director, VP of Operations or Corporate QA may request that additional information be added to the report.

On a monthly basis, Corporate QA compiles information from all the monthly laboratory reports. The Corporate Quality Directors prepare a report that includes a compilation of all metrics and notable information and concerns regarding the QA programs within the laboratories. The report also includes a listing of new regulations that may potentially impact the laboratories. This report is presented to the Senior Management Team and VPs of Operations.

16.2 ANNUAL MANAGEMENT REVIEW

The senior lab management team (Laboratory Director, Technical Managers, QA Manager, and the Client Relations Manager) conducts a review annually of its quality systems and LIMS to ensure its continuing suitability and effectiveness in meeting client and regulatory requirements and to introduce any necessary changes or improvements. It will also provide a platform for defining goals, objectives, and action items that feed into the laboratory planning system. Corporate Operations and Corporate QA personnel are included in this meeting at the discretion of the Laboratory Director. The LIMS review consists of examining any audits, complaints or concerns that have been raised through the year that are related to the LIMS. The laboratory summarizes any critical findings that cannot be solved by the lab and reports them to Corporate IT.

This management systems review (Corporate SOP No. CA-Q-S-004 Management Systems Review & Work Instruction No. CW-Q-WI-003 uses information generated during the preceding year to assess the "big picture" by ensuring that routine quality actions taken and reviewed on a monthly basis are not components of larger systematic concerns. The monthly review keeps the quality systems current and effective, therefore, the annual review is a formal senior management process to review specific existing documentation. Significant issues from the following documentation are compiled or summarized by the QA Manager prior to the review meeting:

- Matters arising from the previous annual review.
- Prior Monthly QA Reports issues.
- Laboratory QA Metrics.
- Review of report reissue requests.
- Review of client feedback and complaints.

- Issues arising from any prior management or staff meetings.
- Minutes from prior senior lab management meetings. Issues that may be raised from these meetings include:
  - Adequacy of staff, equipment and facility resources.
  - Adequacy of policies and procedures.
  - Future plans for resources and testing capability and capacity.
- The annual internal double blind PT program sample performance (if performed),
- Compliance to the Ethics Policy and Data Integrity Plan. Including any evidence/incidents of inappropriate actions or vulnerabilities related to data Integrity.

A report is generated by the QA Manager and management. The report is distributed to the appropriate General Manager and the Quality Director. The report includes, but is not limited to:

- The date of the review and the names and titles of participants.
- A reference to the existing data quality related documents and topics that were reviewed.
- Quality system or operational changes or improvements that are made as a result of the review [e.g., an implementation schedule including assigned responsibilities for the changes (Action Table)].

Changes to the quality systems requiring update to the laboratory QAM are included in the next revision of the QAM.

16.3 POTENTIAL INTEGRITY RELATED MANAGERIAL REVIEWS

Potential integrity issues (data or business related) must be handled and reviewed in a confidential manner until such time as a follow-up evaluation, full investigation, or other appropriate actions have been completed and issues clarified. TestAmerica's Corporate Internal Investigation SOP is followed (SOP No. CW-L-S-002). All investigations that result in finding of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients.

TestAmerica's President and CEO, Executive VP of Operations, VP of Client & Technical Services, VP of Operations, and Quality Directors receive a monthly report from the VP-QA/EHS summarizing any current data integrity or data recall investigations. The VP's of Operations are also made aware of progress on these issues for their specific labs.

SECTION 17

PERSONNEL

17.1 OVERVIEW

The laboratory's management believes that its highly qualified and professional staff is the single most important aspect in assuring a high level of data quality and service. The staff consists of professionals and support personnel as outlined in the organization chart in Figure 4-1.

All personnel must demonstrate competence in the areas where they have responsibility. Staff that are undergoing training have appropriate supervision until they have demonstrated their ability to perform their job function on their own. Staff shall be qualified for their tasks based on appropriate education, training, experience and/or demonstrated skills as required.

The laboratory employs sufficient personnel with the necessary education, training, technical knowledge and experience for their assigned responsibilities.

All personnel are responsible for complying with all QA/QC requirements that pertain to the laboratory and their area of responsibility. Each staff member must have a combination of experience and education to adequately demonstrate a specific knowledge of their particular area of responsibility. Technical staff must also have a general knowledge of lab operations, test methods, QA/QC procedures and records management.

Laboratory management is responsible for formulating goals for lab staff with respect to education, training and skills and ensuring that the laboratory has a policy and procedures for identifying training needs and providing training of personnel. The training is relevant to the present and anticipated responsibilities of the lab staff.

The laboratory only uses personnel that are employed by or under contract to the laboratory. Contracted personnel, when used, must meet competency standards of the laboratory and work in accordance to the laboratory's quality system.

17.2 EDUCATION AND EXPERIENCE REQUIREMENTS FOR TECHNICAL PERSONNEL

The laboratory makes every effort to hire analytical staff that possess a college degree (AA, BA, BS) in an applied science with some chemistry in the curriculum. Exceptions may be made based upon the technical nature of the position and the individual's experience and abilities. Selection of qualified candidates for laboratory employment begins with documentation of minimum education, training, and experience prerequisites needed to perform the prescribed task. Minimum education and training requirements for TestAmerica employees are outlined in job descriptions and are generally summarized for analytical staff in the table below.

The laboratory maintains job descriptions for all personnel who manage, perform or verify work affecting the quality of the environmental testing the laboratory performs. Job Descriptions are

located on the TestAmerica intranet site's Human Resources web-page (also see Section 4 for position descriptions/responsibilities).

As a general rule for analytical staff:

Specialty	Education	Experience
Extractions, Digestions, some electrode methods (pH, DO, Redox, etc.), or Titrimetric and Gravimetric Analyses	H.S. Diploma	On the job training (OJT)
CVAA, Single component or short list Chromatography (e.g., Fuels, BTEX-GC, IC	A college degree in an applied science or 2 years of college and at least 1 year of college chemistry	Or 2 years prior analytical experience is required
ICP, ICPMS, Long List or complex chromatography (e.g., Pesticides, PCB, Herbicides, HPLC, etc.), GCMS	A college degree in an applied science or 2 years of college chemistry	Or 5 years of prior analytical experience
Spectra Interpretation	A college degree in an applied science or 2 years of college chemistry	And 2 years relevant experience or 5 years of prior analytical experience
Technical Managers/Department Managers – **General**	Bachelors Degree in an applied science or engineering with 24 semester hours in chemistry An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years experience in environmental analysis of representative analytes for which they will oversee

When an analyst does not meet these requirements, they can perform a task under the direct supervision of a qualified analyst, peer reviewer or Group Leader, and are considered an analyst in training. The person supervising an analyst in training is accountable for the quality of the analytical data and must review and approve data and associated corrective actions.

17.3 TRAINING

The laboratory is committed to furthering the professional and technical development of employees at all levels.

Orientation to the laboratory's policies and procedures, in-house method training, and employee attendance at outside training courses and conferences all contribute toward employee proficiency. Below are examples of various areas of required employee training:

Required Training	Time Frame	Employee Type
Environmental Health & Safety	Prior to lab work	All

Required Training	Time Frame	Employee Type
Ethics – New Hires	1 week of hire	All
Ethics - Comprehensive	90 days of hire	All
Data Integrity	30 days of hire	Technical and PMs
Quality Assurance	90 days of hire	All
Ethics – Comprehensive Refresher	Annually	All
Initial Demonstration of Capability (DOC)	Prior to unsupervised method performance	Technical

The laboratory maintains records of relevant authorization/competence, education, professional qualifications, training, skills and experience of technical personnel (including contracted personnel) as well as the date that approval/authorization was given. These records are kept on file at the laboratory. Also refer to “Demonstration of Capability” in Section 19.

The training of technical staff is kept up to date by:

- Each employee must have documentation in their training file that they have read, understood and agreed to follow the most recent version of the laboratory QAM and SOPs in their area of responsibility. This documentation is updated as SOPs are updated.
- Documentation from any training courses or workshops on specific equipment, analytical techniques or other relevant topics are maintained in their training file.
- Documentation of proficiency (refer to Section 19).
- An Ethics Agreement signed by each staff member (renewed each year) and evidence of annual ethics training.
- A Confidentiality Agreement signed by each staff member signed at the time of employment.
- Human Resources maintains documentation and attestation forms on employment status and records; benefit programs; timekeeping/payroll; and employee conduct (e.g., ethics). This information is maintained in the employee’s secured personnel file.

The QA Manager is responsible for QA and Ethics Orientation, Initial and On-Going Ethics and Data Integrity Training and QA training. The EH&S Coordinator is responsible for EH&S Orientation and Training. Group Leaders and Technical Managers are responsible for technical training.

The QA Manager evaluates the effectiveness of training through the review of demonstration of capability documentation, on-going proficiency test results, nonconformances and corrective action reports, and internal and external audit reports.

Further details of the laboratory's training program are described in the Personnel Orientation and Training SOP KNOX-QA-0009.

17.4 DATA INTEGRITY AND ETHICS TRAINING PROGRAM

Establishing and maintaining a high ethical standard is an important element of a Quality System. Ethics and data integrity training is integral to the success of TestAmerica and is provided for each employee at TestAmerica**.** It is a formal part of the initial employee orientation within 1 week of hire followed by technical data integrity training within 30 days, comprehensive training within 90 days, and an annual refresher for all employees. Senior management at each facility performs the ethics training for their staff.

In order to ensure that all personnel understand the importance TestAmerica places on maintaining high ethical standards at all times; TestAmerica has established a Company Wide Ethics Policy No. CW-L-P-004 and an Ethics Statement. All initial and annual training is documented by signature on the Ethics Statement demonstrating that the employee has participated in the training and understands their obligations related to ethical behavior and data integrity.

Violations of this Ethics Policy will not be tolerated. Employees who violate this policy will be subject to disciplinary actions up to and including termination. Criminal violations may also be referred to the Government for prosecution. In addition, such actions could jeopardize TestAmerica's ability to do work on Government contracts, and for that reason, TestAmerica has a Zero Tolerance approach to such violations.

Employees are trained as to the legal and environmental repercussions that result from data misrepresentation. Key topics covered in the presentation include:

- Organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting.
- Ethics Policy.
- How and when to report ethical/data integrity issues. Confidential reporting.
- Record keeping.
- Discussion regarding data integrity procedures.
- Specific examples of breaches of ethical behavior (e.g., peak shaving, altering data or computer clocks, improper macros, etc., accepting/offering kickbacks, illegal accounting practices, unfair competition/collusion).
- Internal monitoring. Investigations and data recalls.
- Consequences for infractions including potential for immediate termination, debarment, or criminal prosecution.
- Importance of proper written narration / data qualification by the analyst and project manager with respect to those cases where the data may still be usable but are in one sense or another partially deficient.

Additionally, a data integrity hotline (1-800-736-9407) is maintained by TestAmerica and administered by the Corporate Quality Department.

SECTION 18

ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS

18.1 OVERVIEW

The laboratory is a 28,000 ft^2 secure laboratory facility with controlled access and designed to accommodate an efficient workflow and to provide a safe and comfortable work environment for employees. All visitors sign in and are escorted by laboratory personnel. Access is controlled by various measures.

The laboratory is equipped with structural safety features. Each employee is familiar with the location, use, and capabilities of general and specialized safety features associated with their workplace. The laboratory provides and requires the use of protective equipment including safety glasses, protective clothing, gloves, etc. OSHA and other regulatory agency guidelines regarding required amounts of bench and fume hood space, lighting, ventilation (temperature and humidity controlled), access, and safety equipment are met or exceeded.

Traffic flow through sample preparation and analysis areas is minimized to reduce the likelihood of contamination. Adequate floor space and bench top area is provided to allow unencumbered sample preparation and analysis space. Sufficient space is also provided for storage of reagents and media, glassware, and portable equipment. Ample space is also provided for refrigerated sample storage before analysis and archival storage of samples after analysis. Laboratory HVAC and deionized water systems are designed to minimize potential trace contaminants.

The laboratory is separated into specific areas for sample receiving, sample preparation, volatile organic sample analysis, non-volatile organic sample analysis, specialty organics sample preparation, specialty organics analysis, metals sample preparation, metals analysis, inorganic sample analysis, and administrative functions.

18.2 ENVIRONMENT

Laboratory accommodation, test areas, energy sources, lighting are adequate to facilitate proper performance of tests. The facility is equipped with heating, ventilation, and air conditioning (HVAC) systems appropriate to the needs of environmental testing performed at this laboratory.

The environment in which these activities are undertaken does not invalidate the results or adversely affect the required accuracy of any measurements.

The laboratory provides for the effective monitoring, control and recording of environmental conditions that may affect the results of environmental tests as required by the relevant specifications, methods, and procedures. Such environmental conditions include humidity controls, temperature controls, and voltage conditioning with an uninterruptible backup power supply.

When any of the method or regulatory required environmental conditions change to a point where they may adversely affect test results, analytical testing is discontinued until the environmental conditions are returned to the required levels.

Environmental conditions of the facility housing the computer network and LIMS are regulated to protect against raw data loss.

18.3 WORK AREAS

There is effective separation between neighboring areas when the activities therein are incompatible with each other. For example:

- Volatile organic chemical handling areas, including sample preparation and waste disposal, and volatile organic chemical analysis areas.

Access to and use of all areas affecting the quality of analytical testing is defined and controlled by secure access to the laboratory building as described below in the Building Security section.

Adequate measures are taken to ensure good housekeeping in the laboratory and to ensure that any contamination does not adversely affect data quality. These measures include regular cleaning to control dirt and dust within the laboratory.

Work areas are available to ensure an unencumbered work area. Work areas include:

- Access and entryways to the laboratory.
- Sample receipt areas.
- Sample storage areas.
- Chemical and waste storage areas.
- Data handling and storage areas.
- Sample processing areas.
- Sample analysis areas.

18.4 FLOOR PLAN

A floor plan can be found in Appendix 1.

18.5 BUILDING SECURITY

Building access codes and alarm codes are distributed to employees as necessary.

Visitors to the laboratory sign in and out in a visitor's logbook. A visitor is defined as any person who visits the laboratory who is not an employee of the laboratory. In addition to signing into the laboratory, the Environmental, Health and Safety Manual contains requirements for visitors and vendors. There are specific safety forms that must be reviewed and signed.

Visitors (with the exception of company employees) are escorted by laboratory personnel at all times, or the location of the visitor is noted in the visitor's logbook.

SECTION 19

TEST METHODS AND METHOD VALIDATION

19.1 OVERVIEW

The laboratory uses methods that are appropriate to meet our clients' requirements and that are within the scope of the laboratory's capabilities. These include sampling, handling, transport, storage and preparation of samples, and, where appropriate, an estimation of the measurement of uncertainty as well as statistical techniques for analysis of environmental data.

Instructions are available in the laboratory for the operation of equipment as well as for the handling and preparation of samples. All instructions, Standard Operating Procedures (SOPs), reference methods and manuals relevant to the working of the laboratory are readily available to all staff. Deviations from published methods are documented (with justification) in the laboratory's approved SOPs. SOPs are submitted to clients for review at their request. Significant deviations from published methods require client approval and regulatory approval where applicable.

The list of test methods used by the laboratory can be found in Table 19-1.

19.2 STANDARD OPERATING PROCEDURES (SOPs)

The laboratory maintains SOPs that accurately reflect all phases of the laboratory such as assessing data integrity, corrective actions, handling customer complaints as well as all analytical methods and sampling procedures. The method SOPs are derived from the most recently promulgated/approved, published methods and are specifically adapted to the laboratory facility. Modifications or clarifications to published methods are clearly noted in the SOPs. All SOPs are controlled in the laboratory.

- All SOPs contain a revision number, effective date, and appropriate approval signatures. Controlled copies are available to all staff.
- Procedures for writing an SOP by reference to TestAmerica's Corporate SOP entitled 'Writing a Standard Operating Procedure (SOP)', No, CW-Q-S-002 or the laboratory's SOPs KNOX-QA-0018 "Preparation and Management of Standard Operating Procedures," and KNOX-QA-0011 "Document Control and Distribution."
- SOPs are reviewed at a minimum of every 2 years (annually for Drinking Water and DoD/DOE SOPs), and where necessary, revised to ensure continuing suitability and compliance with applicable requirements. (Note: The laboratory must ensure laboratory analysts comply with the procedures in its VAP approved SOPs.)

19.3 LABORATORY METHODS MANUAL

For each test method, the laboratory has available the published referenced method as well as the laboratory developed SOP.

Note: If more stringent standards or requirements are included in a mandated test method or regulation than those specified in this manual, the laboratory demonstrates that such requirements are met. If it is not clear which requirements are more stringent, the standard from

the method or regulation is to be followed. Any exceptions or deviations from the referenced methods or regulations are noted in the specific analytical SOP.

The laboratory maintains an SOP Index for both technical and non-technical SOPs. Technical SOPs are maintained to describe a specific test method. Non-technical SOPs are maintained to describe functions and processes not related to a specific test method.

19.4 SELECTION OF METHODS

Since numerous methods and analytical techniques are available, continued communication between the client and laboratory is imperative to assure the correct methods are utilized. Once client methodology requirements are established, this and other pertinent information is summarized by the Project Manager. These mechanisms ensure that the proper analytical methods are applied when the samples arrive for log-in. For non-routine analytical services (e.g., special matrices, non-routine compound lists, etc.), the method of choice is selected based on client needs and available technology. The methods selected must be capable of measuring the specific parameter of interest, in the concentration range of interest, and with the required precision and accuracy.

19.4.1 Sources of Methods

Routine analytical services are performed using standard EPA-approved methodology. In some cases, modification of standard approved methods may be necessary to provide accurate analyses of particularly complex matrices. When the use of specific methods for sample analysis is mandated through project or regulatory requirements, only those methods are used.

When clients do not specify the method to be used or methods are not required, the methods used are clearly validated and documented in an SOP and available to clients and/or the end user of the data.

The analytical methods used by the laboratory are those currently accepted and approved by the U. S. EPA and the state or territory from which the samples were collected. Reference methods include:

- *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, US EPA, January 1996.*
- *Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act, Analysis and Sampling Procedures; 40CFR Part 136 as amended by Method Update Rule; May 18, 2012, Methods for Chemical Analysis of Water and Wastes, EPA 600 (4-79-020), 1983.*
- *Methods for the Determination of Inorganic Substances in Environmental Samples, EPA-600/R-93/100, August 1993.*
- *Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91/010, June 1991. Supplement I: EPA-600/R-94/111, May 1994.*
- *Standard Methods for the Examination of Water and Wastewater, 18th/19th /20th edition; Eaton, A.D. Clesceri, L.S. Greenberg, A.E. Eds; American Water Works Association, Water Pollution Control Federation, American Public Health Association: Washington, D.C.*
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II,*

September 1994; Final Update IIB, January 1995; Final Update III, December 1996, Final Update IV, January 2008. Final Update V, August 2015

- *Annual Book of ASTM Standards, American Society for Testing & Materials (ASTM), Philadelphia, PA.*
- *National Status and Trends Program, National Oceanographic and Atmospheric Administration, Volume I-IV, 1985-1994.*
- *Manual for the Certification of Laboratories Analyzing Drinking Water (EPA 815-R-05-004, January 2005)*
- *Code of Federal Regulations (CFR) 40, Parts 136, 141, 172, 173, 178, 179 and 261*

The laboratory reviews updated versions to all the aforementioned references for adaptation based upon capabilities, instrumentation, etc., and implements them as appropriate. As such, the laboratory strives to perform only the latest versions of each approved method as regulations allow or require.

Other reference procedures for non-routine analyses may include methods established by specific states (e.g., Underground Storage Tank methods), ASTM or equipment manufacturers. Sample type, source, and the governing regulatory agency requiring the analysis will determine the method utilized.

The laboratory informs the client when a method proposed by the client may be inappropriate or out of date. After the client has been informed, and they wish to proceed contrary to the laboratory's recommendation, it is documented.

19.4.2 Demonstration of Capability

Before the laboratory may institute a new method and begin reporting results, the laboratory confirms that it can properly operate the method. In general, this demonstration does not test the performance of the method in real world samples, but in an applicable and available clean matrix sample. If the method is for the testing of analytes that are not conducive to spiking, demonstration of capability may be performed on quality control samples.

19.4.2.1 A demonstration of capability (DOC, Lab SOP# KNOX-QA-0009) is performed whenever there is a change in instrument type (e.g., new instrumentation), method or personnel (e.g., laboratory analyst has not performed the test within the last 12 months). Note: The laboratory shall have a DOC for all analytes included in the methods that the laboratory performs, and proficiency DOCs for each analyst shall include all analytes that the laboratory routinely performs. Addition of non-routine analytes does not require new DOCs for all analysts if those analysts are already qualified for routine analytes tested using identical chemistry and instrument conditions.

19.4.2.2 The initial demonstration of capability must be thoroughly documented and approved by the Technical Manager and QA Manager prior to independently analyzing client samples. All associated documentation must be retained in accordance with the laboratory's archiving procedures.

19.4.2.3 The laboratory must have an approved SOP, demonstrate satisfactory performance, and conduct a method detection limit study (when applicable). There may be other requirements as stated within the published method or regulations (e.g., retention time window study).

Note: In some instances, a situation may arise where a client requests that an unusual analyte be reported using a method where this analyte is not normally reported. If the analyte is being reported for regulatory purposes, the method must meet all procedures outlined within this QAM (SOP, MDL, and Demonstration of Capability). If the client states that the information is not for regulatory purposes, the result may be reported as long as the following criteria are met:

- The instrument is calibrated for the analyte to be reported using the criteria for the method and ICV/CCV criteria are met (unless an ICV/CCV is not required by the method or criteria are per project DQOs).
- The laboratory's nominal or default reporting limit (RL) is equal to the limit of quantitation (LOQ), must be at or above the lowest non-zero standard in the calibration curve and must be reliably determined. Project RLs are client specified reporting levels which may be higher than the LOQ. Results reported below the LOQ must be qualified as estimated values. Also see Section 19.6.1.3, Relationship of Limit of Detection (LOD) to Limit of Quantitation (LOQ).
- The client request is documented and the lab informs the client of its procedure for working with unusual compounds. The final report must be footnoted: (e.g., *Reporting Limit based on the low standard of the calibration curve.)*

19.4.3 Initial Demonstration of Capability (IDOC) Procedures

19.4.3.1 A quality control sample shall be obtained from an outside source. If not available, the QC sample may be prepared by the laboratory using stock standards that are prepared independently from those used in instrument calibration.

19.4.3.2 The analyte(s) shall be diluted in a volume of clean matrix sufficient to prepare four aliquots at the concentration specified by the method or the laboratory SOP.

19.4.3.3 At least four aliquots are prepared (including any applicable routine clean-up procedures) and analyzed according to the test method (either concurrently or over a period of days).

19.4.3.4 Using all of the results, calculate the mean recovery in the appropriate reporting units and the standard deviation for each parameter of interest.

19.4.3.5 When it is not possible to determine the mean and standard deviation, such as for presence, absence and logarithmic values, the laboratory will assess performance against criteria described in the laboratory SOP.

19.4.3.6 Compare the information obtained above to the corresponding acceptance criteria for precision and accuracy in the test method (if applicable) or in laboratory generated acceptance criteria (LCS or interim criteria) if there is no mandatory criteria established. If any one of the parameters do not meet the acceptance criteria, the performance is unacceptable for that parameter.

19.4.3.7 When one or more of the tested parameters fail at least one of the acceptance criteria, the analyst must proceed according to either option listed below:

- Locate and correct the source of the problem and repeat the test for all parameters of interest beginning with 19.4.3.3 above.
- Beginning with 19.4.3.3 above, repeat the test for all parameters that failed to meet criteria. Repeated failure, however, will confirm a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds of interest beginning with 19.4.3.1 above.

Note: Results of successive LCS analyses can be used to fulfill the DOC requirement.

19.4.3.8 Refer to SOP KNOX-QA-0009, Personnel Orientation and Training for further details.

A certification statement (see Figure 19-1 for an example) is used to document the completion of each initial demonstration of capability. A copy of the certification is archived in the analyst's training file.

19.5 LABORATORY DEVELOPED METHODS AND NON-STANDARD METHODS

Any new method developed by the laboratory must be fully defined in an SOP and validated by qualified personnel with adequate resources to perform the method. Method specifications and the relation to client requirements must be clearly conveyed to the client if the method is a non-standard method (not a published or routinely accepted method). The client must also be in agreement to the use of the non-standard method.

19.6 VALIDATION OF METHODS

Validation is the confirmation by examination and the provision of objective evidence that the particular requirements for a specific intended use are fulfilled.

All non-standard methods, laboratory designed/developed methods, standard methods used outside of their scope, and major modifications to published methods must be validated to confirm they are fit for their intended use. The validation will be as extensive as necessary to meet the needs of the given application. The results are documented with the validation procedure used and contain a statement as to the fitness for use.

19.6.1 Method Validation and Verification Activities for All New Methods

While method validation can take various courses, the following activities can be required as part of method validation. Method validation records are designated QC records and are archived accordingly.

19.6.1.1 Determination of Method Selectivity

Method selectivity is the demonstrated ability to discriminate the analyte(s) of interest from other compounds in the specific matrix or matrices from other analytes or interference. In some

cases to achieve the required selectivity for an analyte, a confirmation analysis is required as part of the method.

19.6.1.2 Determination of Method Sensitivity

Sensitivity can be both estimated and demonstrated. Whether a study is required to estimate sensitivity depends on the level of method development required when applying a particular measurement system to a specific set of samples. Estimations and/or demonstrations of sensitivity are performed as required by regulation or client agreement, such as the procedure in 40 CFR Part 136 Appendix B, under the Clean Water Act.

19.6.1.3 Relationship of Limit of Detection (LOD) to the Limit of Quantitation (LOQ)

An important characteristic of expression of sensitivity is the difference in the LOD and the QL. The LOD is the minimum level at which the presence of an analyte can be reliably concluded. The QL is the minimum concentration of analyte that can be quantitatively determined with acceptable precision and bias. For most instrumental measurement systems, there is a region where semi-quantitative data is generated around the LOD (both above and below the estimated MDL or LOD) and below the QL. In this region, detection of an analyte may be confirmed but quantification of the analyte is unreliable within the accuracy and precision guidelines of the measurement system. When an analyte is detected below the QL, and the presence of the analyte is confirmed by meeting the qualitative identification criteria for the analyte, the analyte can be reliably reported, but the amount of the analyte can only be estimated. If data is to be reported in this region, it must be done so with a qualification that denotes the semi-quantitative nature of the result.

19.6.1.4 Determination of Interferences

A determination that the method is free from interferences in a blank matrix is performed.

19.6.1.5 Determination of Range

Where appropriate to the method, the quantitation range is determined by comparison of the response of an analyte in a curve to established or targeted criteria. Generally the upper quantitation limit is defined by highest acceptable calibration concentration. The lower Limit of Quantitation or LOQ cannot be lower than the lowest non-zero calibration level (QL check standard level for ICP), and can be constrained by required levels of bias and precision.

19.6.1.6 Determination of Accuracy and Precision

Accuracy and precision studies are generally performed using replicate analyses, with a resulting percent recovery and measure of reproducibility (standard deviation, relative standard deviation) calculated and measured against a set of target criteria.

19.6.1.7 Documentation of Method

The method is formally documented in an SOP. If the method is a minor modification of a standard laboratory method that is already documented in an SOP, an SOP Attachment describing the specific differences in the new method is acceptable in place of a separate SOP.

19.6.1.8 Continued Demonstration of Method Performance

Continued demonstration of Method Performance is addressed in the SOP. Continued demonstration of method performance is generally accomplished by batch specific QC samples such as LCS, method blanks or PT samples.

19.7 METHOD DETECTION LIMITS (MDL)/ LIMITS OF DETECTION (LOD)

Method detection limits (MDL) are initially determined in accordance with 40 CFR Part 136, Appendix B or alternatively by other technically acceptable practices that have been accepted by regulators. MDL is also sometimes referred to as Limit of Detection (LOD). The MDL theoretically represents the concentration level for each analyte within a method at which the analyst is 99% confident that the true value can be differentiated from blanks. The MDL is determined for each analyte initially during the method validation process and updated as required in the analytical methods, whenever there is a significant change in the procedure or equipment, or based on project specific requirements (refer to 20.7.10). Generally, the analyst prepares at least seven replicates of solution spiked at one to five times the estimated method detection limit (most often at the lowest standard in the calibration curve) into the applicable matrix with all the analytes of interest. Each of these aliquots is extracted (including any applicable clean-up procedures) and analyzed in the same manner as the samples. Where possible, the seven replicates should be analyzed over 2-4 days to provide a more realistic MDL. The replicates may be prepared and analyzed over a period of time (e.g. over multiple batches) or they may be performed within the same batch. If more than seven replicates are used, care must be taken to ensure the appropriate t-value multiplier is applied. MDL studies for work in support of Ohio EPA VAP must be spiked at or below the reporting limit.

19.7.1 Refer to the Corporate SOP No. CA-Q-S-006 and SOP KNOX-QA-0023 for details on the laboratory's MDL process.

19.8 INSTRUMENT DETECTION LIMITS (IDL)

19.8.1 The IDL is sometimes used to assess the reasonableness of the MDLs or in some cases required by the analytical method or program requirements. IDLs are most used in metals analyses but may be useful in demonstration of instrument performance in other areas.

19.8.2 IDLs are calculated to determine an instrument's sensitivity independent of any preparation method. IDLs are calculated either using 7 replicate spike analyses, like MDL but without sample preparation, or by the analysis of 10 instrument blanks and calculating 3 x the absolute value of the standard deviation.

19.8.3 If IDL is > than the MDL, it may be used as the reported MDL.

19.9 VERIFICATION OF DETECTION AND REPORTING LIMITS

19.9.1 Once an MDL is established, it must be verified, on each instrument, by analyzing a quality control sample (prepared as a sample) at no more than 3 times the calculated MDL for single analyte analyses (e.g., most wet chemistry methods) and no more than 4 times the calculated MDL for multiple analyte methods (e.g., GC, GCMS, ICP, etc.). The analytes must be qualitatively identified. This verification does not apply to methods that are not readily spiked (e.g. pH, turbidity, etc.) or where the lab does not report to the MDL. If the MDL does not verify, then the lab redevelops their MDL or use the level where qualitative identification is established. MDLs must be verified at least annually.

The following applies to methods specified on the laboratory's DoD ELAP scope of accreditation. Once the MDL is determined, it must be verified on each instrument used for the given method to analyze DoD/DOE samples. TestAmerica defines the DoD/DOE Quality System Manual (QSM) Detection Limit (DL) as being equal to the MDL. TestAmerica also defines the DoD/DOE QSM Limit of Detection (LOD) as being equal to the lowest concentration standard that successfully verifies the MDL, also referred to as the MDLV standard. MDL and MDLV standards are extracted/digested and analyzed through the entire analytical process. The MDL and MDLV determinations do not apply to methods that are not readily spiked (e.g. pH, turbidity, etc.) or where the lab does not report to the MDL. If the MDLV standard is not successful, then the laboratory will redevelop their MDL or perform and pass two consecutive MDLVs at a higher concentration and set the LOD at the higher concentration. Initial and quarterly verification is required for all methods listed in the laboratory's DoD ELAP Scope of Accreditation. Refer to the laboratory SOP CA-Q-S-006 and the laboratory attachment for further details.

19.9.2 When the laboratory establishes a quantitation limit, it must be initially verified by the analysis of a low level standard or QC sample at 1-2 times the reporting limit and annually thereafter. The annual requirement is waved for methods that have an annually verified MDL.

The following applies to methods specified on the laboratory's DoD ELAP scope of accreditation. The laboratory quantitation limit is equivalent to the DoD/DOE Limit of Quantitation (LOQ), which is at a concentration equal to or greater than the lowest non-zero calibration standard. The DoD/DOE QSM requires the laboratory to perform an initial characterization of the bias and precision at the LOQ and quarterly LOQ verifications thereafter. If the quarterly verification results are not consistent with three-standard deviation confidence limits established initially, then the bias and precision will be reevaluated and clients contacted for any on-going projects where the bias and precision at the LOQ has been specified in the project planning documents. For DoD/DOE projects, TestAmerica makes a distinction between the Reporting Limit (RL) and the LOQ. The RL is a level at or above the LOQ that is used for specific project reporting purposes, as agreed to between the laboratory and the client. The RL cannot be lower than the LOQ concentration, but may be higher.

19.10 RETENTION TIME WINDOWS

Most organic analyses and some inorganic analyses use chromatography techniques for qualitative and quantitative determinations. For every chromatography analysis each analyte will have a specific time of elution from the column to the detector. This is known as the analyte's retention time. The variance in the expected time of elution is defined as the retention time window. As the key to analyte identification in chromatography, retention time windows must be

established on every column for every analyte used for that method. These records are kept with the files associated with each instrument as applicable. Complete details are available in the laboratory SOPs.

19.11 EVALUATION OF SELECTIVITY

The laboratory evaluates selectivity by following the checks within the applicable analytical methods, which include mass spectral tuning, mass resolution, second column confirmation, ICP interelement interference checks, chromatography retention time windows, and method blanks.

19.12 ESTIMATION OF UNCERTAINTY OF MEASUREMENT

19.12.1 Uncertainty is "a parameter associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand" (as defined by the International Vocabulary of Basic and General Terms in Metrology, ISO Geneva, 1993, ISBN 92-67-10175-1). Knowledge of the uncertainty of a measurement provides additional confidence in a result's validity. Its value accounts for all the factors which could possibly affect the result, such as adequacy of analyte definition, sampling, matrix effects and interferences, climatic conditions, variances in weights, volumes, and standards, analytical procedure, and random variation. Some national accreditation organizations require the use of an "expanded uncertainty": the range within which the value of the measurand is believed to lie within at least a 95% confidence level with the coverage factor k=2.

19.12.2 Uncertainty is not error. Error is a single value, the difference between the true result and the measured result. On environmental samples, the true result is never known. The measurement is the sum of the unknown true value and the unknown error. Unknown error is a combination of systematic error, or bias, and random error. Bias varies predictably, constantly, and independently from the number of measurements. Random error is unpredictable, assumed to be Gaussian in distribution, and reducible by increasing the number of measurements.

19.12.3 The minimum uncertainty associated with results generated by the laboratory can be determined by using the Laboratory Control Sample (LCS) accuracy range for a given analyte. The LCS limits are used to assess the performance of the measurement system since they take into consideration all of the laboratory variables associated with a given test over time (except for variability associated with the sampling and the variability due to matrix effects). The percent recovery of the LCS is compared either to the method-required LCS accuracy limits or to the statistical, historical, in-house LCS accuracy limits.

19.12.4 Refer to SOP KNOX-QA-0019 "Estimation of Measurement Uncertainty" for details regarding calculations that may be used to estimate measurement uncertainty associated with laboratory results.

19.12.5 In the case where a well recognized test method specifies limits to the values of major sources of uncertainty of measurement (e.g. 524.2, 525, etc) and specifies the form of presentation of calculated results, no further discussion of uncertainty is required.

19.13 CONTROL OF DATA

The laboratory has policies and procedures in place to ensure the authenticity, integrity, and accuracy of the analytical data generated by the laboratory.

19.13.1 Computer and Electronic Data Related Requirements

The three basic objectives of our computer security procedures and policies are shown below. More detail is outlined in the laboratory SOPs KNOX-IT-0001, 'Good Automated Laboratory Practices' and KNOX-IT-0002, 'Electronic Data and Software Backup.' The laboratory is currently running TALS which is a TestAmerica developed LIMS system that has been highly customized to meet the needs of TestAmerica Knoxville. It is referred to as LIMS for the remainder of this section. The LIMS utilizes a SQL Server Enterprise Addition-SQL2008-SP3 which is an industry standard relational database platform. It is referred to as Database for the remainder of this section.

19.13.1.1 Maintain the Database Integrity: Assurance that data is reliable and accurate through data verification (review) procedures, password-protecting access, anti-virus protection, data change requirements, as well as an internal LIMS permissions procedure.

- LIMS Database Integrity is achieved through data input validation, internal user controls, and data change requirements.
- Spreadsheets and other software developed in-house must be verified with documentation through hand calculations prior to use. Cells containing calculations must be lock-protected.
- Instrument hardware and software adjustments are safeguarded through maintenance logs, audit trails, and controlled access.

19.13.1.2 Ensure Information Availability: Protection against loss of information or service through scheduled back-ups, stable file server network architecture, secure storage of media, line filter, Uninterruptible Power Supply (UPS), and maintaining older versions of software as revisions are implemented.

19.13.1.3 Maintain Confidentiality: Ensure data confidentiality through physical access controls such as password protection or controlled website access approval.

19.13.2 Data Reduction

The complexity of the data reduction depends on the analytical method and the number of discrete operations involved (e.g., extractions, dilutions, instrument readings and concentrations). The laboratory analyst calculates the final results from the raw data or uses appropriate computer programs to assist in the calculation of final reportable values.

Manual integration of peaks will be documented and reviewed and the raw data will be flagged in accordance with the TestAmerica Corporate SOP CA-Q-S-002, "*Acceptable Manual Integration Practices"* and SOP KNOX-QA-0022.

Analytical results are reduced to appropriate concentration units specified by the analytical method, taking into account factors such as dilution, sample weight or volume, etc. Method Blank correction is not performed unless it is specifically required by the method. Calculations are independently verified by appropriate laboratory staff. Calculations and data reduction steps for the methods are summarized in the respective analytical SOPs.

In general, data will be processed by a laboratory analyst in one of the following ways:

- Manual computation of results directly on the data sheet or on calculation pages attached to the data sheets.
- Input of raw data for computer processing.
- Direct acquisition and processing of raw data by a computer.

19.13.2.1 If data are manually processed by a laboratory analyst, all steps in the computation are provided including equations used and the source of input parameters such as response factors (RFs), dilution factors, and calibration constants. If calculations are not performed directly on the data sheet, they may be attached to the data sheets. (Note: This section does not apply to the Ohio VAP as all computations are done by the instrument data system and by the LIMS.)

19.13.2.2 For data that are input by a laboratory analyst and processed using a computer, a copy of the input is kept and uniquely identified with the project number and other information as needed. The samples analyzed must be clearly identified.

19.13.2.3 If data are directly acquired from instrumentation and processed, the laboratory analyst must verify that the following are correct:

- Project and sample numbers
- Calibration constants/RFs
- Units
- Numerical values used for reporting limits.

19.13.2.4 In general, sample results are reported to 2 significant figures on the final report.

19.13.3 Logbook / Worksheet Use Guidelines

Logbooks and worksheets are filled out ‘real time’ and have enough information on them to trace the events of the applicable analysis/task. (e.g. calibrations, standards, analyst, sample ID, date, time on short holding time tests, temperatures when applicable, calculations are traceable, etc.).

- Corrections are made following the procedures outlined in Section 12.
- Logbooks are controlled by the QA department. A record is maintained of all logbooks in the lab.
- Unused portions of pages must be “Z”’d out, signed and dated.
- Worksheets are created with the approval of the Technical Director/QA Manager at the facility. The QA Manager or designee controls all worksheets following the procedures in Section 6.

19.13.4 Review / Verification Procedures

A minimum of three levels of review are performed before final sample data is reported to the client.

- First level technical review.
- Second level technical review.
- Third level project management completeness review.

19.13.4.1 The initial first level technical review ensures that:

- Sample preparation information is correct and complete including documentation of standard identification, sample amounts, etc.
- Analysis information is correct and complete including proper identification of analysis output (charts, chromatograms, mass spectra, etc.).
- Analytical results are correct and complete including calculation or verification of instrument calibration, QC results, and qualitative and quantitative sample results with appropriate qualifiers.
- The appropriate SOPs have been followed and are identified in the project records.
- Proper documentation procedures have been followed.
- All nonconformances have been documented.
- Special sample preparation and analytical requirements have been met.
- The data generated have been reported with the appropriate number of significant figures as defined by the analytical method in the LIMS or otherwise specified by the client.

The initial verification of the data reduction (level 1 review) by the laboratory analyst is documented on a data review checklist, which is signed and dated by the laboratory analyst. The data review checklists identify which records must be checked as part of the data review.

19.13.4.2 Following the completion of the initial verification by the laboratory analyst performing the data reduction, a systematic check of the data that has been fully reduced and checked through level 1 review is performed by an experienced peer, group leader, or designee. This check (level 2 review) is performed to ensure that level 1 review has been completed correctly and thoroughly. This review includes an evaluation of all items required in the raw data package. Any exceptions noted by the laboratory analyst must be reviewed. Included in this review is an assessment of the acceptability of the data with respect to:

- Adherence of the procedure used to the requested analytical method SOP.
- Correct interpretation of chromatograms, mass spectra, etc.
- Correctness of numerical input when computer programs are used (checked randomly).
- Correct identification and quantitation of constituents with appropriate qualifiers.
- Numerical correctness of calculations and formulas (checked randomly).
- Acceptability of QC data.
- Documentation that instruments were operating according to method specifications (calibrations, performance checks, etc.).
- Documentation of dilution factors, standard concentrations, etc.
- Sample holding time assessment.

The level 2 review also serves as verification that the process the laboratory analyst

has followed is correct in regard to the following:

- The analytical procedure follows the methods and specific instructions given on the project QAS or equivalent summary form.
- Nonconforming events have been addressed by corrective action as defined on a nonconformance memo.
- Valid interpretations have been made during the examination of the data and the review comments of the initial reviewer are correct.
- Manual Integrations are valid and properly documented.
- The package contains all of the necessary documentation for data review and report production and results are reported in a manner consistent with the method used for preparation of data reports.

The specific items covered in the level 2 review may vary according to the analytical method, but this review of the data must be documented by signing the data review checklist.

19.13.4.3 A third-level review is performed by the PM. This review is required before results are submitted to clients. This review serves to verify the completeness of the data report and to ensure that project requirements are met for the analyses performed. The items to be reviewed are:

- Analysis results are present for every sample in the analytical batch, reporting group, or sample delivery group (SDG).
- Every parameter or target compound requested is reported with either a value or reporting limit.
- The correct units and correct number of significant figures are utilized.
- All nonconformances and receipt variances with the resolution, including holding time violations and data evaluation statements that impact the data quality, are accompanied by clearly expressed comments from the laboratory.
- The final report is legible, contains all the supporting documentation required by the project, and is in either the standard TestAmerica Knoxville format or in the client-required format.

A narrative to accompany the final report is finalized by the PM. This narrative will include relevant comments collected during the earlier reviews.

19.13.4.4 Additional reviews are performed by the QA department. These reviews are typically performed after the data has been reported to the client. These reviews are a routine part of the Quality System and are discussed in further detail in Section 15.1. For example, the QA department reviews 10% of all DoD and DOE data packages for technical completeness and accuracy.

19.13.5 Manual Integrations

Computerized data systems provide the laboratory analyst with the ability to re-integrate raw instrument data in order to optimize the interpretation of the data. Though manual integration of data is an invaluable tool for resolving variations in instrument performance and some sample matrix problems, when used improperly, this technique would make unacceptable data appear to meet quality control acceptance limits. Improper re-integrations lead to legally indefensible data, a poor reputation, or possible laboratory decertification. Because guidelines for re-integration of data are not provided in the methods and most methods were written prior to widespread implementation of computerized data systems, the laboratory trains all analytical staff on proper manual integration techniques using TestAmerica's Corporate SOP CA-Q-S-002 and SOP KNOX-QA-0022 as the guidelines**.**

19.13.5.1 The laboratory analyst must adjust the baseline or the area of a peak in some situations, for example when two compounds are not adequately resolved or when a peak shoulder needs to be separated from the peak of interest. The laboratory analyst must use professional judgment and common sense to determine when manual integrating is required. Laboratory Analysts are encouraged to ask for assistance from a senior laboratory analyst or manager when in doubt.

19.13.5.2 Laboratory Analysts must not increase or decrease peak areas for the sole purpose of achieving acceptable QC recoveries that would have otherwise been unacceptable. The intentional recording or reporting of incorrect information (or the intentional omission of correct information) is against company principles and policy and is grounds for immediate termination.

19.13.5.3 Client samples, performance evaluation samples, and quality control samples are all treated equally when determining whether or not a peak area or baseline is manually adjusted.

19.13.5.4 All manual integrations receive a second level review. Manual integrations must be indicated on an expanded scale "after" chromatograms such that the integration performed can be easily evaluated during data review. Expanded scale "before" chromatograms are also required for all manual integrations on QC parameters (initial calibrations, calibration verifications, laboratory control samples, internal standards, surrogates, etc.) unless the laboratory has another documented corporate approved procedure in place that can demonstrate an active process for detection and deterrence of improper integration practices.

Figure 19-1.
Example - Demonstration of Capability Documentation

Analyst Demonstration of Capability
TestAmerica Knoxville

Analyst Name

MM/DD/YYYY

Preparation Method(s):
Analytical Method(s):
Matrix:
Method Description:

Preparation SOP No:

Analytical SOP No:

We, the undersigned, CERTIFY that:

1. The analyst identified above, using the cited test method with the specifications in the cited SOP, which is in use at this facility for the analysis of samples under the laboratory's Quality Assurance Plan, has completed the Demonstration of Capability (DOC).
2. The test method(s) was performed by the analyst identified on this certificate.
3. A copy of test method(s) and laboratory SOPs are available for all personnel on-site.
   These documents have been reviewed by the analyst as part of this DOC.
4. The data associated with the demonstration of capability are true, accurate, complete and self-explanatory.
5. All raw data necessary to reconstruct and validate these analyses have been retained at the facility. The associated information is organized and available for review.

Analyst	**Signature**	**Date**

Technical Director	**Signature**	**Date**

Quality Assurance Officer	**Signature**	**Date**

Table 19-1 Analytical Methods and Matrices

Analytical Parameters	Fields of Testing[1]				
	Drinking Water (SDWA)	**Non-Potable Water (CWA/RCRA)**	**Solid and Chemical Materials (RCRA-SW846)**	**Air and Emissions (CAA)**	**Biological Tissue**
Anions (Br^-, Cl^-, F^-, NO_2, NO_3, o-PO_4, SO_4	**EPA 300.0**	**EPA 300.0 (CWA) EPA 9056 (RCRA)**	**EPA 9056**	Mod Method 26A/0050 (9057 Mod)	---
Ash	---	---	**ASTM D482**	---	---
Density	---	---	ASTM D1963, D854	---	---
Halogens	---	---	EPA 5050/9056 (KNOX-WC-0016)	---	---
Heat of Combustion (Btu)	---	---	**ASTM D5865, D240**	---	---
Hexavalent Chromium	---	---	---	Method 0061/7199	---
pH	---	EPA 9040C (RCRA) SM4500 H+B (CWA)	EPA 9040C EPA 9045D	---	---
Hardness	---	**SM 2340B (CWA)**	---	---	---
Particulates	---	---	---	PM-10, **0050/5, 5B, 5J**, 201A, **202**, **TCEQ-23**, OTM-27, OTM-28	---
Mercury	---	**EPA 7470A (RCRA)**	**EPA 7471A&B**	**EPA 29/0060/7470A** ASTM D6784-02/7470A EPA IO-3.1/7470A	**EPA3051/3052/ 7470A**
Metals	---	**EPA 200.7 (CWA) EPA 3005A/ 6010B&C EPA 3010A/ 6010B&C (RCRA)**	**EPA 3050B/ 6010B&C EPA 3051/3052/6010B&C**	**EPA 29/ 0060/6010B&C EPA IO-3.1/6010B&C 40CFR60-12 (Pb)**	**EPA 3051/3052/ 6010B&C**
Sulfur	---	---	ASTM D3177, ASTM D129	---	---
Viscosity	---	---	**ASTM D445**	---	---

Table 19-1 (continued) Analytical Methods and Matrices

Analytical Parameters	Fields of Testing[1]				
	Drinking Water (SDWA)	**Non-Potable Water (CWA/RCRA)**	**Solid and Chemical Materials (RCRA-SW846)**	**Air and Emissions (CAA)**	**Biological Tissue**
Volatiles by GC/MS	---	**EPA 5030B EPA 8260B (RCRA)**	**EPA 5035 EPA 8260B**	**TO-14A, TO-15 EPA 0031/5041A (VOST)**	---
Volatiles by GC	---	---	---	EPA 0040 Condensates **ASTM D1946**	---
Semivolatiles by GC/MS	---	**EPA 3520C EPA 8270C&D (RCRA)**	**EPA3550B&C EPA 3640A EPA 8270C&D**	**EPA 3542/8270C&D TO-13A**	---
Semivolatiles by GC	---	**EPA 3520C PCBs EPA 8082A (RCRA)**	**EPA 3550B&C EPA 3640A EPA 8082A**	**EPA 3542**/8082A **EPA 3542**/8081A **TO-4A, TO-10A** TCO/Grav	**EPA 3550B&C EPA 3640A** PCBs EPA 8082A
Dioxins/Furans by HRGC/HRMS	**EPA 1613B**	**EPA 1613B (CWA) EPA 8290 EPA 8290A (RCRA)**	**EPA 3640A EPA 8290 EPA 8290A**	**TO-9A**, **Method 23/8290/8290A EPA 0023A/8290/8290A**	**EPA 3640A EPA 8290 EPA 8290A EPA 1613B**
Lipids	---	---	---	---	EPA 8290, Micro-Lipids (KNOX-OP-0019)
PCBs by HRGC/HRMS	---	**EPA 1668A&B&C CWA**	**EPA3640A EPA 1668A&B&C**	**EPA 1668A&B&C**	**EPA 3640A EPA 1668A&B&C**
Polycyclic Aromatic Hydrocarbons (PAH)	---	**EPA 3520C EPA 8270C&D** ID0016	**EPA 3550B&C/3640A/ 8270C&D EPA 3540C/3640A/ ID0016**	**EPA 3542/8270C&D EPA 3542/ID0016**	**EPA 3550B&C/ 3640A/** 8270C&D EPA **3540C/3640A/ ID0016**

(1) NELAC accredited analytical methods and accepted prep methods are highlighted in bold fon

SECTION 20

EQUIPMENT and CALIBRATIONS

20.1 OVERVIEW

The laboratory purchases the most technically advanced analytical instrumentation for sample analyses. Instrumentation is purchased on the basis of accuracy, dependability, efficiency and sensitivity. Each laboratory is furnished with all items of sampling, preparation, analytical testing and measurement equipment necessary to correctly perform the tests for which the laboratory has capabilities. Each piece of equipment is capable of achieving the required accuracy and complies with specifications relevant to the method being performed. Before being placed into use, the equipment (including sampling equipment) is calibrated and checked to establish that it meets its intended specification. The calibration routines for analytical instruments establish the range of quantitation. Calibration procedures are specified in laboratory SOPs for the analytical methods. A list of laboratory equipment and instrumentation is presented in Table 20-1.

Equipment is only operated by authorized and trained personnel. Manufacturer's instructions for equipment use are readily accessible to all appropriate laboratory personnel.

20.2 PREVENTIVE MAINTENANCE

20.2.1 The laboratory follows a well-defined maintenance program to ensure proper equipment operation and to prevent the failure of laboratory equipment or instrumentation during use. This program of preventive maintenance helps to avoid delays due to instrument failure.

20.2.2 Routine preventive maintenance procedures and frequency, such as cleaning, and replacements, are performed according to the procedures outlined in the manufacturer's manual. Qualified personnel must also perform maintenance when there is evidence of degradation of peak resolution, a shift in the calibration curve, loss of sensitivity, or failure to continually meet one of the quality control criteria.

20.2.3 Table 20-2 summarizes the schedules for routine maintenance. It is the responsibility of each Group Leader to ensure that instrument maintenance logs are kept for all equipment in his/her department. Preventative maintenance procedures may also be outlined in analytical SOPs or instrument manuals. (Note: for some equipment, the log used to document maintenance is also used to monitor performance.)

20.2.4 Instrument maintenance logs are controlled and are used to document instrument problems, instrument repair and maintenance activities. Maintenance logs are kept for all major pieces of equipment. Instrument maintenance logs may also be used to specify instrument operating parameters.

20.2.4.1 Documentation must include all major maintenance activities such as contracted preventive maintenance and service and in-house activities such as the replacement of electrical components, lamps, tubing, valves, columns, detectors, cleaning and adjustments.

20.2.4.2 Each entry in the instrument log includes the Laboratory Analyst's initials, the date, a detailed description of the problem (or maintenance needed/scheduled), a detailed explanation of the solution or maintenance performed, and a verification that the equipment is functioning properly (state what was used to determine a return to control, e.g., continuing instrument calibration verification (CCV) run on *'date'* was acceptable, or instrument recalibrated on 'date' with acceptable verification, etc.). An entry in the associated analytical runlog documenting successful calibration may also be used to document instrument return to control following maintenance.

20.2.4.3 When maintenance or repair is performed by an outside agency, service receipts detailing the service performed are affixed into the maintenance logbook. The analyst signs across the entered item and the logbook page so that it is clear that the insert is missing if only half a signature is found in the logbook.

20.2.4.4 In addition, the maintenance records contain:

- The identification of the instrument/equipment **(**instrument's Serial Number and Model Number).
- The date the instrument/equipment was put into use.
- If available, the condition when the instrument was received (e.g., new, used, reconditioned).

20.2.5 If an instrument requires repair (subjected to overloading or mishandling, gives suspect results, or otherwise has shown to be defective or outside of specified limits), it is taken out of operation and tagged as out of service or otherwise isolated until such a time as the repairs have been made and the instrument can be demonstrated as operational by calibration and/or verification or other test to demonstrate acceptable performance. The laboratory examines the effect of this defect on previous analyses (refer to Sections 12 and 13).

20.2.6 In the event of equipment malfunction that cannot be resolved, service is obtained from the instrument vendor manufacturer, or qualified service technician, if such a service can be tendered. If on-site service is unavailable, arrangements are made to have the instrument shipped back to the manufacturer for repair. Back up instruments, which have been approved for the analysis perform the analysis normally carried out by the malfunctioning instrument. If the back up is not available and the analysis cannot be carried out within the needed timeframe, the samples are subcontracted.

20.2.7 At a minimum, if an instrument is sent out for service or transferred to another facility, it must be recalibrated and the laboratory MDL verified (using an MDLV) prior to return to lab operations.

20.2.8 An inventory of critical spare parts is maintained to minimize delays in the completion of analyses. For most test methods, back-up instrumentation is also maintained to minimize delays.

20.3 SUPPORT EQUIPMENT

This section applies to all devices that may not be the actual test instrument, but are necessary to support laboratory operations. These include but are not limited to: balances, ovens,

refrigerators, freezers, incubators, water baths, temperature measuring devices, and volumetric dispensing devices if quantitative results are dependent on their accuracy, as in standard preparation and dispensing or dilution into a specified volume. All raw data records associated with the support equipment are retained to document instrument performance. Refer to Table 20-3.

20.3.1 Weights and Balances

The accuracy of the balances used in the laboratory is checked every working day, before use. All balances are placed on stable counter tops. Balances must have their calibration checked each day of use with two weights bracketing the working range; refer to Table 20-3.

Each balance is checked prior to initial serviceable use with at least two certified ASTM type 1 weights spanning its range of use (weights that have been calibrated to ASTM type 1 weights may also be used for daily verification). ASTM type 1 weights used only for calibration of other weights (and no other purpose) are inspected for corrosion, damage or nicks at least annually and if no damage is observed, they are calibrated at least every 5 years by an outside calibration laboratory. Any weights (including ASTM Type 1) used for daily balance checks or other purposes are recalibrated/recertified annually to NIST standards (this may be done internally if the laboratory maintains “calibration only” ASTM type 1 weights).

All balances are serviced annually by a qualified service representative who supplies the laboratory with a certificate that identifies traceability of the calibration to the NIST standards.

All of this information is recorded in logs, and the recalibration/recertification certificates are kept on file. Further details on balance calibration may be found in SOP KNOX-QA-0005, Balance Calibration and Weight Verification.

20.3.2 pH and Conductivity Meters

The pH meters used in the laboratory are accurate to $\pm$ 0.1 pH units, and have a scale readability of at least 0.05 pH units. The meters automatically compensate for the temperature, and are calibrated with at least two working range buffer solutions before each use.

Conductivity meters are also calibrated before each use with a known standard to demonstrate the meters do not exceed an error of 1% or one umhos/cm.

All of this information is documented in logbooks.

Consult the pH and Routine Monitoring of Deionized Water SOPs for further information.

20.3.3 Thermometers

All thermometers are calibrated on an annual basis with a NIST-traceable thermometer. IR thermometers and digital thermometers are calibrated quarterly.

• If the temperature measuring device is used over a range of 10°C or less, then a single point verification within the range of use is acceptable;

• If the temperature measuring device is used over a range of greater than 10°C, then the verification must bracket the range of use.

The NIST mercury reference thermometer(s) are recalibrated every five years (unless thermometer has been exposed to temperature extremes or apparent separation of internal liquid) by an approved outside service and the provided certificate of traceability is kept on file. NIST digital reference thermometers are recalibrated every two years. The NIST thermometer(s) have increments of 1ºC, and have a range applicable to all method and certification requirements. The NIST traceable thermometer is used for no other purpose than to calibrate other thermometers.

Thermometer calibrations are documented as described in SOP KNOX-QA-0010, Temperature Monitoring and Thermometer Calibration.

20.3.4 Refrigerators/Freezer Units, Waterbaths, Ovens and Incubators

The temperatures of all refrigerator units and freezers used for sample and standard storage are monitored each working day. Monitoring is performed 7 days per week to ensure that samples remain within an acceptable range.

Ovens, waterbaths and incubators are monitored on days of use.

All of this equipment has a unique identification number, and is assigned a unique thermometer for monitoring.

Sample storage refrigerator temperatures are kept between > 0ºC and ≤ 6 ºC.

Specific temperature settings/ranges for other refrigerators, ovens waterbaths, and incubators can be found in method specific SOPs.

The temperatures are documented in temperature logbooks or in the method-specific logbooks/benchsheets.

20.3.5 Autopipettors, Dilutors, and Syringes

Mechanical volumetric dispensing devices including burettes (except Class A Glassware and Glass microliter syringes) are given unique identification numbers and the delivery volumes are verified gravimetrically, at a minimum, on a quarterly basis.
Any device not regularly verified cannot be used for any quantitative measurements.

Refer to SOP KNOX-QA-0012, Pipetter and Volumetric Labware Calibration Verification.

Micro-syringes are purchased from Hamilton Company. Each syringe is traceable to NIST. The laboratory keeps on file an “Accuracy and Precision Statement of Conformance” from Hamilton attesting established accuracy.

20.4 INSTRUMENT CALIBRATIONS

Calibration of analytical instrumentation is essential to the production of quality data. Strict calibration procedures are followed for each method. These procedures are designed to determine and document the method detection limits, the working range of the analytical instrumentation and any fluctuations that may occur from day to day.

Sufficient raw data records are retained to allow an outside party to reconstruct all facets of the initial calibration. Records contain, but are not limited to, the following: calibration date, method, instrument, laboratory analyst(s) initials or signatures, analysis date, analytes, concentration, response, type of calibration (Avg RF, curve, or other calculations that are used to reduce instrument responses to concentration).

Sample results must be quantitated from the initial calibration and must not be quantitated from any continuing instrument calibration verification unless otherwise required by regulation, method or program.

If the initial calibration results are outside of the acceptance criteria, corrective action is performed and any affected samples are reanalyzed if possible. If the reanalysis is not possible, any data associated with an unacceptable initial calibration is reported with appropriate data qualifiers (refer to Section 13).

Note: Instruments are calibrated initially and as needed after that and at least annually. The annual initial calibration requirement does not apply to isotope dilution methods**.**

20.4.1 CALIBRATION STANDARDS

20.4.1.1 Calibration standards are prepared using the procedures indicated in the Reagents and Standards section of the determinative method SOP. If a reference method does not specify the number of calibration standards, a minimum of 3 calibration points (exception being ICP and ICP/MS methods) shall be used.

20.4.1.2 Standards for instrument calibration are obtained from a variety of sources. All standards are traceable to national or international standards of measurement, or to national or international standard reference materials.

20.4.1.3 The lowest concentration calibration standard that is analyzed during an initial calibration must be at or below the stated reporting limit for the method based on the final volume of extract (or sample).

20.4.1.4 The other concentrations define the working range of the instrument/method or correspond to the expected range of concentrations found in actual samples that are also within the working range of the instrument/method. Results of samples not bracketed by initial instrument calibration standards (within calibration range to at least the same number of significant figures as that used to report the sample data) must be reported as having less certainty, e.g., defined qualifiers or flags (additional information may be included in the case narrative). The exception to these rules is ICP methods which define the working range with periodic linear dynamic range studies, rather than through the range of concentrations of daily calibration standards.

20.4.1.5 All initial calibrations are verified with a standard obtained from a second source and traceable to a national standard, when available (or vendor certified different lot if a second source is not available). For unique situations, such as air analysis where no other source or lot is available, a standard made by a different laboratory analyst is used for verification. This verification occurs immediately after the calibration curve has been analyzed, and before the analysis of any samples.

20.4.2 Continuing Calibration Verification (CCV)

The calibration relationship established during the initial calibration must be verified at least daily as specified in the laboratory method SOPs in accordance with the referenced analytical methods and in the 2009 TNI Standard. The process of calibration verification applies to both external standard and internal standard calibration techniques, as well as to linear and non-linear calibration models.

Note: The process of calibration verification referred to is fundamentally different from the approach called "calibration" in some methods. As described in those methods, the calibration factors or response factors calculated during calibration are used to update the calibration factors or response factors used for sample quantitation. This approach, while employed in other EPA programs, amounts to a daily single-point calibration.

All target analytes and surrogates, including those reported as non-detects, must be included in periodic calibration verifications for purposes of retention time confirmation and to demonstrate that calibration verification criteria are being met.

Note: For Ohio EPA VAP projects the calibration solution used for calibration verification must be from the same source as that used for the calibration curve unless the method states otherwise.

All samples must be bracketed by periodic analyses of standards that meet the QC acceptance criteria (e.g., calibration and retention time). The required frequency is found in the analytical method SOPs.

Note: If an internal standard calibration is being used (basically GCMS and some GC methods) then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

Generally, the initial calibrations must be verified at the beginning of each 12-hour analytical shift during which samples are analyzed. (Some methods may specify more or less frequent verifications). The 12-hour analytical shift begins with the injection of the continuing calibration verification standard (or the MS tuning standard in MS methods). The shift ends after the completion of the analysis of the last sample, QC, or standard that can be injected within 12 hours of the beginning of the shift.

A continuing calibration verification (CCV) must be repeated at the beginning and, for methods that have quantitation by external calibration models, at the end of each analytical batch. Some

methods have more frequent CCV requirements see specific SOPs. Most Inorganic methods require the CCV to be analyzed after ever 10 samples or injections, including matrix or batch QC samples.

Note: If an internal standard calibration is being used (basically GCMS) then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

If the results of a CCV are outside the established acceptance criteria and analysis of a second consecutive (and immediate) CCV fails to produce results within acceptance criteria, corrective action shall be performed. Once corrective actions have been completed & documented, the laboratory shall demonstrate acceptable instrument / method performance by analyzing two consecutive CCVs, or a new initial instrument calibration shall be performed. (Note: For Ohio EPA VAP projects, if the instrument conditions have been changed, the laboratory must analyze a new calibration curve.)

Sample analyses and reporting of data may not occur or continue until the analytical system is calibrated or calibration verified. However, data associated with an unacceptable continuing calibration verification may be fully useable under the following special conditions listed in Section 20.4.2.1, below, and reported based upon discussion and approval of the client.

20.4.2.1 Verification of Linear or Non-Linear Calibrations

Continuing calibration verification for calibrations involves the calculation of the percent drift or the percent difference of the instrument response between the initial calibration and each subsequent analysis of the continuing calibration verification standard. (These calculations are available in the laboratory method SOPs.) Continuing calibration verification standards are evaluated based on the % Difference from the average CF or RF of the initial calibration or based on % Drift or % Recovery if a linear or quadratic curve is used.

Regardless of whether a linear or non-linear calibration model is used, if initial continuing calibration verification criterion is not met, then no sample analyses may take place until the calibration has been verified or a new initial calibration is performed that meets the specifications listed in the method SOPs. If the calibration cannot be verified after the analysis of a single verification standard, then adjust the instrument operating conditions and/or perform instrument maintenance, and analyze another aliquot of the verification standard. If the calibration cannot be verified with the second standard, then a new initial calibration is performed.

- When the acceptance criteria for the continuing calibration verification are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported. Otherwise, the samples affected by the unacceptable continuing calibration verification shall be reanalyzed after a new initial calibration curve has been established, evaluated and accepted.

- When the acceptance criteria for the continuing calibration verification are exceeded low, i.e., low bias, those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise, the samples affected by the unacceptable verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted. Alternatively, a reporting limit standard may be analyzed to demonstrate that the laboratory can still support non-detects at their reporting limit. (Note: This is not permitted for Ohio EPA VAP projects.)

20.5 TENTATIVELY IDENTIFIED COMPOUNDS (TICS) – GC/MS ANALYSIS

For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by the purpose of the analyses being conducted. Data system library search routines must not use normalization routines that would misrepresent the library or unknown spectra when compared to each other.

Note: If the TIC compound is not part of the client target analyte list but is calibrated by the laboratory and is both qualitatively and/or quantitatively identifiable, it should not be reported as a TIC. If the compound is reported on the same form as true TICs, it must be qualified and/or narrated that the reported compound is qualitatively and quantitatively (if verification in control) reported compared to a known standard that is in control (where applicable). TestAmerica Knoxville will provide this service upon client request.

For example, the RCRA permit or waste delisting requirements may require the reporting of non-target analytes. Only after visual comparison of sample spectra with the nearest library searches may the analyst assign a tentative identification. See SOP KNOX-MS-0014, Tentatively Identified Compounds, for guidelines for making tentative identifications.

Note: For Ohio EPA VAP projects the laboratory may not attest under affidavit that TICs are “certified data.”

20.6 GC/MS TUNING

Prior to any GCMS analytical sequence, including calibration, the instrument parameters for the tune and subsequent sample analyses within that sequence must be set.

Prior to tuning/auto-tuning the mass spec, the parameters may be adjusted within the specifications set by the manufacturer or the analytical method. These generally don't need any adjustment but it may be required based on the current instrument performance. If the tune verification does not pass it may be necessary to clean the source or perform additional maintenance. Any maintenance is documented in the maintenance log or run log.

Table 20-1. Laboratory Instrument List

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Knoxville Instrument List

Instrument Type	Manufacturer	Model Number	Serial Number	Name	LIMS ID	Year Put into Service	Condition When Received
ICP-AES	Thermo Jarrell Ash	61E Trace	248490	ST1	ST1	1994	NEW
ICP-AES	Thermo Scientific	6500 Duo	20101714	Duo	Duo	2010	NEW
Mercury Analyzer (CVAAS)	Leeman Labs, Inc.	Hydra AA	6021	HG	HG	2006	NEW
GC/MS Semivolatiles	Hewlett-Packard	5973/6890	US00035127 (GC) US10450996 (MS)	MY	MY	2000	NEW
GC/MS Semivolatiles	Agilent Technologies	5975/6890	CN10816002 (GC) US81839504 (MS)	MP	MP	2008	NEW
GC/MS Semivolatiles	Hewlett-Packard	5973/6890	US00026427 (GC) US82321805 (MS)	MA	MA	1999	NEW
GC/MS Semivolatiles	Agilent Technologies	5973/6890	US10146146 (GC) US10451834 (MS)	MD	MD	2001	NEW
GC/MS Volatiles	Agilent Technologies	5973/6890	US10129076 (GC) US94260093 (MS)	ME	ME	2001	NEW
GC/MS Volatiles	Agilent Technologies	5975C	CN10031137 (GC) US10053001 (MS)	MR	MR	2010	NEW
GC/MS Volatiles	Agilent Technologies	5973/6890	US10506023 (GC) US44621247 (MS)	MG	MG	2005	NEW
GC/MS Volatiles	Agilent Technologies	5973/6890N	US10345111 (GC) US33220174 (MS)	MK	MK	2003	NEW
GC/MS Volatiles	Hewlett-Packard	5973/6890	DE00020254 (GC) US80310976 (MS)	MZ	MZ	1998	NEW
GC/MS Volatiles	Hewlett-Packard	5973/6890	US00021530 (GC) US80210991 (MS)	MX	MX	1998	NEW
GC/MS Volatiles	Hewlett-Packard	5973/6890	US00028390 (GC) US91911868 (MS)	MJ	MJ	2000	NEW
HRGC/HRMS	Finnigan	MAT-95/6890	2631	M1	M1D M1A	1991	NEW
HRGC/HRMS	Finnigan	MAT-95S/6890	2725	M2	M2A	1998	NEW
HRGC/HRMS	Thermo Scientific	DFS	03097	DFS	D11A	2009	NEW
HRGC/HRMS	Thermo Scientific	DFS	03190	DFS	D2A	2012	USED
Ion Chromatograph	Dionex	DX-320	00070167	Lil Mike	320	2000	NEW
Ion Chromatograph	Dionex	DX-600	02070458	Aragon	600	2002	NEW
Ion Chromatograph	Dionex	ICS-1500	03100244	1500	1500	2003	NEW
Calorimeter	Parr	Bomb Calorimeter 1266	A1126DDEA	NA	NA	2003	NEW
Furnace (Ash)	Barnstead Thermolyne Furnace	30400	1262041236063	NA	NA	2003	NEW
GPC	J2 Scientific	GPC Accuprep	05L-1179-4.0	GPC1	NA	2003	NEW
GPC	J2 Scientific	GPC Accuprep	1122-1.0	GPC2	NA	2008	USED
pH Meter	Accumet	Ab15	AB92318635	pH Meter	NA	2004	NEW
Spectrophotometer	Thermo Electron	Spectronic 20D+	3DUK270002	SPEC20	SPEC20	2007	NEW
GC-FID	Varian	3600 FID	0295	DW	DW	1998	NEW
GC-FID	Varian	3300 FID	3890	CO	CO	1987	NEW
GC-TCD	Varian	3400 TCD	3961	GR	GR	1989	NEW
GC-FID	Varian	3400 FID	4644	GTO	GTO	1987	NEW
GC-FID	Hewlett-Packard	5890 Series II	3126A36555	GX	GX	2006	USED
GC-ECD	Hewlett-Packard	6890 ECD	US00021272	GST	GST	1997	NEW
GC-ECD	Agilent Technologies	6890 ECD	US00041050	GH	GH	2001	NEW
GC-ECD	Hewlett-Packard	5890 ECD	3235A46090	GMN	MN	1986	NEW
GC-ECD	Agilent Technologies	6890 ECD	US10346012	CD	CD	2003	NEW

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Table 20-2 – Preventive Maintenance Procedures for Laboratory Equipment

Instrument/ Equipment Type	Activity	Frequency
Gas chromatograph	Check for sufficient supply of carrier and detector gases. Check for correct column flow and/or inlet pressures.	Daily – documented in runlog
	Fill solvent reservoirs	Daily – documented in runlog
	Check temperature program/instrument method.	Daily – documented in runlog
	Air analyses: Check liquid nitrogen and carrier gas levels.	Daily – documented in runlog
	Break off front portion of capillary columns. Replace column if this fails to restore column performance or when column performance (e.g. peak tailing, poor resolution, high backgrounds, etc.) indicates it is required.	As needed - documented in the instrument maintenance log
	Replace injection port liner when front portion of capillary column is removed or when breakdown exceeds limits.	As needed - documented in the instrument maintenance log
	Replace or repair flow controller if constant gas flow cannot be maintained.	As needed - documented in the instrument maintenance log
	Replace fuse.	As needed - documented in the instrument maintenance log
	Reactivate external carrier gas dryers.	As needed - documented in the instrument maintenance log
	Detectors: clean when baseline indicates contamination or when response is low. FID: clean/replace jet, replace igniter. ECD: follow manufacturers suggested maintenance schedule	As needed - documented in the instrument maintenance log
	Check inlets, septa. Replace septum.	As needed - documented in the instrument maintenance log
	Clean injector port.	As needed - documented in the instrument maintenance log
	Clip column leader.	As needed - documented in the instrument maintenance log
	Reactivate flow controller filter dryers when presence of moisture is suspected.	As needed - documented in the instrument maintenance log
	ECD: perform wipe test.	Semiannually – document in the instrument maintenance log
Ion Chromatograph	Check all lines for crimping, leaks and discoloration.	Daily – documented in runlog
	Check pump and gas pressure.	Daily – documented in runlog

Table 20-2 – Preventive Maintenance Procedures for Laboratory Equipment

Instrument/ Equipment Type	Activity	Frequency
	Clean conductivity cell.	As needed - documented in the instrument maintenance log
	Change column and guard column.	As needed - documented in the instrument maintenance log
	Change column and/or guard column bed support	As needed - documented in the instrument maintenance log
	De-gas pump head when flow is erratic.	As needed - documented in the instrument maintenance log
	Check/replace eluant end line filter.	As needed - documented in the instrument maintenance log
GC (Fixed Gases)	Check for correct column flow and/or inlet pressure	Daily – documented with successful calibration
	Check for correct carrier gas (He or Ar)	Daily – documented with successful calibration
	Check temperatures of injector, detector.	Daily – documented with successful calibration
	Verify temperature programs.	Daily – documented with successful calibration
	Check baseline level (offset)	Daily – documented with successful calibration
	Replace column.	As Needed
GC/MS (LRMS)	Check for correct column flow and/or inlet pressure.	Daily – documented with successful tune and calibration
	Check temperatures of injector, detector. Verify temperature programs.	Daily – documented with successful tune and calibration
	Check inlets, septa	Daily – documented with successful tune and calibration
	Check baseline level.	Daily – documented with successful tune and calibration
	Check relative abundance and mass assignments of the tuning compounds	Daily – documented with successful tune and calibration
	Ensure communication is established between the mass spec and the GC system.	Daily – documented with successful tune and calibration
	Check mass calibration (PFTBA or FC-43)	As needed - documented in the instrument maintenance log
	Change injection port liner.	As needed - documented in the instrument run/maintenance log
	Clip column	As needed - documented in the instrument run/maintenance log
	Replace electron multiplier when the tuning voltage approaches the maximum and/or when sensitivity falls below required level	As needed - documented in the instrument maintenance log

Table 20-2 – Preventive Maintenance Procedures for Laboratory Equipment

Instrument/ Equipment Type	Activity	Frequency
	Clean source, including lenses – the source cleaning is indicated by a variety of symptoms including inability of the analyst to tune the instrument to specifications, poor response, and high background contamination	As needed - documented in the instrument maintenance log
	Replace filaments when both filaments burn out or performance indicates need for replacement	As needed - documented in the instrument maintenance log
	Check ion source and analyzer (clean, replace parts as needed)	As needed - documented in the instrument maintenance log
	Clean air filters on GC/MS system.	As needed - documented in the instrument maintenance log
	Replace traps on Entech and Tekmar	As needed - documented in the instrument maintenance log
	Replace side plate o-ring.	As needed - documented in the instrument maintenance log
	Change inlet liners, seals and septa as needed, usually indicated by a loss of response in analytes that are sensitive to active sites or dirty parts	As needed - documented in the instrument run/maintenance log
	Check calibration vial.(PFTBA or FC-43)	As needed - documented in the instrument maintenance log
	Replace the exhaust filters on the mechanical rough pump every 1-2 years	As needed - documented in the instrument maintenance log
	Replace the diffusion pump fluid.	As needed - documented in the instrument maintenance log
	Replace the split vent trap between injection port and EPC	As needed - documented in the instrument maintenance log
	Change oil in the mechanical rough pump	Semi-annually: documented in the instrument maintenance log
ICP	Check that argon manifold gas pressure is 80 psi.	Daily – documented on chart cover page
	Check that nebulizer is not clogged.	Daily – documented on chart cover page
	Check that capillary tubing is clean and in good condition.	Daily – documented on chart cover page
	Check that peristaltic pump windings are secure.	Daily – documented on chart cover page
	Check that high voltage switch is on.	Daily – documented on chart cover page
	Check that exhaust fans are working.	Daily – documented on chart cover page
	Clean plasma torch assembly to remove accumulated deposits.	Daily – documented on chart cover page

Table 20-2 – Preventive Maintenance Procedures for Laboratory Equipment

Instrument/ Equipment Type	Activity	Frequency
	Check spray chamber O-rings	Daily – documented on chart cover page
	Clean nebulizer and drain chamber.	As needed
	Clean filters on back of power unit to remove dust.	As needed
	Replace when needed: peristaltic pump tubing sample capillary tubing autosampler sipper probe.	As needed
	Clean and lubricate autosampler arm.	As needed
	Check that cooling water supply system is full and drain bottle is not full.	As needed
	Clean air filter on water cooling system.	As needed
	Manufacturer service engineer for scheduled preventive maintenance service.	Annually
	Change vacuum pump oil on ST1	Annually
Cold Vapor Atomic Absorption (Leeman Mercury Analyzer)	Check tubing.	Daily
	Check maintenance schedule flags.	Daily
	Adjust/change Hg lamp.	As needed
	Clean or replace optical cell.	As needed
	Lubricate pump and autosampler arm.	As needed
	Change the drying tube.	As needed
GCMS HRGC/HRMS Isotope Dilution	Replace septum	As needed
	Replace injection port liner	As needed
	Perform column maintenance	As needed
	Replace carrier gas filter	As needed
	Check carrier gas pressure (record)	Weekly
	Install column (type and ID No.)	As needed
	Evaluate air spectrum, masses 28,32	Weekly
	Check tray chiller and water level.	Monthly
	Replace inlet seal.	As needed
	Clean injection port body.	As needed
	Replace interface ferrule on xfer line.	As needed
	Clean ion source	As needed
	Install clean ion volume	As needed
	Install new filament	As needed
	Replace reference gas reservoir septum (HRMS)	As needed

Table 20-2 – Preventive Maintenance Procedures for Laboratory Equipment

Instrument/ Equipment Type	Activity	Frequency
	Change mechanical pump oil	Annually
	Check coolant level and temp	As needed
	Check cooling fans	Weekly
	Check PCB seating and alignment	Biannually
	Check power supply voltages	As needed
	Check 5 volt card cage power supply (MAT 95, 95S, and 90S)	Monthly
Gel Permeation Chromatography (GPC)	Check solvent reservoir and waste container	Daily
	Check system for air bubbles	Daily
	Check all lines, valves and fittings for leaks	Daily
	Check column for dry patches, voids or channeling	Daily
	Check column pressure	Daily
	Prime sample pump several times before first injection	Daily
	Always watch first injection of ensure entire sample is loaded and there are no leaks at the injection port	Daily
	Perform flow rate check of the system	Weekly
	Verify tray calibration	Monthly
	Replace the solvent pump inlet check valve and outlet check valve	Yearly
	Replace the solvent pump seal	Yearly
	Replace the injection port seal on direct inject systems	Yearly
	Repack column with new beads when calibration does not meet QC criteria	As needed
	Do a Methanol cleaning run when column becomes extremely colored	As needed
	If separation is noticed in the column bed and plunger, push column bed back together and perform a calibration check to ensure the dump/collect windows have not changes	As needed
	Replace solvent line filters	As needed
	Replace the detector lamp	As needed
	Verify tray snap points each time trays are removed from the auto-sampler base	As needed
	Replace the syringe pump assembly	As needed
Sonicator	Tune sonicator assembly	Daily

Table 20-2 – Preventive Maintenance Procedures for Laboratory Equipment

Instrument/ Equipment Type	Activity	Frequency
	Disassemble and clean sonicator probe tips.	As Needed
	Replace probe tip.	As Needed
Calorimeter	Check O_2 tank level and change tank if low.	Daily – documented with successful calibration
	Verify temperature with external thermometer if method performance criteria cannot be consistently met.	As Needed
	Replace defective or worn parts and stems on bombs.	As Needed
	Polish bomb interior.	As Needed
Gas Chromatograph (ACS group)	Check for correct column flow and/or inlet pressure	Daily
	Check temperatures of injector, detector.	Daily
	Verify temperature programs.	Daily
	Check baseline level (offset)	Daily
	Replace sparger septum in PAT used for Method 0040	Weekly
	Replace the trap on the purge-and trap.	As Needed
	For Method 0040: Replace the carrier gas and purge gas filters.	As Needed
	Clip column ends and reinstall column	As Needed
	Replace column.	As Needed
	Clean sparger for Method 0040.	As Needed
	Re-ignite FID	As Needed
Muffle Furnace (ACS group)	Verify temperatures with platinum resistance thermometer per SOP.	Annually

Table 20-3. Periodic Calibration

Instrument/ Device	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
Analytical Balance	Accuracy determined using NIST traceable weights. Minimum of 2 standards bracketing the weight of interest.	Each day of use	Varies by balance and weight. See Balance SOP.	Clean, check level, recheck. If fails, call QA.
Top Loading Balance	Accuracy determined using NIST traceable weights. Minimum of 2 standards bracketing the weight of interest.	Each day of use	Varies by balance. See Balance SOP.	Clean, check level, recheck. If fails, call QA.
NIST Traceable Working Weights	Accuracy verified against NIST Reference Weights	Annually	See Balance and Weights SOP	Replace
NIST Reference Weights	Accuracy determined by A2LA or NVLAP accredited weights and measurement laboratory.	5 years	As per certificate.	Replace.
NIST-Traceable Reference Thermometer	Accuracy determined by approved calibration laboratory.	5 years for mercury (2 years for digital)	As per certificate.	Replace (or service digital).
Liquid in Glass Working Thermometer	Against NIST-traceable thermometer	When received and annually at appropriate temperature range for intended use	+/-0.5°C	Replace
Digital Working Thermometers	Against NIST-traceable thermometer	Quarterly	+/-0.5°C	Replace
Refrigerator	Temperature checked using NIST-traceable thermometer.	Daily.	> 0ºC and ≤ 6 ºC	Check temperature, reread, issue nonconformance, tag out, and move samples to working unit as described in SOP KNOX-QA-0010 Temperature Monitoring and Thermometer Calibration.

Instrument/ Device	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
Freezer	Temperature checked using NIST-traceable thermometer	Daily.	<-10°C <-20°C for Sediment and Tissue Samples	Check temperature, reread, issue nonconformance, tag out, and move samples to working unit as described in SOP KNOX-QA-0010 Temperature Monitoring and Thermometer Calibration.
Oven	Temperature checked using NIST-traceable thermometer.	When in use.	104 ± 1°C (% moisture) or as defined in analytical SOP	Adjust. Repair or Replace.
Volumetric Dispensing Devices (Eppendorf ® pipette, automatic volumetric or dispensing devices)	One delivery by weight. Using DI water, dispense into tared vessel. Record weight with device ID number. Volumetric dispensing devices used in support of DoD QSM require 10 replicate weighings. See SOP KNOX-QA-0012 for further details.	Quarterly	± 3% (+/-2% D for 10 replicate average)	Adjust. Repair or Replace.
Volumetric Labware (e.g. Class B volumetric glassware)	For non Class A Volumetric labware: 10 replicate weighings prior to first use. See SOP KNOX-QA-0012 for further details.	Before first use.	+/-2% D for 10 replicate average	Replace.
Non-Volumetric Labware (Non-Class A) used for measuring initial sample volume or final extract or digestate volume.	Verified by weight of DI water. Volumetric labware used in support of DoD QSM require 10 replicate weighings. See SOP KNOX-QA-0012 for further details	Once Per New Lot of Volumetric Labware	± 3%	Replace.

SECTION 21

MEASUREMENT TRACEABILITY

21.1 OVERVIEW

Traceability of measurements are assured using a system of documentation, calibration, and analysis of reference standards. Laboratory equipment that are peripheral to analysis and whose calibration is not necessarily documented in a test method analysis or by analysis of a reference standard are subject to ongoing certifications of accuracy. At a minimum, these must include procedures for checking specifications of ancillary equipment: balances, thermometers, temperature, Deionized (DI) and Reverse Osmosis (RO) water systems, automatic pipettes and other volumetric measuring devices. (Refer to Section 20.3) With the exception of Class A Glassware and Glass microliter syringes, quarterly accuracy checks are performed for all mechanical volumetric devices. Wherever possible, subsidiary or peripheral equipment is checked against standard equipment or standards that are traceable to national or international standards. Class A Glassware and Glass microliter syringes are routinely inspected for chips, acid etching or deformity (e.g., bent needle). If the Class A glassware or syringe is suspect, the accuracy of the glassware will be assessed prior to use.

21.2 NIST-TRACEABLE WEIGHTS AND THERMOMETERS

Reference standards of measurement are used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

For NIST-traceable weights and thermometers, the laboratory requires that all calibrations be conducted by a calibration laboratory accredited by A2LA, NVLAP (National Voluntary Laboratory Accreditation Program), APLAC (Asia-Pacific Laboratory Accreditation Cooperation), or EA (European Cooperation for Accreditation). A certificate and scope of accreditation is kept on file at the laboratory.

An external certified service engineer services laboratory balances on an annual basis. This service is documented on each balance with a signed and dated certification sticker. Balance calibrations are checked each day of use. All mercury thermometers are calibrated annually against a traceable reference thermometer. Temperature readings of ovens, refrigerators, and freezers are checked on each day of use.

21.3 REFERENCE STANDARDS / MATERIALS

Reference standards/materials, where commercially available, are traceable to certified reference materials. Commercially prepared reference standards, to the extent available, are purchased from vendors that are accredited to ISO Guide 34 and ISO/IEC Guide 17025. All reference standards from commercial vendors shall be accompanied with a certificate that includes at least the following information:

- Manufacturer
- Analytes or parameters calibrated
- Identification or lot number
- Calibration method

- Concentration with associated uncertainties
- Purity

If a standard cannot be purchased from a vendor that supplies a Certificate of Analysis, the purity of the standard is documented by analysis. The receipt of all reference standards must be documented. Reference standards are labeled with a unique Standard Identification Number and expiration date. All documentation received with the reference standard is retained as a QC record and references the Standard Identification Number.

All reference, primary and working standards/materials, whether commercially purchased or laboratory prepared, must be checked regularly to ensure that the variability of the standard or material from the 'true' value does not exceed method requirements. The accuracy of calibration standards is checked by comparison with a standard from a second source. In cases where a second standard manufacturer is not available, a vendor certified different lot is acceptable for use as a second source. For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst is acceptable for this comparison. The appropriate Quality Control (QC) criteria for specific standards are defined in laboratory SOPs. In most cases, the analysis of an Initial Calibration Verification (ICV) or LCS (where there is no sample preparation) is used as the second source confirmation. These checks are generally performed as an integral part of the analysis method (e.g., calibration checks, laboratory control samples).

All standards and materials must be stored and handled according to method or manufacturer's requirements in order to prevent contamination or deterioration. Refer to the Corporate Environmental Health and Safety Manual or laboratory SOPs. For safety requirements, please refer to method SOPs and the laboratory Environmental Health and Safety Manual.

Standards and reference materials shall not be used after their expiration dates unless their reliability is verified by the laboratory and their use is approved by the Quality Assurance Manager. The laboratory must have documented contingency procedures for re-verifying expired standards.

21.4 DOCUMENTATION AND LABELING OF STANDARDS, REAGENTS, AND REFERENCE MATERIALS

Reagents must be at a minimum the purity required in the test method. The date of reagent receipt and the expiration date are documented. The lots for most of the common solvents and acids are tested for acceptability prior to company wide purchase. Refer to TestAmerica's Corporate SOP No. CA-Q-S-001, Solvent and Acid Lot Testing.

All manufacturer or vendor supplied Certificates of Analysis or Purity must be retained, stored appropriately, and readily available for use and inspection. These records are maintained in the analytical laboratory. Records must be kept of the date of receipt and date of expiration of standards, reagents and reference materials. In addition, records of preparation of laboratory standards, reagents, and reference materials must be retained, stored appropriately, and be readily available for use and inspection. For detailed information on documentation and labeling, please refer to SOP KNOX-QA-0001, Standard/Reagent Labeling and Documentation.

Commercial materials purchased for preparation of calibration solutions, spike solutions, etc.., are usually accompanied with an assay certificate or the purity is noted on the label. If the assay purity is 96% or better, the weight provided by the vendor may be used without correction. If the assay purity is less than 96%, a correction is made to concentrations applied to solutions prepared from the stock commercial material. (For 1613B dioxin/furan analyses the purity must be 98% or corrections must be made.) Blended gas standard cylinders use a nominal concentration if the certified value is within +/-15%, otherwise the certified values is used for the canister concentration.

21.4.1 All standards, reagents, and reference materials must be labeled in an unambiguous manner. Standards are logged into the laboratory's LIMS system, and are assigned a unique identification number. The following information is typically recorded in the electronic database within the LIMS.

- Standard ID
- Description of Standard
- Department
- Preparer's name
- Final volume and number of vials prepared
- Solvent type and lot number
- Preparation Date
- Expiration Date
- Standard source type (stock or daughter)
- Standard type (spike, surrogate, other)
- Parent standard ID (if applicable)
- Parent Standard Analyte Concentration (if applicable)
- Parent Standard Amount used (if applicable)
- Component Analytes
- Final concentration of each analyte
- Comment box (text field)

Note: All solvents and acids are stored at ambient temperature unless otherwise specified in the SOPs.

Records are maintained electronically for standard and reference material preparation. These records show the traceability to purchased stocks or neat compounds. These records also include method of preparation, date of preparation, expiration date and preparer's name or initials. Preparation procedures are provided in the Method SOPs and as described below.

21.4.2 All standards, reagents, and reference materials must be clearly labeled with a minimum of the following information:

- Expiration Date (include prep date for reagents)
- Standard ID
- Special Health/Safety warnings if applicable (Refer to the Health and Safety Manual)

Note: Refer to SOP KNOX-QA-0001 for more details.

All containers of prepared reagents must include an expiration date and an ID number to trace back to preparation.

Procedures for preparation of reagents can be found in the Method SOPs.

Standard ID numbers must be traceable through associated logbooks, worksheets and preparation/analytical batch records.

All reagents and standards must be stored in accordance to the following priority: 1) with the manufacturer's recommendations; 2) with requirements in the specific analytical methods and 3) according to the analytical SOPs.

SECTION 22

SAMPLING

22.1 OVERVIEW

TestAmerica Knoxville does not provide sampling services. The laboratory's responsibility in the sample collection process lies in supplying the sampler with the necessary coolers, reagent water, sample containers, preservatives, sample labels, custody seals, COC forms, ice, and packing materials required to properly preserve, pack, and ship samples to the laboratory. TestAmerica Knoxville also provides pre-cleaned sampling media for sample collection (e.g. source emission testing air sampling media).

22.2 SAMPLING CONTAINERS

The laboratory offers clean sampling containers for use by clients. The laboratory purchases clean containers from ESS and I-Chem (ESS QC class and I-Chem 300 Series containers). Certificates of cleanliness for bottles and preservatives are provided by the supplier and maintained at the laboratory. Alternatively, the certificates may be maintained by the supplier and available to the laboratory on-line.

22.2.1 Preservatives

Upon request, preservatives are provided to the client in pre-cleaned sampling containers. In some cases containers are purchased pre-preserved from the container supplier. Whether prepared by the laboratory or bought pre-preserved, the grades of the preservatives are at a minimum:

- Hydrochloric Acid – Reagent ACS (Certified VOA Free) or equivalent
- Methanol – Purge and Trap grade (for Volatiles with TerraCore)
- Nitric Acid – Instra-Analyzed or equivalent
- Sodium Bisulfate – ACS Grade or equivalent (for Volatiles with TerraCore)
- Sodium Hydroxide – Instra-Analyzed or equivalent
- Sulfuric Acid – Instra-Analyzed or equivalent

22.3 DEFINITION OF HOLDING TIME

The date and time of sampling documented on the COC form establishes the day and time zero. As a general rule, when the maximum allowable holding time is expressed in "days" (e.g., 14 days, 28 days), the holding time is based on calendar day measured. Holding times expressed in "hours" (e.g., 6 hours, 24 hours, etc.) are measured from date and time zero. The first day of holding time ends twenty-four hours after sampling. Holding times for analysis include any necessary reanalysis.

22.3.1 Semi-Volatile - Holding times for sample preparation for semi-volatile organics are measured from the sampling date until the day solvent contacts the sample. Holding times for analysis are measured from the date of initiation of extraction to the date of injection into the gas chromatograph.

22.3.2 Volatiles - Holding times for volatile organics are measured from the date (and time where applicable) of sampling to the date of injection into the gas chromatograph. Holding times for Encore preservation of volatiles samples is measured from the date and time of sampling to the date and time of sample preservation.

22.3.3 Inorganics - For inorganic and metals analysis, the preparation/digestion/distillation must be started within the maximum holding time as measured from the sampling date (and time where applicable). TestAmerica Knoxville measures the holding time for inorganics from sampling date (and time where applicable) to analysis date (and time where applicable).

22.4 SAMPLING CONTAINERS, PRESERVATION REQUIREMENTS, HOLDING TIMES

The preservation and holding time criteria specified in the following tables are derived from the source documents for the methods. If method required holding times (refer to Tables 22-1 to 22-6) -or preservation requirements are not met, the reports are qualified using a flag, footnote or case narrative. As soon as possible or “ASAP” is an EPA designation for tests for which rapid analysis is advised, but for which neither EPA nor the laboratory have a basis for a holding time.

22.5 SAMPLE ALIQUOTS / SUBSAMPLING

Taking a representative sub-sample from a container is necessary to ensure that the analytical results are representative of the sample collected in the field. The size of the sample container, the quantity of sample fitted within the container, and the homogeneity of the sample need consideration when sub-sampling for sample preparation. It is the laboratory’s responsibility to take a representative subsample or aliquot of the sample provided for analysis.

Analysts must handle each sample as if it is potentially dangerous. At a minimum, safety glasses, gloves, and lab coats must be worn when preparing aliquots for analysis.

Refer to SOP KNOX-QA-0006, Subsampling, for details on the procedures to obtain representative subsamples for analysis from the samples submitted by the client.

Tables 22-1 to 22-6 detail holding times, preservation and container requirements, and sample volumes for SDWA and NPDES methods. The sample volumes are intended to be a minimal amount to perform the method, the containers that are used may be of larger size. ***Please Note:*** *the holding times are program specific and different programs may have different holding times for equivalent methods (e.g., there are differences in Holding times for many Organic analytes between SDWA and NPDES. RCRA methods may also be different).*

Table 22-1.
Holding Times, Preservation and Container Requirements: Drinking Water (SDWA)

PARAMETER	CONTAINER	PRESERVATION[1,2] Temp.[6]	Chemical	HOLDING TIME[3]	SAMPLE VOLUME
Nitrate	Plastic/Glass	4ºC	None	48 hours[4]	250 mL
Dioxin	Glass[5]	4ºC	$Na_2S_2O_3$	1 year	1 L

Key to Table

1. Sample preservation should be performed immediately upon sample collection. For composite chemical samples, each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.
2. When any sample is to be shipped by common carrier or sent through the United States mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring compliance. For the preservation requirements of Table 6-8, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid, (HCl) in water, solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).
3. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Holding Times are determined from time of collection to time of analysis.
4. If the sample is chlorinated, the holding time for an un-acidified sample kept at 4°C is extended to 14 days.
5. With Teflon lined septum.
6. For samples with a temperature requirement of 4°C, a sample temperature of just above the water freezing temperature to < 6°C is acceptable.

Table 22-2
Holding Times, Preservation and Container Requirements: NPDES - Inorganic

PARAMETER	CONTAINER [1]	PRESERVATION[2,3] Temp[10].	Chemical	HOLDING TIME[4]	SAMPLE VOLUME
Boron	Plastic[5]	None	HNO_3 to pH<2	6 months	200 mL
Bromide	Plastic/Glass	None	None	28 days	100 mL
Chloride	Plastic/Glass	None	None	28 days	50 mL
Fluoride	Plastic	None	None	28 days	300 mL
Hardness	Plastic/Glass	None	HNO_3 to pH<2[7]	6 months	100 mL
Hydrogen Ion (pH)	Plastic/Glass	None	None	15 min.[6]	200 mL
Mercury	Plastic/Glass	None	HNO_3 to pH<2	28 days	200 mL
Metals[8,9]	Plastic/Glass	None	HNO_3 to pH<2[11]	6 months	200 mL
Nitrate	Plastic/Glass	≤ 6ºC	None	48 hours	100 mL
Nitrate-Nitrite	Plastic/Glass	≤ 6ºC	H_2SO_4 to pH <2	28 days	100 mL
Nitrite	Plastic/Glass	≤ 6ºC	None	48 hours	100 mL
Orthophosphate	Plastic/Glass	≤ 6ºC	Filter within 15 min.	48 hours	250 mL
Sulfate	Plastic/Glass	≤ 6ºC	None	28 days	250 mL

Key to Table

1. Plastic should be Polyethylene.
2. Sample preservation should be performed immediately upon sample collection. For composite chemical samples, each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at ≤ 6ºC until compositing and sample splitting is completed.
3. When any sample is to be shipped by common carrier or sent through the United States mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring compliance. For the preservation requirements of Table 6-8, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid, (HCl) in water, solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).
4. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Holding Times are determined from time of collection to time of analysis.
5. May also be collected in quartz or PFTE Plastic.
6. For compliance testing, the analysis must be performed in the field at the time of analysis. If transported to the laboratory for analysis, the analysis will be performed as soon as practical and reported qualified.
7. H_2SO_4 to a pH <2 is also acceptable.
8. Except Mercury and Hexavalent Chromium.
9. For dissolved metals, samples must be filtered on site before adding HNO_3 preservative (or before

Key to Table

shipping to laboratory).

10. Aqueous samples must be preserved at ≤6 °C unless otherwise indicated, and should not be frozen unless data demonstrating that sample freezing does not adversely impact sample integrity is maintained on file and accepted as valid by the regulatory authority. Also, for purposes of NPDES monitoring, the specification of ‘‘≤ °C’’ is used in place of the ‘‘4 °C’’ and ‘‘<4 °C’’ sample temperature requirements listed in some methods.

11 Acid preservation may be omitted for shipping and laboratory will acidify at least 24 hours prior to analysis.

Table 22-3
Holding Times, Preservation and Container Requirements: NPDES - Organic

PARAMETER	CONTAINER	PRESERVATION[1,2] Temp.[7]	PRESERVATION[1,2] Chemical	HOLDING TIME[3]	SAMPLE VOLUME
CDD/CDFs[6] – Aqueous: Field/Lab Preservation	Glass	≤ 6ºC	pH <9, 0.008 % $Na_2S_2O_3$[5]	1 year	1 L
CDD/CDFs[6] – Solids/Mixed Phase/ - Field Preservation	Glass	≤ 6ºC	None	7 days[8]	10 grams/1 L
CDD/CDFs[6] – Tissue – Field Preservation	Glass	≤ 6ºC	None	24 hours[8]	10 grams
CDD/CDFs[6] – Solids/Mixed Phase/Tissue - Lab Preservation	Glass	< -10ºC	None	1 year	10 grams/1 L
Polychlorinated Biphenyls (PCB Congeners): Aqueous: Field/Lab Preservation[9]	Glass	≤ 6ºC	0.008 % $Na_2S_2O_3$[5]	1 year	1 L
Polychlorinated Biphenyls (PCB Congeners): Solid/Mixed Phase– Field Preservation[9]	Glass	≤ 6ºC	None	1 year	10 grams/1 L
Polychlorinated Biphenyls (PCB Congeners): Tissue- Field Preservation[9]	Glass	≤ 6ºC	None	24 hours[8]	10 grams
Polychlorinated Biphenyls (PCB Congeners): Solid/Mixed Phase/Tissue – Lab Preservation[9]	Glass	< -10ºC	None	1 year	10 grams/1 L

Key to Table

1. Sample preservation should be performed immediately upon sample collection. For composite chemical samples, each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at ≤ 6°C until compositing and sample splitting is completed.
2. When any sample is to be shipped by common carrier or sent through the United States mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring compliance. For the preservation requirements of Table 6-8, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid, (HCl) in water, solutions at concentrations of 0.04% by

Key to Table

weight or less (pH about 1.96 or greater); Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

3. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Holding Times are determined from time of collection to time of analysis (See also Footnote 8).
4. With Teflon lined septum.
5. Should only be used in the presence of residual chlorine. Ascorbic may be used instead.
6. When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity. When the analytes of concern fall within two or more categories, the sample may be preserved by cooling to $\leq 6^{o}C$ reducing residual chlorine with 0.0008 % sodium thiosulfate, storing in the dark, and adjusting the pH to 6-9. Samples preserved in this manner may be held for 7 days before extraction and for 40 days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (re the requirement for thiosulfate reduction of residual chlorine) and footnotes 10 and 11(re the analysis of Benzidine).
7. Aqueous samples must be preserved at ≤6 °C unless otherwise indicated, and should not be frozen unless data demonstrating that sample freezing does not adversely impact sample integrity is maintained on file and accepted as valid by the regulatory authority. Also, for purposes of NPDES monitoring, the specification of ''≤ °C'' is used in place of the ''4 °C'' and ''<4 °C'' sample temperature requirements listed in some methods.

8 Holding time from sampling field preservation at <6ºC to time of preservation at <-10ºC.

9 Polychlorinated biphenyls (PCB congeners) are in the proposed 40CFR Part 136 Rule September 23, 2010.

Table 22-4.
Holding Times, Preservation and Container Requirements: RCRA - Aqueous

PARAMETER	CONTAINER [1]	PRESERVATION[2,3] Temp.[9]	Chemical	HOLDING TIME[4]	SAMPLE VOLUME
Chloride	Plastic/Glass	4ºC	None	28 days	100 mL
Hydrogen Ion (pH)	Plastic/Glass	4ºC	None	24 hours[8]	100 mL
Nitrate	Plastic/Glass	4ºC	None	48 hours	28 days
Sulfate	Plastic/Glass	4ºC	None	28 days	400 mL
Mercury	Plastic/Glass	None	HNO_3 to pH<2	28 days	250 mL
Other Metals	Plastic/Glass	None	HNO_3 to pH<2	6 months	250 mL
Acrolein and Acrylonitrile	Glass[7]	4ºC	0.0008 % Na2S2O3[5] Adjust pH to 4-5[10]	14 days	1 L
Benzidines	Glass[7]	4ºC	0.0008 % $Na_2S_2O_3$[5]	7 days[6]	1 L
Chlorinated Hydrocarbons	Glass[7]	4ºC	0.0008 % $Na_2S_2O_3$[5]	7 days[6]	1 L
Dioxins and Furans	Glass[7]	4ºC	0.0008 % $Na_2S_2O_3$[5]	30 days[6]	1 L
Haloethers	Glass[7]	4ºC	0.0008 % $Na_2S_2O_3$[5]	7 days[6]	1 L
Nitroaromatics and cyclic ketones	Glass[7]	4ºC	0.0008 % $Na_2S_2O_3$[5], store in dark	7 days[6]	1 L
Nitrosamines	Glass[7]	4ºC	0.0008 % $Na_2S_2O_3$[5], store in dark	7 days[6]	1 L
PCBs	Glass[7]	4ºC	None	1 year[6]	1 L
Phenols	Glass[7]	4ºC	0.0008 % $Na_2S_2O_3$[5]	7 days[6]	1 L
Phthalate Esters	Glass[7]	4ºC	None	7 days[6]	1 L
Polynuclear Aromatic Hydrocarbons	Glass[7]	4ºC	0.0008 % $Na_2S_2O_3$[5], store in dark	7 days[6]	1 L
Purgeable Hydrocarbons	Glass[7]	4ºC	0.0008 % $Na_2S_2O_3$[5] Adjust pH <2[2]	14 days	40 mL
Purgeable Halocarbons	Glass[7]	4ºC	0.0008 % $Na_2S_2O_3$[5]	14 days	40 mL

Key to Table

1. Plastic should be Polyethylene.
2. Sample preservation should be performed immediately upon sample collection. For composite chemical samples, each aliquot should be preserved at the time of collection. When use of an automated sampler

Key to Table

makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.

3. When any sample is to be shipped by common carrier or sent through the United States mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring compliance. For the preservation requirements of Table 6-8, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid, (HCl) in water, solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).
4. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Holding Times are determined from time of collection to time of preparation (or to time of analysis if there is no separate preparation step).
5. Free Chlorine must be removed by the appropriate addition of $Na_2S_2O_3$.
6. 7 days to extraction. 40 days from extraction to analysis. For Dioxins/Furans: 30 days to extraction 45 days from extraction to analysis. For PCBs, no holding time is specified in SW-846 Chapter 4.
7. With Teflon lined septum.
8. Holding Time is listed as “As Soon as Possible” in SW 846. Per EPA MICE, the recommended maximum holding time for pH in water is 24 hours and pH in soil is 7 days. There are no mandated regulatory requirements.
9. For samples with a temperature requirement of 4°C, a sample temperature of just above the water freezing temperature to $\leq$ 6°C is acceptable.
10 Based on guidance from EPA MICE, if samples are received without pH adjustment, the holding time is 7 days.

Table 22-5.
Holding Times, Preservation and Container Requirements: RCRA – Non-Aqueous

PARAMETER	CONTAINER [1]	PRESERVATION Temp.[7]	PRESERVATION Chemical	HOLDING TIME[2]	SAMPLE WEIGHT
Chloride	Glass	4ºC	None	28 days	50 g
Hydrogen Ion (pH)	Glass	4ºC	None	7 days[6]	50 g
Nitrate	Glass	4ºC	None	N/A	50 g
Mercury	Plastic/Glass	4ºC	None	28 days	50 g
Other Metals	Plastic/Glass	None	None	6 months	50 g
Acrolein and Acrylonitrile	Glass[4]	4ºC	None	14 days	50 g
Benzidines	Glass[4]	4ºC	None	14 days[3]	50 g
Chlorinated Hydrocarbons	Glass[4]	4ºC	None	14 days[3]	50 g
Dioxins and Furans	Glass[4]	4ºC	None	30 days[3]	50 g
Haloethers	Glass[4]	4ºC	None	14 days[3]	50 g
Nitroaromatics and cyclic ketones	Glass[4]	4ºC	None	14 days[3]	50 g
Nitrosamines	Glass[4]	4ºC	None	14 days[3]	50 g
PCBs	Glass[4]	4ºC	None	1 year[3]	50 g
Phenols	Glass[4]	4ºC	None	14 days[3]	50 g
Phthalate Esters	Glass[4]	4ºC	None	14 days[3]	50 g
Polynuclear Aromatic Hydrocarbons	Glass[4]	4ºC	None	14 days[3]	50 g
Purgeable Hydrocarbons	Glass[4]	4ºC	None	14 days[5]	50 g
Purgeable Halocarbons	Glass[4]	4ºC	None	14 days[5]	50 g

Key to Table

1. Plastic should be Polyethylene.
2. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid.
3. 14 days to extraction. 40 days from extraction to analysis. For Dioxins/Furans (Method 8290) in Matrices other than tissue: 30 days to extraction 45 days from extraction to analysis. For Dioxins/Furans (Method 8290) in Tissue: 30 days to extraction 45 days from collection to analysis. Holding Times are determined from time of collection to time of preparation (or to time of analysis if there is no separate preparation

step). For PCBs, no holding time is specified in SW-846 Chapter 4.

4. With Teflon Lined Septum
5. See Volatile SOP for more detailed preservation requirements.
6. Holding Time is listed as “As Soon as Possible” in SW 846. Per EPA MICE, the recommended maximum holding time for pH in water is 24 hours and pH in soil is 7 days. There are no mandated regulatory requirements.
7. For samples with a temperature requirement of $4^{o}C$, a sample temperature of just above the water freezing temperature to $\leq 6^{o}C$ is acceptable.

Table 22-6.
Holding Times, Preservation and Container Requirements: Air Samples[1]

PARAMETER	CONTAINER	PRESERVATION Temp.	PRESERVATION Chemical	HOLDING TIME[2]	SAMPLE WEIGHT
Volatile Organics (TO-15, TO-14A)	Summa Canister	None	None	30 days	6L or 1L
Volatile Organics (TO-15, TO-14A)	Tedlar Bag	None	None	72 hrs[3,4]	1 L
Polynuclear Aromatic Hydrocarbons (TO-13A)	PUF/XAD	4ºC[5]	None	7 days[6]	N/A
Organochlorine Pesticides/PCBs (TO-4A)	PUF/XAD	4ºC[5]	None	7 days[6]	N/A
Dioxins/Furans (TO-9A)	PUF/XAD	4ºC[5]	None	7 days[6]	N/A

Key to Table

1. For details on Source Air Emission Holding Times, Containers, and Preservation please contact the laboratory for method specific information.
2. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Holding Times are determined from time of collection to time of preparation (or to time of analysis if there is no separate preparation step).
3. Holding Time is based on SW 846 Method 0040 "SAMPLING OF PRINCIPAL ORGANIC HAZARDOUS CONSTITUENTS FROM COMBUSTION SOURCES USING TEDLAR® BAGS". Some states specifically enforce this holding time (e.g. Florida, New Jersey) and others have not specified this information in their regulatory requirements.
4. The holding time is 72 hours unless the laboratory has a documented validation study that indicates a longer HT is acceptable for the analytes of interest. Alternatively, the sample may be transferred into a Summa Canister within 72 hours.

5 For samples with a temperature requirement of 4°C, a sample temperature of just above the water freezing temperature to $\leq$ 6°C is acceptable.

6 7 days from collection to extraction, 40 days from extraction to analysis.

SECTION 23

HANDLING OF SAMPLES

Sample management procedures at the laboratory ensure that sample integrity and custody are maintained and documented from sampling/receipt through disposal.

23.1 CHAIN OF CUSTODY (COC)

The COC form is the written documented history of any sample and is initiated at the time of sampling. This form is completed by the sampling personnel and accompanies the samples to the laboratory where it is received and stored under the laboratory's custody. The purpose of the COC form is to provide a legal written record of the handling of samples from the time of collection until they are received at the laboratory. It also serves as the primary written request for analyses from the client to the laboratory. The COC form acts as a purchase order for analytical services when no other contractual agreement is in effect. An example of a COC form is found in Figure 23-1.

23.1.1 Field Documentation

The information the sampler needs to provide at the time of sampling on the container label is:

- Sample identification
- Date and time
- Preservative

During the sampling process, the COC form is completed and must be legible (see Figure 23-1). This form includes information such as:

- Client name, address, phone number and fax number (if available)
- Project name and/or number
- The sample identification
- Date, time and location of sampling
- Sample collectors name
- The matrix description
- The container description
- The total number of each type of container
- Preservatives used
- Analysis requested
- Requested turnaround time (TAT)
- Any special instructions
- Purchase Order number or billing information (e.g. quote number) if available
- The date and time that each person received or relinquished the sample(s), including their signed name.

When the sampling personnel deliver the samples directly to TestAmerica personnel, the samples are stored in a cooler with ice, as applicable, and remain solely in the possession of the client's field technician until the samples are delivered to the laboratory. The sample collector must assure that each container is in his/her physical possession or in his/her view at all times, or stored in such a place and manner to preclude tampering. The field technician relinquishes the samples in writing on the COC form to the sample receiving personnel at the laboratory or to a TestAmerica courier. When sampling personnel deliver the samples through a common carrier (Fed-Ex, UPS), the COC relinquished date/time is completed by the field personnel and samples are released to the carrier. Samples are only considered to be received by lab when personnel at the fixed laboratory facility have physical contact with the samples.

Note: Independent couriers are not required to sign the COC form.

23.1.2 Legal / Evidentiary Chain-of-Custody

TestAmerica Knoxville provides internal sample chain-of-custody tracking. However, it does not provide chain-of-custody evidence for samples identified for legal/evidentiary purposes as defined by the 2003 NELAC Standard Section 5.4.12.

23.2 SAMPLE RECEIPT

Per State and/or Federal Regulation, the client is responsible to ensure that samples are shipped in accordance with DOT/IATA requirements, and that radioactive materials may only be delivered to licensed facilities. Any samples containing (or suspected to contain) Source, Byproduct, or Special Nuclear Material as defined by 10 CFR should be delivered directly to facilities licensed to handle such radioactive material. Natural material or ores containing naturally occurring radionuclides may be delivered to any TestAmerica facility or courier as long as the activity concentration of the material does not exceed 270 pCi/g alpha or 2700 pCi/g beta (49 CFR Part 173).

Samples are received at the laboratory by designated sample receiving personnel and a unique laboratory project identification number is assigned. Each sample container is assigned a unique sample identification number that is cross-referenced to the client identification number such that traceability of test samples is unambiguous and documented. Each sample container is affixed with a durable sample identification label. Sample acceptance, receipt, tracking and storage procedures are summarized in the following sections.

23.2.1 Laboratory Receipt

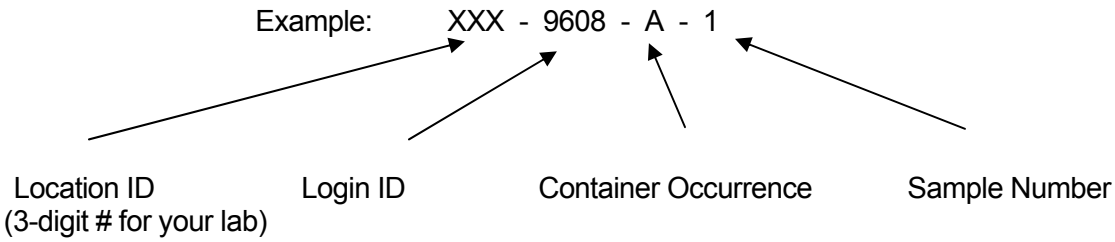
When samples arrive at the laboratory, sample receiving personnel inspect the coolers and samples. The integrity of each sample must be determined by comparing sample labels or tags with the COC and by visual checks of the container for possible damage. Any non-conformance, irregularity, or compromised sample receipt must be documented on a Condition Upon Receipt Variance Form (See Example form in Figure 23-3). Details on the receipt of samples are found in SOP KNOX-SC-0003, Sample Receipt and Log-in.

Note: North Carolina requires that they be notified when samples are processed that do not meet sample acceptance criteria.

23.2.1.1 Unique Sample Identification

All samples that are processed through the laboratory receive a unique sample identification to ensure that there can be no confusion regarding the identity of such samples at anytime. This system includes identification for all samples, subsamples and subsequent extracts and/or digestates.

The laboratory assigns a unique identification (e.g., Sample ID\) code to each sample container received at the laboratory. This Primary ID is made up of the following information (consisting of 4 components):



The above example states that TestAmerica <location> Laboratory (Location XXX). Login ID is 9608 (unique to a particular client/job occurrence). The container code indicates it is the first container ("A") of Sample #1.

If the primary container goes through a prep step that creates a "new" container, then the new container is considered secondary and gets another ID. An example of this being a client sample in a 1-Liter amber bottle is sent through a Liquid/Liquid Extraction and an extraction vial is created from this step. The vial would be a SECONDARY container. The secondary ID has 5 components.

Example: XXX - 9608 - A - 1 - **A** ← **Secondary Container Occurrence**

Example: 140-9608-A-1-A, would indicate the PRIMARY container listed above that went through a step that created the 1st occurrence of a Secondary container.

With this system, a client sample can literally be tracked throughout the laboratory in every step from receipt to disposal

23.3 SAMPLE ACCEPTANCE POLICY

The laboratory has a written sample acceptance policy (Figure 23-2) that clearly outlines the circumstances under which samples are accepted or rejected. These include:

1 a COC filled out completely;
2 samples must be properly labeled;
3 proper sample containers with adequate volume for the analysis and necessary QC;
4 samples must be preserved according to the requirements of the requested analytical method;

5 sample holding times must be adhered to;

6 the client is notified if any sample is received in damaged condition.

Data from samples which do not meet these criteria are flagged and the nature of the variation from policy is defined.

23.4 SAMPLE STORAGE

In order to avoid deterioration, contamination or damage to a sample during storage and handling, from the time of receipt until all analyses are complete, samples are stored in refrigerators, freezers or protected locations suitable for the sample matrix. Samples for methods that do not require refrigeration (e.g., aqueous samples for ICP metals analysis) are stored on shelves at ambient temperature. In addition, samples to be analyzed for volatile organic parameters are stored in separate refrigerators designated for volatile organic parameters only. Samples are never to be stored with reagents, standards or materials that may create contamination.

To ensure the integrity of the samples during storage, refrigerator blanks are maintained in the volatile sample refrigerators and analyzed every two weeks.

Laboratory Analysts retrieve the sample container(s) allocated to their analysis from the designated storage location, analyze the sample, and return the remaining sample to the storage location from which it originally came. Residual samples are maintained in the designated storage location until disposal at least thirty days after the report is issued. (Exception: TO-14A or TO-15 canister samples are subject to disposal two days after the report is issued.) Special arrangements are made to store samples for longer periods of time.

Access to the laboratory is controlled such that sample storage need not be locked at all times unless a project specifically demands it. Samples are accessible to laboratory personnel only. Visitors to the laboratory are prohibited from entering the refrigerator and laboratory areas unless accompanied by an employee of TestAmerica.

23.5 HAZARDOUS SAMPLES AND FOREIGN SOILS

All samples are assumed to be hazardous. All samples are either returned to the client or disposed of appropriately through a hazardous waste disposal firm. All soil samples are sent out for incineration by a USDA-approved waste disposal facility.

23.6 SAMPLE SHIPPING

In the event that the laboratory needs to ship samples, the samples are placed in a cooler with enough ice to ensure the samples remain just above freezing and at or below 6.0°C during transit. The samples are carefully surrounded by packing material to avoid breakage (yet maintain appropriate temperature). A trip blank is enclosed for those samples requiring water/solid volatile organic analyses. The chain-of-custody form is signed by the sample control technician and attached to the shipping paperwork. Samples are generally shipped overnight express or hand-delivered by a TestAmerica courier to maintain sample integrity. All personnel involved with shipping and receiving samples must be trained to maintain the proper chain-of-

custody documentation and to keep the samples intact and on ice. The Environmental, Health and Safety Manual contains additional shipping requirements.

Note: If a client does not request trip blank analysis on the COC or other paperwork, the laboratory will not analyze the trip blanks that were supplied. However, in the interest of good client service, the laboratory will advise the client at the time of sample receipt that it was noted that they did not request analysis of the trip blank; and that the laboratory is providing the notification to verify that they are not inadvertently omitting a key part of regulatory compliance testing.

23.7 SAMPLE DISPOSAL

Samples should be retained for a minimum of 30 days after the project report is sent, however, provisions may be made for earlier disposal of samples once the holding time is exceeded. Some samples are required to be held for longer periods based on regulatory or client requirements (e.g., 60 days after project report is sent). The laboratory must follow the longer sample retention requirements where required by regulation or client agreement. Several possibilities for sample disposal exist: the sample may be consumed completely during analysis, the sample may be returned to the customer or location of sampling for disposal, or the sample may be disposed of in accordance with the laboratory's waste disposal procedures (SOP: KNOX-SC-0005, Sample Disposal Return and Archive). All procedures in the laboratory Environmental, Health and Safety Manual are followed during disposal. Samples are normally maintained in the laboratory no longer than two months from receipt unless otherwise requested. Unused portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work. Waste disposal complies with all federal and state laws and regulations.

Figure 23-1. Example: Chain of Custody (COC)

TestAmerica Knoxville
5815 Middlebrook Pike
Knoxville, TN 37921
phone 865-291-3000

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager:**	**Site Contact:**	**Date:**	COC No:
Company Name	**Tel/Fax:**	**Lab Contact:**	**Carrier:**	_____ of _____ COCs
Address	**Analysis Turnaround Time**			Job No.
City/State/Zip	Calendar (C) or Work Days (W) _____			
Phone	TAT if different from Below _____			
Project Name:	☐ 2 weeks			SDG No.
Site:	☐ 1 week			
P O #	☐ 2 days			
Sampler Name:	☐ 1 day			

Sample Identification	**Sample Date**	**Sample Time**	**Sample Type**	**Matrix**	**# of Cont.**	**Filtered Sample**	Sample Specific Notes:

Preservation Used: 1= Ice, 2= HCl; 3= H_2SO_4; 4=HNO_3; 5=NaOH; 6= Other _____

Possible Hazard Identification

☐ *Non-Hazard* ☐ *Flammable* ☐ *Skin Irritant* ☐ *Poison B* ☐ *Unknown*

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ *Return To Client* ☐ *Disposal By Lab* ☐ *Archive For _____ Months*

Special Instructions/QC Requirements & Comments:

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:

Figure 23-2. Example: Sample Acceptance Policy

NELAC specifies requirements under which any NELAC accredited laboratory will accept or reject samples. TestAmerica Knoxville will review your sample shipment against those requirements listed below, and will communicate any discrepancies to you. Your project manager will assist you in the appropriate resolution of any issues related to sample receipt. Please contact your project manager with any questions.

When completing the chain of custody form, please do not forget to sign your name in the "relinquished by" box.

NELAC requirements are as follows:

- Proper, full and complete documentation, which includes sample identification, the location, date and time of collection, the collector's name, the preservation type, the sample matrix type, the requested testing method, and any special remarks concerning the samples shall be provided. (Chain of Custody filled out properly)

- Each sample shall be labeled with unique, durable and indelible identification, (See note below regarding SUMMA canisters and VOST tubes).

- The samples shall be collected in the appropriate sample containers.

- The samples shall arrive at the laboratory within the specified holding time for the analyses requested.

- Sufficient sample volume must be available to perform the requested analyses and associated quality control.

- All samples submitted for water/solid Volatile Organic analyses must have a Trip Blank submitted at the same time

- The laboratory will notify the client upon sample receipt if the samples exhibit obvious signs of damage, contamination or inadequate preservation. Also, if there is a breach in the chain-of-custody associated with the sample(s), the client will be notified to determine the disposition of the samples.

- Samples shall be rejected if they are received in broken containers or if they exceed the laboratory radiological license limits. The client will be notified to determine the disposition of the samples.

NOTE: Never affix a label directly on a SUMMA canister. A special tag is attached to each canister for this purpose. Never place a label on a VOST tube; use the external container for labeling.

NOTE: Canisters and flow controllers must be returned even if they were not used. Sampling equipment that is lost or not returned will be invoiced to the client at the replacement costs.

Figure 23-3. Example: Condition Upon Receipt Form

Return to Forms Navigator

TESTAMERICA KNOXVILLE SAMPLE RECEIPT/CONDITION UPON RECEIPT ANOMALY CHECKLIST **Log In Number:**

Review Items	Yes	No	NA	If No, what was the problem?	Comments/Actions Taken
1. Are the shipping containers intact?				☐ **Containers, Broken**	
2. Were ambient air containers received intact?				☐ Checked in lab	
3. The coolers/containers custody seal if present, is it intact?				☐ Yes ☐ NA	
4. Is the cooler temperature within limits? (> freezing temp. of water to 6 °C, VOST: 10°C) Thermometer ID :_____ Correction factor: _____				☐ **Cooler Out of Temp, Client Contacted, Proceed/Cancel** ☐ **Cooler Out of Temp, Same Day Receipt**	
5. Were all of the sample containers received intact?				☐ **Containers, Broken**	
6. Were samples received in appropriate containers?				☐ **Containers, Improper; Client Contacted; Proceed/Cancel**	
7. Do sample container labels match COC? (IDs, Dates, Times)				☐ **COC & Samples Do Not Match** ☐ **COC Incorrect/Incomplete** ☐ **COC Not Received**	
8. Were all of the samples listed on the COC received?				☐ **Sample Received, Not on COC** ☐ **Sample on COC, Not Received**	
9. Is the date/time of sample collection noted?				☐ **COC; No Date/Time; Client Contacted**	
10. Was the sampler identified on the COC?				☐ **Sampler Not Listed on COC**	**Labeling Verified by:** **Date:**
11. Is the client and project name/# identified?				☐ **COC Incorrect/Incomplete**	
12. Are tests/parameters listed for each sample?				☐ **COC No tests on COC**	**pH test strip lot number:**
13. Is the matrix of the samples noted?				☐ **COC Incorrect/Incomplete**	
14. Was COC relinquished? (Signed/Dated/Timed)				☐ **COC Incorrect/Incomplete**	
15. Were samples received within holding time?				☐ **Holding Time - Receipt**	
16. Were samples received with correct chemical preservative (excluding Encore)?				☐ **pH Adjusted, pH Included (See box 16A)** ☐ **Incorrect Preservative**	
17. Were VOA samples received without headspace?				☐ **Headspace (VOA only)**	
18. Did you check for residual chlorine, if necessary? (e.g. 1613B, 1668) Chlorine test strip lot number:_____				☐ **Residual Chlorine**	
19. For 1613B water samples is pH<9?				☐ If no, lab will adjust	
20. For rad samples was sample activity info. Provided?				☐ Project missing info	

Box 16A: pH Preservation	Box 18A: Residual Chlorine
Preservative:	
Lot Number:	
Exp Date:	
Analyst:	
Date:	
Time:	

Project #: _____ PM Instructions: _____

Sample Receiving Associate: _____ Date: _____ QA026R30.doc, 080916

Section 24

ASSURING THE QUALITY OF TEST RESULTS

24.1 OVERVIEW

In order to assure our clients of the validity of their data, the laboratory continuously evaluates the quality of the analytical process. The analytical process is controlled not only by instrument calibration as discussed in Section 20, but also by routine process quality control measurements (e.g. Method Blanks, Laboratory Control Samples (LCS), Matrix Spikes (MS), duplicates (DUP), surrogates, Internal Standards (IS)). These quality control checks are performed as required by the method or regulations to assess precision and accuracy. In addition to the routine process quality control samples, Proficiency Testing (PT) Samples (concentrations unknown to laboratory) are analyzed to help ensure laboratory performance.

24.2 CONTROLS

Sample preparation or pre-treatment is commonly required before analysis. Typical preparation steps include homogenization, solvent extraction, sonication, acid digestion, distillation, evaporation, drying and ashing. During these pre-treatment steps, samples are arranged into discrete manageable groups referred to as preparation (prep) batches. Prep batches provide a means to control variability in sample treatment. Control samples are added to each prep batch to monitor method performance and are processed through the entire analytical procedure with investigative/field samples. Refer to the analytical SOPs for further information regarding the type, frequency and acceptance criteria for the control samples.

24.3 NEGATIVE CONTROLS

Table 24-1. Example – Negative Controls

Control Type	Details
Method Blank (MB)	Are used to assess preparation and analysis for possible contamination during the preparation and processing steps.
	The specific frequency of use for method blanks during the analytical sequence is defined in the specific standard operating procedure for each analysis. Generally it is 1 for each batch of samples; not to exceed 20 environmental samples.
	The method blank is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (e.g., Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The method blank goes through all of the steps of the process (including as necessary: filtration, clean-ups, etc.).
	Reanalyze or qualify associated sample results when the concentration of a targeted analyte in the method blank is at or above the reporting limit as established by the method or by regulation, AND is greater than 1/10 of the amount measured in the sample. (Ohio VAP method blanks must be <RL)
Calibration Blanks	Are prepared and analyzed along with calibration standards where applicable or injected at specified frequencies throughout an analytical sequence.. They are prepared using the same reagents that are used to prepare the standards. In some analyses the calibration blank is included in the calibration curve. These blanks are termed Initial Calibration Blanks (ICB) or Continuing Calibration Blanks (CCB)

Table 24-1. Example – Negative Controls

Control Type	Details
Instrument Blanks	Are reagents or reagent water that are processed during an analytical sequence in order to assess contamination in the analytical system. In general, instrument blanks are used to differentiate between contamination caused by the analytical system and that caused by the sample handling or sample prep process. Instrument blanks may also be inserted throughout the analytical sequence to minimize the effect of carryover from samples with high analyte content.
Trip Blanks [1]	Are required to be submitted by the client with each shipment of samples requiring aqueous and solid volatiles analyses (or as specified in the client's project plan). Additionally, trip blanks are prepared and analyzed for volatile analysis of air samples, when required by the client. A trip blank is purchased (certified clean) or is prepared by the laboratory by filling a clean container with pure deionized water that has been purged to remove any volatile compounds. Appropriate preservatives are also added to the container. The trip blank is sent with the bottle order and is intended to reflect the environment that the containers are subjected to throughout shipping and handling and help identify possible sources if contamination is found. The field sampler returns the trip blank in the cooler with the field samples.
Field Blanks [1]	Are sometimes used for specific projects by the field samplers. A field blank prepared in the field by filling a clean container with pure reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken. (EPA OSWER)
Equipment Blanks [1]	Are also sometimes created in the field for specific projects. An equipment blank is a sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (TNI)
Holding Blanks	Also referred to as refrigerator or freezer blanks, are used to monitor the sample storage units for volatile organic compounds during the storage of VOA samples in the laboratory

[1] When known, these field QC samples are not selected for matrix QC as it does not provide information on the behavior of the target compounds in the field samples. Usually, the client sample ID will provide information to identify the field blanks with labels such as "FB", "EB", or "TB."

Evaluation criteria and corrective action for these controls are defined in the specific standard operating procedure for each analysis.

24.4 POSITIVE CONTROLS

Control samples (e.g., QC indicators) are analyzed with each batch of samples to evaluate data based upon (1) Method Performance (Laboratory Control Sample (LCS) or Blank Spike (BS)), which entails both the preparation and measurement steps; and (2) Matrix Effects (Matrix Spike (MS) (Matrix spikes are not applicable to air) or Sample Duplicate (MD, DUP), which evaluates field sampling accuracy, precision, representativeness, interferences, and the effect of the matrix on the method performed. Each regulatory program and each method within those programs specify the control samples that are prepared and/or analyzed with a specific batch.

Note that frequency of control samples vary with specific regulatory, methodology and project specific criteria. Complete details on method control samples are listed in each analytical SOP.

24.4.1 Method Performance Control - Laboratory Control Sample (LCS)

24.4.1.1 The LCS measures the accuracy of the method in a matrix and assesses method performance independent of potential field sample matrix affects in a laboratory batch.

24.4.1.2 The LCS is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (for example: Reagent water, Ottawa sand, glass

beads, etc.) and is processed along with and under the same conditions as the associated samples. The LCS is spiked with verified known amounts of analytes or is made of a material containing known and verified amounts of analytes, and taken through all preparation and analysis steps along with the field samples. Where there is no preparation for an analysis (such as in aqueous volatiles), or when all samples and standards undergo the same preparation and analysis process (such as Phosphorus), a continuing calibration verification standard is reported as the LCS. In some instances (e.g., ICP metals in soil), aqueous LCS's are processed for solid matrices; final results are calculated as mg/kg or ug/kg, assuming 100% solids.

24.4.1.3 The specific frequency of use for LCS during the analytical sequence is defined in the specific standard operating procedure for each analysis. It is generally 1 for each batch of samples; not to exceed 20 environmental samples.

24.4.1.4 If the mandated or requested test method, or project requirements, do not specify the spiking components, the laboratory spikes all reportable components to be reported in the Laboratory Control Sample (and Matrix Spike) where applicable (e.g., no spike of pH). However, in cases where the components interfere with accurate assessment (such as simultaneously spiking chlordane, toxaphene and PCBs in Method 608), the test method has an extremely long list of components or components are incompatible, at a minimum, a representative number of the listed components (see below) are used to control the test method. The selected components of each spiking mix represent all chemistries, elution patterns and masses, permit specified analytes and other client requested components. However, the laboratory ensures that all reported components are used in the spike mixture within a two-year time period. Note: this section is not applicable to Ohio EPA VAP projects.

24.4.1.4.1 For methods that have 1-10 target analytes, spike all components.

24.4.1.4.2 For methods that include 11-20 target analytes, spike at least 10 or 80%, whichever is greater.

24.4.1.4.3 For methods with more than 20 target analytes, spike at least 16 components.

24.4.1.4.4 Exception: Due to analyte incompatibility in pesticides, Toxaphene and Chlordane are only spiked at client request based on specific project needs.

24.4.1.4.5 Exception: Due to analyte incompatibility between the various PCB Aroclors, Aroclors 1016 and 1260 are used for spiking as they cover the range of all of the Aroclors. Specific Aroclors may be used by request on a project specific basis.

24.5 SAMPLE MATRIX CONTROLS

Table 24-3. Sample Matrix Control

Control Type	Details	
Matrix Spikes (MS)	Use	Used to assess the effect sample matrix of the spiked sample has on the precision and accuracy of the results generated by the method used;
	Typical Frequency [1]	At a minimum, with each matrix-specific batch of samples processed, an MS is carried through the complete analytical procedure. Unless specified by the client, samples used for spiking are randomly selected and rotated between different client projects. If the mandated or requested test method does not specify the spiking components, the laboratory spikes all reportable components to be reported in the Laboratory Control Sample and Matrix Spike. Refer to the method SOP for complete details
	Description	essentially a sample fortified with a known amount of the test analyte(s).
Surrogate	Use	Measures method performance to sample matrix (organics only).
	Typical Frequency [1]	Are added to all samples, standards, and method blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. The recovery of the surrogates is compared to the acceptance limits for the specific method. Poor surrogate recovery may indicate a problem with sample composition and is reported, with data qualifiers, to the client whose sample produced poor recovery.
	Description	Are similar to matrix spikes except the analytes are compounds with properties that mimic the analyte of interest and are unlikely to be found in environment samples.
Duplicates[2]	Use	For a measure of analytical precision, with each matrix-specific batch of samples processed, a matrix duplicate (MD or DUP) sample, matrix spike duplicate (MSD), or LCS duplicate (LCSD) is carried through the complete analytical procedure.
	Typical Frequency [1]	Duplicate samples are usually analyzed with methods that do not require matrix spike analysis.
	Description	Performed by analyzing two aliquots of the same field sample independently or an additional LCS.
Internal Standards	Use	Are spiked into all environmental and quality control samples (including the initial calibration standards) to monitor the qualitative aspect of organic and some inorganic analytical measurements.
	Typical Frequency [1]	All organic and ICP methods as required by the analytical method.
	Description	Used to correct for matrix effects and to help troubleshoot variability in analytical response and are assessed after data acquisition. Possible sources of poor internal standard response are sample matrix, poor analytical technique or instrument performance.

[1] See the specific analytical SOP for type and frequency of sample matrix control samples.

[2] LCSD's are normally not performed except when regulatory agencies or client specifications require them. The recoveries for the spiked duplicate samples must meet the same laboratory established recovery limits as the accuracy QC samples. If an LCSD is analyzed both the LCS and LCSD must meet the same recovery criteria and be included in the final report. The precision measurement is reported as "Relative Percent Difference" (RPD). Poor precision between duplicates (except LCS/LCSD) may indicate non-homogeneous matrix or sampling.

24.6 ACCEPTANCE CRITERIA (CONTROL LIMITS)

24.6.1 As mandated by the test method, each individual analyte in the LCS, MS, or Surrogate Spike are evaluated against the control limits as published in the test method. Where there are no established acceptance criteria, the laboratory calculates control limits with the use of control charts or, in some cases, utilizes client project specific control limits. When this occurs, the regulatory or project limits will supersede the laboratory's in-house limits.

Note: For methods, analytes and matrices with very limited data (e.g., unusual matrices not analyzed often), interim limits are established using available data or by analogy to similar methods or matrices.

24.6.2 Once control limits have been established, they are verified, reviewed, and updated if necessary on an annual basis unless the method requires more frequent updating. Control limits are established per method (as opposed to per instrument) regardless of the number of instruments utilized.

24.6.3 Laboratory generated % Recovery acceptance (control) limits are generally established by taking $\pm$ 3 Standard Deviations (99% confidence level) from the average recovery of a minimum of 20-30 data points (more points are preferred).

24.6.3.1 Regardless of the calculated limit, the limit should be no tighter than the Continuing Calibration Verification (CCV) limits (unless the analytical method specifies a tighter limit).

24.6.3.2 In-house limits cannot be any wider than those mandated in a regulated analytical method (e.g., SDWA Dioxin Method 1613B 2,3,7,8-TCDD on-going precision and recovery limits of 73% to 146% recovery). Client or contract required control limits are evaluated against the laboratory's statistically derived control limits to determine if the data quality objectives (DQOs) can be achieved. If laboratory control limits are not consistent with DQOs, then alternatives must be considered, such as method improvements or use of an alternate analytical method.

24.6.4 The lab must be able to generate a current listing of their control limits and track when the updates are performed. In addition, the laboratory must be able to recreate historical control limits.

24.6.4.1 Refer to SOP KNOX-QA-0004, Control Limits and Control Charting for details on the generation of control limits and the use of control charts at TestAmerica Knoxville.

24.6.5 A LCS that is within the acceptance criteria establishes that the analytical system is in control and is used to validate the process. Samples that are analyzed with an LCS with recoveries outside of the acceptance limits may be determined as out of control and should be reanalyzed if possible. If reanalysis is not possible, then the results for all affected analytes for samples within the same batch must be qualified when reported. The internal corrective action process (see Section 12) is also initiated if an LCS exceeds the acceptance limits. Sample results may be qualified and reported without reanalysis if:

24.6.5.1 The analyte results are below the reporting limit and the LCS is above the upper control limit.

24.6.5.2 If the analytical results are above the relevant regulatory limit and the LCS is below the lower control limit. (Note: This is not applicable to Ohio EPA VAP projects.)

24.6.5.3 For Department of Defense (DOD) and Department of Energy (DOE) work, there are an allowable number of Marginal Exceedances (ME). The use of allowable marginal exceedances may also be used for evaluation of LCS recoveries for TNI accredited

methods. Note: For Ohio EPA VAP, if an analyte is identified as a contaminant of interest, then the analyte must meet the LCS criteria and marginal exceedance limits are not applicable.

<11 analytes	0 marginal exceedances are allowed.
11 – 30 Analytes	1 marginal exceedance is allowed
31-50 Analytes	2 marginal exceedances are allowed
51-70 Analytes	3 marginal exceedances are allowed
71-90 Analytes	4 marginal exceedances are allowed
> 90 Analytes	5 marginal exceedances are allowed

24.6.5.3.1 Marginal exceedances are recovery exceedances between 3 SD and 4 SD from the mean recovery limit (TNI). (Note: The DOD/DOE QSM has defined limits for marginal exceedances. Refer to the DOD QSM SOP KNOX-QA-0021, DOD/DOE QSM Program Requirements.)

24.6.5.3.2 Marginal exceedances must be random. If the same analyte exceeds the LCS control limit repeatedly, it is an indication of a systematic problem. The source of the error must be located and corrective action taken. The laboratory has a system to monitor marginal exceedances to ensure that they are random. Refer to the DOD/DOE QSM SOP KNOX-QA-0021, DOD/DOE QSM Program Requirements for details on how the laboratory ensures that the marginal exceedences are random.

24.6.5.3.3 Though marginal exceedences may be allowed, the data must still be qualified to indicate it is outside of the normal limits.

24.6.6 If the MS/MSDs do not meet acceptance limits, the MS/MSD and the associated spiked sample is reported with a qualifier for those analytes that do not meet limits. If obvious preparation errors are suspected, or if requested by the client, unacceptable MS/MSDs are reprocessed and reanalyzed to prove matrix interference. A more detailed discussion of acceptance criteria and corrective action can be found in the analytical SOPs and in Section 12.

24.6.7 If a surrogate standard falls outside the acceptance limits, if there is not obvious chromatographic matrix interference, reanalyze the sample to confirm a possible matrix effect. If the recoveries confirm or there was obvious chromatographic interference, results are reported from the original analysis and a qualifier is added. If the reanalysis meets surrogate recovery criteria, the second run is reported (or both are reported if requested by the client).

24.7 ADDITIONAL PROCEDURES TO ASSURE QUALITY CONTROL

24.7.1 The laboratory has written and approved method SOPs to assure the accuracy of the test method including calibration (see Section 20), use of certified reference materials (see Section 21) and use of PT samples (see Section 15).

24.7.2 A discussion regarding MDLs, Limit of Detection (LOD) and Limit of Quantitation (LOQ) can be found in Section 19.

24.7.3 Use of formulae to reduce data is discussed in the method SOPs and in Section 20.

24.7.4 Selection of appropriate reagents and standards is included in Section 9 and 21.

24.7.5 A discussion on selectivity of the test is included in Section 5.

24.7.6 Constant and consistent test conditions are discussed in Section 18.

24.7.7 The laboratories sample acceptance policy is included in Section 23.

SECTION 25

REPORTING RESULTS

25.1 OVERVIEW

The results of each test are reported accurately, clearly, unambiguously, and objectively in accordance with State and Federal regulations as well as client requirements. Analytical results are issued in a format that is intended to satisfy customer and laboratory accreditation requirements as well as provide the end user with the information needed to properly evaluate the results. Where there is a conflict between the client requests and laboratory ethics or regulatory requirements, the laboratory's ethical and legal requirements are paramount, and the laboratory works with the client during project set up to develop and acceptable solution. Refer to Section 7.

A variety of report formats are available to meet specific needs.

In cases where a client asks for simplified reports, there must be a written request from the client. There still must be enough information that would show any analyses that were out of conformance (QC out of limits) and there should be a reference to a full report that is made available to the client.

Review of reported data is included in Section 19.

25.2 TEST REPORTS

Analytical results are reported in a format that is satisfactory to the client and meets all requirements of applicable accrediting authorities and agencies. A variety of report formats are available to meet specific needs. The report is printed on laboratory letterhead, reviewed, and signed by the appropriate project manager. At a minimum, the standard laboratory report contains the following information:

25.2.1 A report title (e.g., Analytical Report) on the cover page with a "Result" column header on the sample results page.

25.2.2 Each report cover page printed on company letterhead, which includes the laboratory name, address and telephone number.

25.2.3 A unique identification of the report (e.g., Lot Number) and on each page an identification in order to ensure the page is recognized as part of the report and a clear identification of the end.

Note: Page numbers of reports are represented on the upper right hand corner of each page. A table of contents precedes the cover page on each report which includes the page number of each section as well as the total number of pages.

25.2.4 A copy of the chain of custody (COC).

- Any COCs involved with Subcontracting are included.

25.2.5 The name and address of client and a project name/number, if applicable.

25.2.6 Client project manager or other contact.

25.2.7 Description and unambiguous identification of the tested sample(s) including the client identification code.

25.2.8 Date of receipt of sample, date and time of collection, and date(s) of test preparation and performance, and time of preparation or analysis if the required holding time for either activity is less than or equal to 72 hours. Both date and time of preparation and analysis are required to be included in the data report for work done in support of the DoD QSM; see SOP KNOX-QA-0021, "Department of Defense Quality Systems Manual Program Requirements."

25.2.9 Date reported or date of revision, if applicable.

25.2.10 Method of analysis including method code (EPA, Standard Methods, etc).

25.2.11 Reporting limit or Minimum Level.

25.2.12 Method detection limits or Estimated Detection Limits (if requested).

25.2.13 Definition of Data qualifiers and reporting acronyms (e.g. ND).

25.2.14 Sample results.

25.2.15 QC data consisting of method blank, surrogate, LCS, and MS/MSD (if applicable) recoveries and control limits.

25.2.16 Condition of samples at receipt including temperature. This may be accomplished in a narrative or by attaching sample login sheets. This is discussed in the narrative and a copy of the condition upon receipt form is included with the chain of custody.

25.2.17 A statement to the effect that the results relate only to the items tested and the sample as received by the laboratory.

25.2.18 A statement that the report shall not be reproduced except in full, without the written approval of the laboratory.

25.2.19 A signature and title of the person(s) accepting responsibility for the content of the report and date of issue. Authorized signatories are qualified Project Managers appointed by the Manager of Project Managers

25.2.20 When TNI accreditation is required, the lab certifies that the test results meet all requirements of TNI or provides reasons and/or justifications if they do not.

25.2.21 Where applicable, a narrative to the report that explains the issue(s) and corrective action(s) taken in the event that a specific accreditation or certification requirement was not met.

25.2.22 When soil samples are analyzed, a specific identification as to whether soils are reported on a "wet weight" or "dry weight" basis.

25.2.23 Appropriate laboratory certification number for the state of origin of the sample, if applicable.

25.2.24 If only part of the report is provided to the client (client requests some results before all of it is complete), it must be clearly indicated on the report (e.g., preliminary report), and that a complete report will follow once all of the work has been completed. A complete report must be sent once all of the work has been completed.

25.2.25 Any non-TestAmerica subcontracted analysis results are provided as a separate report on the official letterhead of the subcontractor. All TestAmerica subcontracting is clearly identified on the report as to which laboratory performed a specific analysis.

25.2.26 For Ohio EPA VAP work, a VAP affidavit must be completed and included with the report. Refer to the current Ohio Rules OAC 3745-300-04 and 3745-300-13(N) for additional details regarding Ohio EPA VAP affidavits.

25.2.27 A clear statement notifying the client that non-accredited tests were performed and directing the client to the laboratory's accreditation certificates of approval shall be provided when non-accredited tests are included in the report.

25.3 REPORTING LEVEL OR REPORT TYPE

TestAmerica Knoxville offers four standard types of data report format.

- A Standard Report is a report containing the items in Section 25.2 above.
- A CLP Forms Only Report is a standard report using CLP (or CLP like) report forms.
- An Expanded Deliverable Report is a Standard Report which includes the supporting raw data.
- A CLP Expanded Deliverable Report is an Expanded Deliverable report using CLP (or CLP-like) report forms.

Further details, including other specific reporting options, are defined in SOP KNOX-AD-0004, Data Reporting.

25.3.1 Electronic Data Deliverables (EDDs)

EDDs are routinely offered as part of TestAmerica's services in addition to the test report as described in section 25.2. When NELAP accreditation is required and both a test report and EDD are provided to the client, the official version of the test report will be the combined information of the report and the EDD. TestAmerica Knoxville offers a variety of EDD formats including industry standard and client specific electronic deliverables.

EDDs are subject to a review to ensure their accuracy and completeness. If EDD generation is automated, review may be reduced to periodic screening if the laboratory can demonstrate that it can routinely generate that EDD without errors. Any revisions to the EDD format must be reviewed until it is demonstrated that it can routinely be generated without errors. If the EDD can be reproduced accurately and if all subsequent EDDs can be produced error-free, each EDD does not necessarily require a review.

25.4 SUPPLEMENTAL INFORMATION FOR TEST

The lab identifies any unacceptable QC analyses or any other unusual circumstances or observations such as environmental conditions and any non-standard conditions that may have affected the quality of a result. This is typically in the form of a footnote or a qualifier and/or a narrative explaining the discrepancy in the front of the report. See Appendix 4 for example data qualifiers.

25.4.1 Numeric results with values outside of the calibration range, either high or low are qualified as 'estimated'.

25.4.2 Where quality system requirements are not met, a statement of compliance/non-compliance with requirements and/or specifications is required, including identification of test results derived from any sample that did not meet TNI sample acceptance requirements such as improper container, holding time, or temperature.

25.4.3 Where applicable, a statement on the estimated uncertainty of measurements is provided; information on uncertainty is needed when a client's instructions so require.

25.4.4 Opinions and Interpretations - The test report contains objective information, and generally does not contain subjective information such as opinions and interpretations. If such information is required by the client, the Laboratory Director will determine if a response can be prepared. If so, the Laboratory Director will designate the appropriate member of the management team to prepare a response. The response is fully documented, and reviewed by the Laboratory Director, before release to the client. There may be additional fees charged to the client at this time, as this is a non-routine function of the laboratory.

When opinions or interpretations are included in the report, the laboratory provides an explanation as to the basis upon which the opinions and interpretations have been made. Opinions and interpretations are clearly noted as such and where applicable, a comment should be added suggesting that the client verify the opinion or interpretation with their regulator.

25.5 ENVIRONMENTAL TESTING OBTAINED FROM SUBCONTRACTORS

If the laboratory is not able to provide the client the requested analysis, the samples would be subcontracted following the procedures outlined in the Corporate SOP on Subcontracting Procedures (SOP# CA-L-S-002).

Data reported from analyses performed by a subcontractor laboratory are clearly identified as such on the analytical report provided to the client. Results from a subcontract laboratory outside of TestAmerica are reported to the client as provided from the subcontract laboratory.

Note: For Ohio EPA VAP projects TestAmerica's affidavit must not attest that the data from the subcontract laboratory are certified. The subcontractor's affidavit must be included and the report must clearly state the test were subcontracted.

25.6 CLIENT CONFIDENTIALITY

In situations involving the transmission of environmental test results by telephone, facsimile or other electronic means, client confidentiality must be maintained.

TestAmerica will not intentionally divulge to any person (other than the Client or any other person designated by the Client in writing) any information regarding the services provided by TestAmerica or any information disclosed to TestAmerica by the Client. Furthermore, information known to be potentially endangering to national security or an entity's proprietary rights will not be released.

Note: This does not apply to the extent that the information is required to be disclosed by TestAmerica under the compulsion of legal process. TestAmerica will, to the extent feasible, provide reasonable notice to the client before disclosing the information.

Note: Authorized representatives of an accrediting authority are permitted to make copies of any analyses or records relevant to the accreditation process, and copies may be removed from the laboratory for purposes of assessment.

25.6.1 Report deliverable formats are discussed with each new client. If a client requests that reports be faxed or e-mailed, the reports are faxed with a cover sheet or e-mailed with the following note that includes a confidentiality statement similar to the following:

Confidentiality Notice: The information contained in this message is intended only for the use of the addressee, and may be confidential and/or privileged. If the reader of this message is not the intended recipient, or the employee or agent responsible to deliver it to the intended recipient, you are hereby notified that any dissemination, distribution or copying of this communication is strictly prohibited. If you have received this communication in error, please notify the sender immediately.

25.7 FORMAT OF REPORTS

The format of reports is designed to accommodate each type of environmental test carried out and to minimize the possibility of misunderstanding or misuse.

25.8 AMENDMENTS TO TEST REPORTS

Corrections, additions, or deletions to reports are only made when justification arises through supplemental documentation. Justification is documented using the laboratory's corrective action system (refer to Section 12).

The revised report is retained on the archive data server, as is the original report. The revised report is stored in the archive data server under the lot number followed by "rev". The revised report will have the word "revised" on the cover page.

When the report is re-issued, a notation of "Reissued Report" is placed on the cover/signature page of the report or at the top of the narrative page with a brief explanation of reason for the re-issue.

25.9 POLICIES ON CLIENT REQUESTS FOR AMENDMENTS

25.9.1 Policy on Data Omissions or Reporting Limit Increases

Fundamentally, our policy is simply to not omit previously reported results (including data qualifiers) or to not raise reporting limits and report sample results as ND. This policy has few exceptions. Exceptions are:

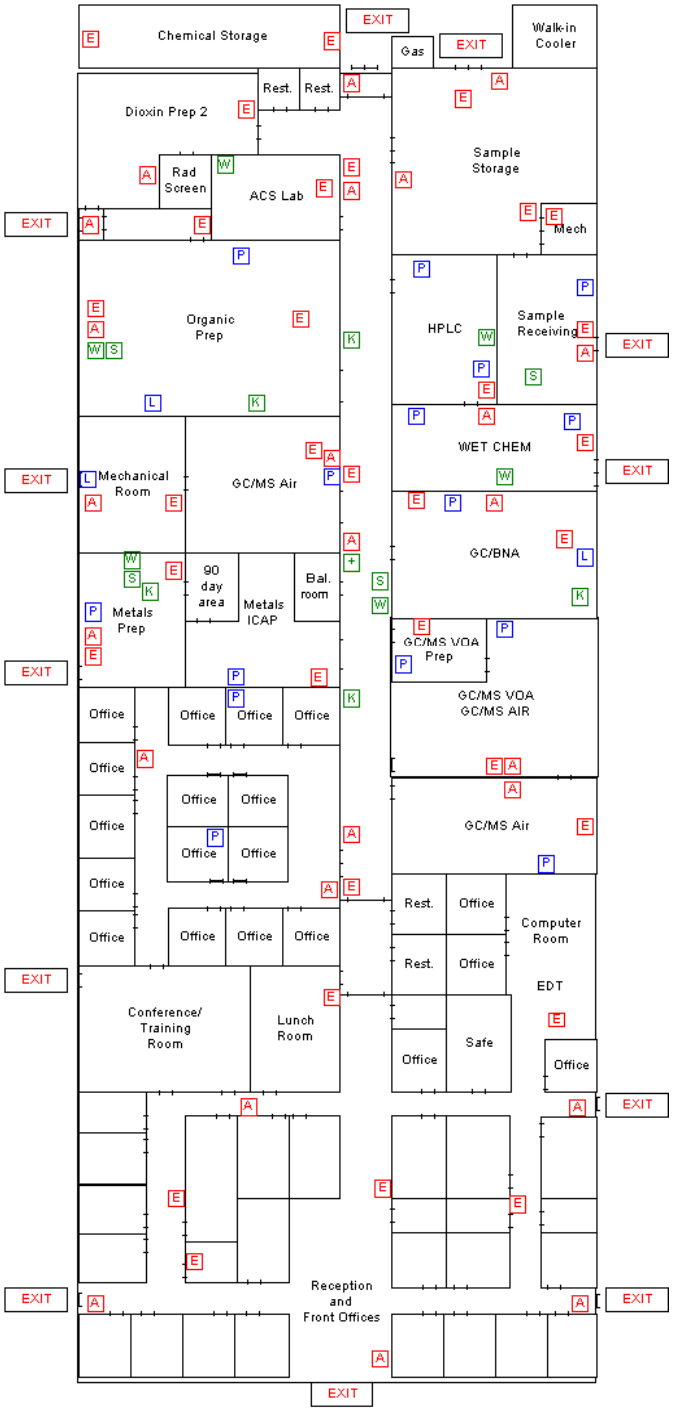
- Laboratory error.
- Sample identification is indeterminate (confusion between COC and sample labels).
- An incorrect analysis (not analyte) was requested (e.g., COC lists 8315 but client wanted 8310). A written request for the change is required.
- Incorrect limits reported based on regulatory requirements.
- The requested change has absolutely *no possible* impact on the interpretation of the analytical results and there is *no possibility* of the change being interpreted as misrepresentation by anyone inside or outside of our company.

25.9.2 Multiple Reports

TestAmerica does not issue multiple reports for the same work order where there is different information on each report (this does not refer to copies of the same report) unless required to meet regulatory needs and approved by QA.

Appendix 1. Laboratory Floor Plan

TestAmerica Knoxville Laboratory
Main Building - Figure 1

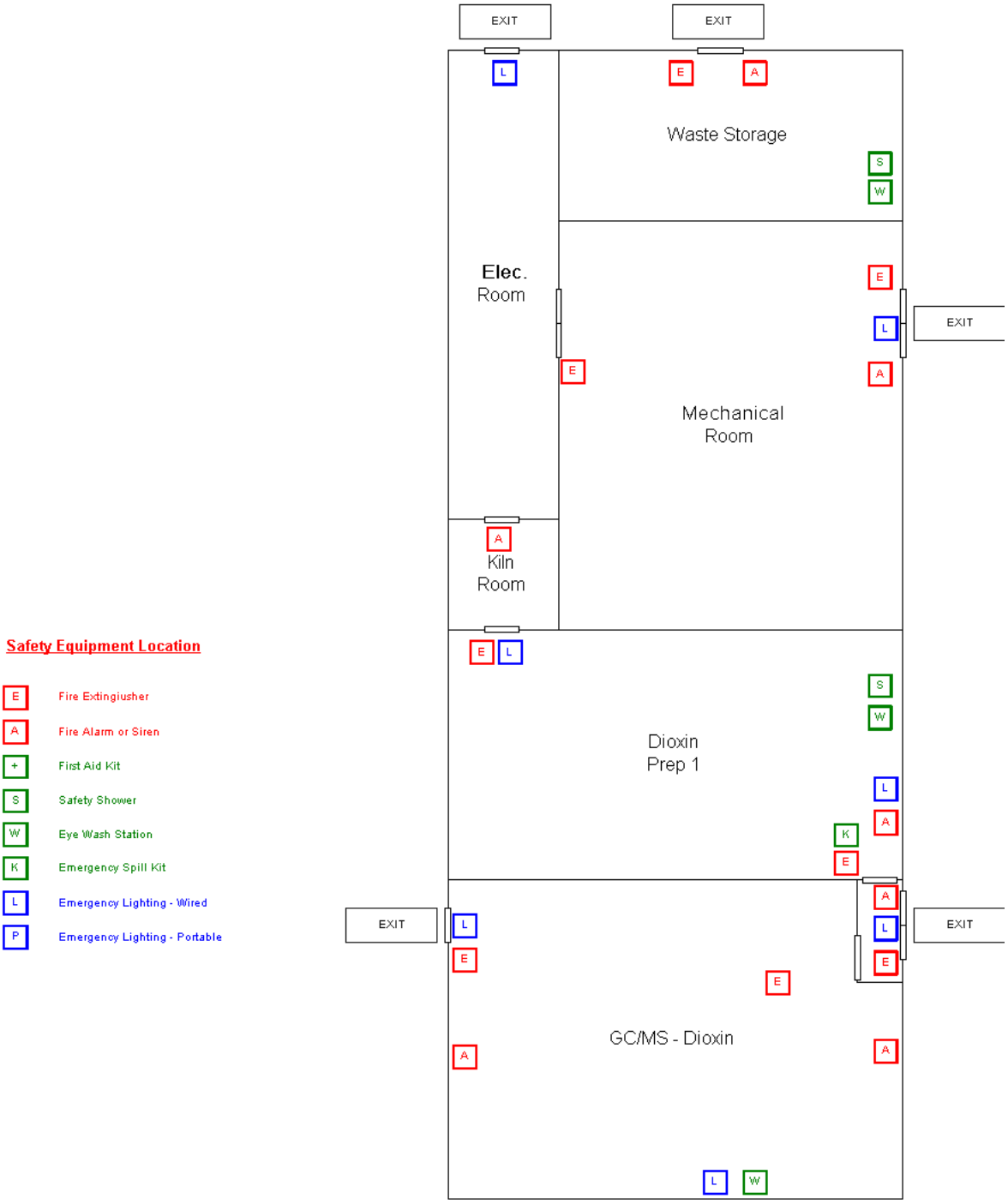


Safety Equipment Location

- E Fire Extingiusher
- A Fire Alarm or Siren
- + First Aid Kit
- S Safety Shower
- W Eye Wash Station
- K Emergency Spill Kit
- L Emergency Lighting - Wired
- P Emergency Lighting - Portable

Appendix 1. Laboratory Floor Plan (continued)

TestAmerica Knoxville Laboratory
Building 2 - Dioxin Lab - Figure 2



Appendix 2. Glossary/Acronyms

Glossary:

Acceptance Criteria:
Specified limits placed on characteristics of an item, process, or service defined in requirement documents. (ASQC)

Accreditation:
The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory.

Accuracy:
The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (QAMS)

Analyst: [aka: Laboratory Analyst]
The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.

Analytical Uncertainty:
A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis. (TNI)

Anomaly:
A condition or event, other than a deficiency, that may affect the quality of the data, whether in the laboratory's control or not.

Assessment:
The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of laboratory accreditation). (TNI)

Audit:
A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives. (TNI)

Batch:
Environmental samples which are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A preparation batch is composed of one to 20 environmental samples of the same matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24

hours. An analytical batch is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group An analytical batch can include prepared samples originating from various quality system matrices and can exceed twenty (20) samples. (TNI)

Bias:
The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value). (TNI)

Blank:
A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. (ASQC)

Calibration:

A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. (TNI)

1) In calibration of support equipment the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI).

2) In calibration according to methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications

Calibration Curve:
The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (TNI)

Calibration Standard:
A substance or reference material used to calibrate an instrument (QAMS)

Certified Reference Material (CRM):
A reference material, accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute. (TNI)

Chain of Custody (COC) Form:
Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; the collector; time of collection; preservation; and requested analyses. (TNI)

Compromised Samples:
Those samples which are improperly sampled, insufficiently documented (chain of custody and other sample records and/or labels), improperly preserved, collected in improper containers, or exceeding holding times when delivered to a laboratory. Under normal conditions, compromised samples are not analyzed. If emergency situation require analysis, the results must be appropriately qualified.

Confidential Business Information (CBI):
Information that an organization designates as having the potential of providing a competitor with inappropriate insight into its management, operation or products. TNI and its representatives agree to safeguarding identified CBI and to maintain all information identified as such in full confidentiality.

Confirmation:
Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited toSecond column confirmation,Alternate wavelength,Derivatization,Mass spectral interpretation,Alternative detectors,or Additional Cleanup proceduresTNI

Conformance:
An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements. (ANSI/ASQC E4-1994)

Corrective Action:
The action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO 8402)

Data Audit:
A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data re of acceptable quality (i.e., that they meet specified acceptance criteria).

Data Reduction:
The process of transforming the number of data items by arithmetic or statistical calculations, standard curves, and concentration factors, and collation into a more useable form. (TNI)

Deficiency:
An unauthorized deviation from acceptable procedures or practices, or a defect in an item. (ASQC), whether in the laboratory's control or not.

Demonstration of Capability:
A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision. (TNI)

Document Control:
The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly, and controlled to

ensure use of the correct version at the location where the prescribed activity if performed. (ASQC)

Duplicate Analyses:
The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. (EPA-QAD)

Equipment Blank:
Sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures.

External Standard Calibration:
Calibrations for methods that do not utilize internal standards to compensate for changes in instrument conditions.

Field Blank:
Blank prepared in the field by filing a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken (EPA OSWER)

Field of Accreditation:
Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.

Holding Blank:
A blank matrix stored with field samples of a similar matrix (volatiles only) that measures storage contribution to any source of contamination.

Holding Times:
The maximum times that samples may be held prior to analyses and still be considered valid or not compromised. (40 CFR Part 136)

Internal Standard:
A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical test method. (TNI)

Internal Standard Calibration:
Calibrations for methods that utilize internal standards to compensate for changes in instrument conditions.

Instrument Blank:
A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. (EPA-QAD)

Instrument Detection Limit (IDL):
The minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific instrument. The IDL is associated with the instrumental portion of a specific method only, and sample preparation

steps are not considered in its derivation. The IDL is a statistical estimation at a specified confidence interval of the concentration at which the relative uncertainty is ± 100%. The IDL represents a range where qualitative detection occurs on a specific instrument. Quantitative results are not produced in this range.

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample):
A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes, taken through all preparation and analysis steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

An LCS is prepared at a minimum of 1 per batch of 20 or less samples per matrix type per sample extraction or preparation method except for analytes for which spiking solutions are not available such as total suspended solids, total dissolved solids, total volatile solids, total solids, pH, color, odor, temperature, dissolved oxygen or turbidity. The results of these samples are used to determine batch acceptance.

Least Squares Regression (1st Order Curve):
The least squares regression is a mathematical calculation of a straight line over two axes. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The regression calculation will generate a correlation coefficient (r) that is a measure of the "goodness of fit" of the regression line to the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r must be greater than or equal to 0.99 for organics and 0.995 for inorganics.

Limit(s) of Detection (LOD): [a.k.a., Method Detection Limit (MDL)]:
A laboratory's estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect in their facility. (TNI)

LOD Verification [a.k.a., MDL Verification]:
A processed QC sample in the matrix of interest, spiked with the analyte at no more than 3X the LOD for single analyte tests and 4X the LOD for multiple analyte tests and processed through the entire analytical procedure.

Limit(s) of Quantitation (LOQ) [a.k.a., Reporting Limit]:
The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. (TNI)

(QS) Matrix:
The component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions are used:

> Aqueous: Any aqueous sample excluded from the definition of Drinking Water matrix or Saline/Estuarine source. Includes surface water, groundwater, effluents, and TCLP or other extracts.

Drinking Water: any aqueous sample that has been designated as a potable or potential potable water source.

Saline/Estuarine: any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.

Non-aqueous Liquid: any organic liquid with <15% settleable solids.

Biological Tissue: any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples are grouped according to origin.

Solids: includes soils, sediments, sludges, and other matrices with >15% settleable solids.

Chemical Waste: a product or by-product of an industrial process that results in a matrix not previously defined.

Air & Emissions: whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device. (TNI)

Matrix Spike (spiked sample or fortified sample):

A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Matrix Spike Duplicate (spiked sample or fortified sample duplicate):
A replicate matrix spike prepared and analyzed to obtain a measure of the precision of the recovery for each analyte.

Method Blank:
A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.

Method Detection Limit:
The minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40 CFR Part 136, Appendix B)

Negative Control:
Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results.

Non-conformance:
An indication, judgment, or state of not having met the requirements of the relevant specifications, contract, or regulation.

Observation:
A record of phenomena that (1) may assist in evaluation of the sample data; (2) may be of importance to the project manager and/or the client, and yet not at the time of the observation have any known effect on quality.

Performance Audit:
The routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory.

Positive Control:
Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects.

Precision:
The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. (TNI)

Preservation:
Any conditions under which a sample must be kept in order to maintain chemical and/or biological integrity prior to analysis. (TNI)

Proficiency Testing:
A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (TNI)

Proficiency Testing Program:
The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories. (TNI)

Proficiency Test Sample (PT):
A sample, the composition of which is unknown to the laboratory and is provided to test whether the laboratory can produce analytical results within specified acceptance criteria. (TNI)

Quality Assurance:
An integrated system of management activities involving planning, implementation, assessment, reporting and quality improvement to ensure that a process, item, or service is of the type of quality needed and expected by the client. (TNI)

Quality Assurance [Project] Plan (QAPP):

A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. (EAP-QAD)

Quality Control:
The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against “out of control” conditions and ensuring that the results are of acceptable quality. (TNI)

Quality Control Sample:
A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control. (TNI)

Quality Manual:
A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. (TNI)

Quality System:
A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC activities. (TNI)

Raw Data:
The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records. (TNI)

Record Retention:
The systematic collection, indexing and storing of documented information under secure conditions.

Reference Material:
Material or substance one or more properties of which are sufficiently homogenous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (TNI)

Reference Standard:
Standard used for the calibration of working measurement standards in a given organization or a given location. (TNI)

Sampling:
Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.

Second Order Polynomial Curve (Quadratic):
The 2nd order curves are a mathematical calculation of a slightly curved line over two axis. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The 2nd order regression will generate a coefficient of determination (COD or r^2) that is a measure of the "goodness of fit" of the quadratic curvature the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r^2 must be greater than or equal to 0.99.

Selectivity:
The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system. (TNI)

Sensitivity:
The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (TNI)

Spike:
A known mass of target analyte added to a blank, sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.

Standard:
The document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies. (TNI)

Standard Operating Procedures (SOPs):
A written document which details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks. (TNI)

Storage Blank:
A blank matrix stored with field samples of a similar matrix (volatiles only) that measures storage contribution to any source of contamination.

Surrogate:
A substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes.

Surrogate compounds must be added to all samples, standards, and method blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. Poor surrogate recovery may indicate a problem with sample composition and is reported to the client whose sample produced poor recovery. (QAMS)

Systems Audit (also Technical Systems Audit):

A thorough, systematic, qualitative on-site assessment of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system. (EPA-QAD)

Technical Manager:
A member of the staff of an environmental laboratory who exercises actual day-to-day supervision of laboratory operations for the appropriate fields of accreditation and reporting of results

Technology:
A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.

Traceability:
The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project. (TNI)

Trip Blank:
A blank matrix placed in a sealed container at the laboratory that is shipped, held unopened in the field, and returned to the laboratory in the shipping container with the field samples.

Uncertainty:
A parameter associated with the result of a measurement that characterizes the dispersion of the value that could reasonably be attributed to the measured value.

Acronyms:

ANSI- American National Standards Institute
ASQC- American Society for Quality Control
CAR – Corrective Action Report
CCV – Continuing Calibration Verification
CF – Calibration Factor
CFR – Code of Federal Regulations
COC – Chain of Custody
DOC – Demonstration of Capability
DQO – Data Quality Objectives
DUP - Duplicate
EDL – Estimated Detection Limit (for Isotope Dilution Methods)
EHS – Environment, Health and Safety
EPA – Environmental Protection Agency
EPA-QAD- Quality Assurance Division
GC - Gas Chromatography
GC/MS - Gas Chromatography/Mass Spectrometry
HPLC - High Performance Liquid Chromatography
ICP - Inductively Coupled Plasma Atomic Emission Spectroscopy
ICP/MS – ICP/Mass Spectrometry
ICV – Initial Calibration Verification
IDL – Instrument Detection Limit
IH – Industrial Hygiene
IS – Internal Standard
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
LIMS – Laboratory Information Management System
LOD – Limit of Detection
LOQ – Limit of Quantitation
MDL – Method Detection Limit
MDLV – MDL Verification Check Standard
MRL – Method Reporting Limit Check Standard
MS – Matrix Spike
MSD – Matrix Spike Duplicate
SDS - Safety Data Sheet
NELAP - National Environmental Laboratory Accreditation Program
PT – Performance Testing
QAM – Quality Assurance Manual
QAMS- QAMS 005/80, Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans (EPA 1980)
QA/QC – Quality Assurance / Quality Control
QAPP – Quality Assurance Project Plan
RF – Response Factor
RPD – Relative Percent Difference
RSD – Relative Standard Deviation
SD – Standard Deviation
SOP: Standard Operating Procedure

TAT – Turn-Around-Time
TNI – The NELAC Institute
VOA – Volatiles
VOC – Volatile Organic Compound

Appendix 3.

Laboratory Certifications, Accreditations, Validations

TestAmerica Knoxville maintains accreditations, certifications, and approvals with numerous state and national entities. Programs vary but may include on-site audits, reciprocal agreements with another entity, performance testing evaluations, review of the Quality Assurance Manual, Standard Operating Procedures, Method Detection Limits, training records, etc. At the time of this QAM revision, the laboratory has accreditation/certification/licensing with the following organizations:

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Certifications

Laboratory	Program	Authority	Identification	Expiration Date
TestAmerica Knoxville	DoD ELAP	L-A-B	L2311	02/13/2019
TestAmerica Knoxville	Federal	USDA	P330-13-00262	08/20/2019
TestAmerica Knoxville	NELAP	Florida	E87177	06/30/2017
TestAmerica Knoxville	NELAP	Kansas	E-10349	10/31/2017
TestAmerica Knoxville	NELAP	Louisiana	83979	06/30/2017
TestAmerica Knoxville	NELAP	Louisiana (DW)	LA160005	12/31/2016
TestAmerica Knoxville	NELAP	New Jersey	TN001	06/30/2017
TestAmerica Knoxville	NELAP	New York	10781	03/31/2017
TestAmerica Knoxville	NELAP	Pennsylvania	68-00576	12/31/2016
TestAmerica Knoxville	NELAP	Texas	T104704380-16-9	08/31/2017
TestAmerica Knoxville	NELAP	Utah	TN00009	07/31/2016 *
TestAmerica Knoxville	NELAP	Virginia	460176	09/14/2017
TestAmerica Knoxville	State Program	Arkansas DEQ	88-0688	06/16/2017
TestAmerica Knoxville	State Program	California	2423	06/30/2018
TestAmerica Knoxville	State Program	Colorado	TN00009	02/28/2017
TestAmerica Knoxville	State Program	Connecticut	PH-0223	09/30/2017
TestAmerica Knoxville	State Program	Georgia	906	04/13/2017
TestAmerica Knoxville	State Program	Hawaii	N/A	04/13/2017
TestAmerica Knoxville	State Program	Kentucky (DW)	90101	12/31/2016
TestAmerica Knoxville	State Program	Maryland	277	03/31/2017
TestAmerica Knoxville	State Program	Michigan	9933	04/13/2017
TestAmerica Knoxville	State Program	Nevada	TN00009	07/31/2017
TestAmerica Knoxville	State Program	North Carolina (DW)	21705	07/31/2017
TestAmerica Knoxville	State Program	North Carolina (WW/SW)	64	12/31/2016
TestAmerica Knoxville	State Program	Ohio VAP	CL0059	01/16/2017
TestAmerica Knoxville	State Program	Oklahoma	9415	08/31/2017
TestAmerica Knoxville	State Program	South Carolina	84001	06/30/2017
TestAmerica Knoxville	State Program	Tennessee	2014	04/13/2017
TestAmerica Knoxville	State Program	Washington	C593	01/19/2017
TestAmerica Knoxville	State Program	West Virginia (DW)	9955C	12/31/2016
TestAmerica Knoxville	State Program	West Virginia DEP	345	04/30/2017
TestAmerica Knoxville	State Program	Wisconsin	998044300	08/31/2017

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* Certification Valid - Laboratory is Pending Renewal with the Program Authority

For more information, or to contact a local TestAmerica representative nearest you, please visit our website at www.testamericainc.com

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The certificates and parameter lists for each organization may be found on the corporate web site, and on the local server in a protected QA share.

* The Agency assigned Laboratory ID number is listed where provided. Otherwise the number corresponds to the Agency Certificate ID where provided.

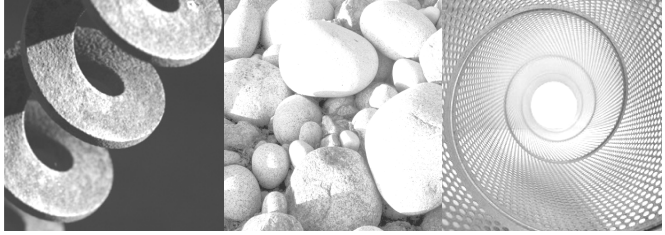
Appendix 4. Example Data Qualifiers (Standard Flagging Suite)[1]

Qualifier	Footnote
!	Laboratory is not accredited for this parameter.
*	RPD of the LCS and LCSD exceeds the control limits
*	LCS or LCSD is outside acceptance limits
>	The analyte exceeded the indicated concentration
^	Instrument related QC is outside acceptance limits
4	MS,MSD: The analyte present in the original sample is greater than 4 times the matrix spike concentration; therefore control limits are not applicable
AP	Altered Pattern
B	Compound was found in the blank and sample
B7	Target analyte detected in the method blank at or above method reporting limit. Concentration found in sample was at 10X the concentration found in the blank
c	Compound falls outside routine control limits, but is within acceptable client specific calibration criteria
cn	Refer to Case Narrative for further detail
D	Sample results are obtained from a dilution; the surrogate or matrix spike recoveries reported are calculated from diluted samples
D	Surrogate or matrix spike recoveries were not obtained because the extract was diluted for analysis; also compounds analyzed at a dilution may be flagged with a D
D	Sample results are obtained from a dilution; the surrogate or matrix spike recoveries reported are calculated from diluted samples.
DW	Result has been dry weight corrected
E	Result exceeded calibration range.
F1	MS and/or MSD Recovery is outside acceptance limits.
F2	MS/MSD RPD exceeds control limits
F3	Duplicate RPD exceeds the control limit
F4	MS/MSD RPD exceeds control limits due to sample size difference.
F5	Duplicate RPD exceeds limit, and one or both sample results are less than 5 times RL. The data are considered valid because the absolute difference is less than the RL.
H	Sample was prepped or analyzed beyond the specified holding time
h	Alternate peak selection upon analytical review.
I	Indicates the presence of an interference, recovery is not calculated.
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
NC	Not Confirmed
p	The %RPD between the primary and confirmation column/detector is >40%. The lower value has been reported.
P	The %RPD between the primary and confirmation column/detector is >40%. The higher value has been reported
Q	Result was qualitatively confirmed, but not quantitated.
q	The reported result is the estimated maximum possible concentration of this analyte, quantitated using the theoretical ion ratio. The measured ion ratio does not meet qualitative identification criteria and indicates a possible interference.

S	Ion suppression
U	Indicates the analyte was analyzed for but not detected.
V	Serial Dilution exceeds the control limits
W	PS: Post-digestion spike was outside control limits
X	Surrogate is outside control limits

1 – This is a standard list of qualifiers commonly used. Other qualifiers are available in LIMS.

APPENDIX I – FIELD SAMPLING PLAN



GEI Consultants

Consulting
Engineers and
Scientists

Field Sampling Plan
Williamsburg Works Site

Brooklyn, New York
AOC Index No. A2-0552-0606
Site #: 224055

Submitted to:
National Grid
One MetroTech Center
Brooklyn, NY 11201

Submitted by:
GEI Consultants, Inc., P.C.
455 Winding Brook Drive, Suite 201
Glastonbury, CT 06033
860-368-5300

July 2021
Project 093060



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Section 1

Introduction

STANDARD OPERATING PROCEDURE

1. Introduction

This document presents the Standard Operating Procedures (SOPs) for the Atlantic and New England Regions of GEI Consultants, Inc. (GEI). The primary intent of the document is to promote consistency in application of Standard Operating Procedures (SOPs) for environmental field and some office operations. Application and use of SOPs will be considered and may be discussed in annual staff reviews.

This SOP document encompasses a broad range of activities to improve the planning, implementation, and documentation of most environmental field and some office operations. The methodologies presented in this manual may not be applicable to site-specific situations. If you are uncertain about a procedure, confirm its adequacy with the project manager, client, and/or regulatory bodies to confirm that procedures are consistent with their expectations.

The document is organized according to the chronological sequence of typical work flow proceeding from project setup to field activities, data collection, and report preparation tasks.

Two types of documents are contained herein:

- General Guidance Procedures – Documents intended to be informative and not prescriptive. These documents are designed to provide necessary background information to adequately understand the process.
- Standard Operating Procedures – Documents intended to describe standard procedures and limitations.

2. SOP Layout Design

2.1. Header Information

- Each SOP contains within its name a two letter abbreviation of the general category in which it belongs (i.e. RE-001 means it is in Site Reconnaissance). The table of contents provides the definition for each abbreviation. The SOP name and number is provided in the header and footer of the document. The revision number is provided in the header of each SOP.
- The effective date is provided in the header of each SOP. The effective date provides the date when the revisions to the SOP are in effect and provides information as to the last time the SOP was updated. Each SOP should contain the most up-to-date version and effective date.

2.2. Footer Information

- Each footer contains the page number and total page numbers as well as a second reference to the SOP name. This should help organize and collate pages.

2.3. Body of Text

- Limitations are provided to describe precautions or common issues associated with the performance of the procedure.
- References provide sources consulted for development of the SOP.
- Attachments provide reference to external documentation that should be reviewed in conjunction with the SOP.
- At least one contact person is provided at the bottom of each SOP. These people should be contacted with any questions or comments on the particular SOP. The contact can clarify the SOP or edit as necessary.

2.4. Process for editing/updating SOPs

Should you need to make a global change to an existing SOP, the current .pdf version can be found on the Intranet.

In order to make your changes, you will need to request a WORD copy of the SOP from Andrea Hippler or Ryan Hoffman. Once you have made your changes, the SOP should be e-mailed to Andrea Hippler and Ryan Hoffman with a note as to what changed.

This document has been provided to all staff performing environmental field tasks for GEI's Atlantic and New England Regions.

3. Attachment

Attachment A – Acronym List

STANDARD OPERATING PROCEDURE

Abbreviations and Acronyms

AOC	Area of Concern
ASTM	American Society for Testing and Materials
BOD	Biological Oxygen Demand
BTEX	Benzene, Toluene, Ethyl Benzene, Xylenes
CAMP	Community Air Monitoring Plan
CERCLA	Comprehensive Environmental Response, Cleanup, and Liability Act
CFR	Code of Federal Regulations
COC	Chain of Custody
DL	Detection Limit
DNAPL	Dense Non-Aqueous Phase Liquid
DO	Dissolved Oxygen
DQO	Data Quality Objectives
EC	Engineering Controls
EIS	Environmental Impact Study
EPA	Environmental Protection Agency
FID	Flame Ionization Detector
FS	Feasiblity Study
FWRIA	Fish and Wildlife Resources Impact Analysis
GAC	Granular Activated Carbon
GC/MS	Gas Chromatograph/Mass Spectrometer
GFAA	Graphite Furnace Atomic Absorption Spectrometry
GIS	Geographic Information Systems
GPR	Ground-penetrating Radar
HASP	Health and Safety Plan
HOC	Halogenated Organic Compound
HDPE	High Density Polyethylene
HPLC	High Pressure Liquid Chromatography
HSO	Health and Safety Officer
IC	Institutional Controls
ICP	Inductively Coupled Plasma Atomic Emission Spectrometry
IDW	Investigation Derived Waste
LEL	Lower Explosive Limit
LNAPL	Light Non-Aqueous Phase Liquid
MCL	Maximum Contaminant Level (for EPA Drinking Water Standards)
MDL	Method Detection Limit
MGP	Manufactured Gas Plant
MSDS	Material Safety Data Sheet
NAPL	Non-aqueous Phase Liquids

NCP	National Contingency Plan
NPL	National Priority List
OSHA	Occupational Safety and Health Administration
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PID	Photoionization Detector
QA/QC	Quality Assurance / Quality Control
QAPP	Quality Assurance Project Plan
QHHEA	Qualitative Health and Human Exposure Assessment
RAO	Remedial Action Objectives
RAP	Remedial Action Plan
RCRA	Resource Conservation Recovery Act
RD	Remedial Design
RI	Remedial Investigation
RFP	Request For Proposal
RP	Responsible Party
SARA	Superfund Amendments and Reauthorization Act
SCGs	Standards, Criteria, and Guidance
SMP	Site Management Plan
SOP	Standard Operating Procedure
SOW	Scope of Work or Statement of Work
SPLP	Synthetic Precipitate Leaching Procedure
STEL	Short-Term Exposure Limit
SVE	Soil Vapor Extraction
SVOC	Semi-Volatile Organic Compounds
SWMU	Solid Waste Management Unit
TCLP	Toxicity Characteristic Leaching Procedure
TIC	Tentatively Indentified Compound from Mass Spectrometry
TOC	Total Organic Carbon
TOSCA	Toxic Substance Control Act
TPH	Total Petroleum Hydrocarbons
TWA	Time Weighted Average
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
USGS	United States Geologic Survey
VOC	Volatile Organic Compounds
WP	Work Plan
XRF	X-Ray Fluorescence

MEASUREMENTS

ppm	Parts per million
ppb	Parts per billion

ppbv	Parts per billion by volume
ppmv	Parts per million by volume
bgs	Below Ground Surface
msl	Mean Sea Level
ppbv	Parts per billion by volume
µg/L	Microgram per liter
µg/Kg	Microgram per kilogram
µg/m3	Microgram per cubic meter
mg/L	Milligram per liter
mg/kg	Milligram per kilogram
Mf/L	Million fibers per liter

Section 2

Pre-Mobilization Activities (PM)

STANDARD OPERATING PROCEDURE

PM-001 Utility Markout and Clearance

1. Objective

Describe typical utility markout/clearance procedures prior to and during excavation. All markout procedures should be performed in accordance with local and state regulations.

Many states, by law, require that utility companies are notified before excavation begins. Actual procedures and requirements differ by state. City/state government may have additional requirements for utility markout procedures. Check the requirements in the locality before beginning. Also check with the GEI project manager to determine whether it is most appropriate for GEI or the drilling/excavation subcontractor to handle mark out and clearance.

2. Execution

Public Utility Markouts

- The drilling/excavation locations should be marked with white paint, stakes, or flags.
- The contractor should call the appropriate one call communication network for the state the work is being conducted in. Refer to the Reference section in this SOP for contact information. Contractors shall provide all necessary information to the one call system. Sample location maps may be provided to clarify sampling locations. The contractor shall provide GEI with the utility clearance ticket number.
- If necessary, contact the municipalities or other utility owners to mark their water, sewer, or other lines if they do not belong to the one call system. The contractor should keep a record of these calls.
- Utility plans, if available, should be obtained from the property owner or municipal offices.
- Prior to excavation, a visual check should be made that all utilities companies and municipalities have marked their locations. This includes looking for signs that a utility exists, and verifying that the markings agree with a visual check. If they do not, contact the appropriate utility to remark their locations.
- Utilities will generally only markout and clear utilities in roadways or other public property up to the property boundary. Owners of fiber optic cables, natural gas pipelines, and other high hazard utilities will often markout on private property if requested. The contractor should request this. See section on private utility clearance below.
- Public agencies, utilities, contractors, other associations, manufacturers and all others involved in excavation should adopt the American Public Works Association (APWA) Uniform Color Code using ANSI standard Z535.1 Safety Colors for temporary marking and utility identification, as follow:

The APWA Uniform Color Code

1. **White** – Proposed Excavation
2. **Pink** – Temporary Survey Markings
3. **Red** – Electric Power Lines, Cables, Conduit and Lighting Cables
4. **Yellow** – Gas, Oil, Steam, Petroleum & Gaseous Material
5. **Orange** – Communications, Alarm or Signal Lines, Cables or Conduit
6. **Blue** – Potable Water
7. **Purple** – Reclaimed Water, Irrigation and Slurry Lines
8. **Green** – Sewers and Drain Lines

However, not all organization do use these colors. Make sure the color scheme is understood.

- The excavator/contractor and consultant begins work on the scheduled work date and time (if all the facility operators have responded) taking care to find and preserve any markings that have been made.
- If markings may be disturbed during work, establish offset marks to create reference points for the underground utilities. Take photographs of the markings before starting work.
- When digging near a buried utility, the excavator/contractor and consultant should be aware of their proximity to the utility and use caution.
- If there is uncertainty about the accuracy of the markings or there are too many utilities in a given location to excavate or drill safely, consideration should be given to hand-digging the first few feet, vacuum excavation, or use of a utility location company as detailed below in Private Utility Markouts.
- Some clients may require hand or vacuum clearance to a minimum depth. Check with the GEI project manager.
- If exposing a utility, the excavator/contractor should provide proper support and protection for the utility to prevent damage. Contact the utility operator for support, guidance, or assistance.
- When the excavation is complete, the excavator/contractor should provide proper backfill for any utilities that have been exposed.

Private Utility Markouts

- Utility markouts on private property should follow the steps outlined above in public utility markouts with the additions below.
- If work is conducted on private property where public utilities may not provide markouts and the property owner cannot provide accurate utility plans, it is

recommended to use a company to determine the utility locations using one or more of the following technologies:

i. Electro-Magnetic (EM) device: This technology uses an electro-magnetic field in the subsurface to accurately locate metallic lines or non-metallic lines incorporating a metallic trace wire along their surface. The field is created either by direct contact to the pipe or tracewire, or by an induced current via radio waves.
ii. Sewer Sonde: For non-metallic lines where internal access is possible (such as clean-out ports in a sewer), a beacon or 'sonde' that emits a signal to the surface receiver as it is snaked through the pipe provides the same accuracy as the EM detector. If the internal condition of the pipe is desired, a camera can be deployed instead of a simple sonde.
iii. Ground Penetrating Radar (GPR): This technology involves radar waves reflecting to a surface receiver which provides a visual real-time map of the subsurface by which anomalies (such as pipes or tanks) may be detected. It has limitations in clay or wet soils and requires a skilled operator for interpretation. GPR should be considered for high risk utilities (e.g. PVC natural gas lines without trace wire) where line-of-sight project from site entry point to a kiosk or other building is uncertain.

- Utility markout on private property should include clearance for other types of underground structures such as underground storage tanks, septic systems, utility or access tunnels, and in-ground irrigation systems.

3. Limitations

- Markout notification time usually does not include holidays. Make sure holidays are considered and markout time is scheduled accordingly. Do not conduct excavation or drilling prior to the required wait time. Do not mark excavation locations using spray paint if it is raining or snowing enough so that the paint markings will be washed away. Consider using long stakes instead of paint if snow is predicted. Excavations within the tolerance zone should be performed with non-powered hand tools until the marked utility is exposed. The tolerance zone may be determined by the utilities, law or codes.
- When excavating close to an underground utility, it is good practice for the contractor/excavator to have a spotter assist and guide the machine operator.
- Take care not to damage the conduit or protective coating of a utility. If the excavator/contractor damages this, leave the damaged utility exposed and immediately call the utility owner.
- If contact to a gas utility occurs, notify police, fire, and emergency personnel, and evacuate employees and general public. No attempt should be made to tamper with or correct the damaged utility.

4. References

Connecticut
Name: Call-Before-You-Dig (CBYD)
Telephone: 811 or 1-800-922-4455
Website: www.cbyd.com
Wait time after notification: 2 business days (excluding holidays)
Expiration of markout: 30 days

Massachusetts, Maine, New Hampshire, Rhode Island and Vermont
Name: Dig Safe
Telephone: 811 or 1-888-DIG-SAFE
Website: www.digsafe.com
Wait time after notification:
MA, ME, NH, and RI: 3 business days (excluding holidays)
VT: 2 business days (excluding holidays)
Expiration of markout: 30 days

New York State
Name: Dig Safely New York
Telephone: 811 or 1-800-962-7962
Website: www.digsafelynewyork.com
Wait time after notification: 2 business days (excluding holidays)
Expiration of markout: 30 days

New York City/Long Island
Name: New York City One Call Center
Telephone: 811 or 1-800-272-4480
Website: www.nycli1calldsi.com
Wait time after notification: 2 to 10 days (excluding holidays)
Expiration of markout: 30 days

New Jersey
Name: New Jersey One Call
Telephone: 811 or 1-800-272-1000
Website: www.nj1-call.org
Wait time after notification: 2 business days
Expiration of markout: 45 days

5. Attachment

Attachment A – Standard Utility Color Codes

6. Contact

Anne Leifer

SOP PM-001

Attachment A – Standard Utility Color Codes

Color Code	Utility Description
Red	Electric
Yellow	Gas-Oil
Orange	Communications
Blue	Water
Green	Sewer
White	Proposed Excavation

Section 3

Field Documentation (FD)

STANDARD OPERATING PROCEDURE

FD-001 Field Notebook

1. Objective

Describe methods for documentation of field activities.

Documentation of site activities is a crucial part of the field investigation process. The field notebook serves as the record of field activities performed or observed during the project. It provides a factual basis for preparing field observation reports, if required, and reports to clients and regulatory agencies. Example field notes are provided in Attachment A.

2. Execution

- Use a separate all-weather bound notebook for each site/location/project number. Spiral notebooks should not be used because pages can be easily removed.
- Write neatly using black or blue pen, preferably a waterproof pen. Use of pencil is also acceptable only with approval of the project manager, such as in but not limited to, certain field conditions [e.g., cold or wet weather].
- Write the project name, project number, book number (i.e., 1 of 3), and date on the front cover. On the inside cover, identify the project name, project number, and "Return Book To:" the office address of the project manager.
- Number all of the pages of the field book starting with the first entry.
- Record activities as they occur. Record only facts and observations, regardless of whether they appear to be relevant at that time.
- Identify conditions or events that could affect/impede your ability to observe conditions (e.g. snow-covered ground surface, inability to access areas of interest).
- Neatly cross out mistakes using a single line and initial them. Erasures are not permitted.
    - If an error is made on an entry in the field notebook, the individual who made the entry should make the corrections. The corrections must be initialed and dated by the person making the correction.
- Sign or initial and date the bottom of every page with an entry if the project requires such documentation.
- Place a diagonal line through unused portions of a page.
- Record the following information upon each arrival at the site:
    - Date/time/weather.
    - GEI personnel.
    - Purpose of visit/daily objectives.
    - People (client, contractor, landowners, etc.) present upon GEI arrival.

- Record the following information during the course of the day:
  - Conversations with contractors/subcontractors, clients, visitors, GEI staff, landowners (site or abutters). If possible, record complete names, titles, and affiliations.
  - Time of arrival and departure of individuals.
  - Activities as they occur.

- Additional examples of observations to record may include and are not limited to:
  - Type and quantity of monitoring well construction materials used.
  - Use of field data sheets or electronic logging equipment (e.g. boring logs, monitoring well sampling logs, etc.).
  - Ambient air monitoring data.
  - Field equipment calibration information.
  - Locations and descriptions of sampling points.
  - Contractor/Subcontractor progress.
  - Sample media (soil, sediment, groundwater, etc.).
  - Sample collection method.
  - Number and volume of sample(s) collected and sample bottle preservatives used.
  - Sample identification number (s) and date and time of sample collection.
  - Approximate volume of groundwater removed before sampling.
  - Any field observations made such as pH, temperature, turbidity, conductivity, water level, etc.
  - References for maps and photographs of the sampling site(s).
  - Information pertaining to sample documentation: bottle lot numbers/ dates, method of sample shipments, chain-of custody record numbers, and overnight shipping numbers.
  - Surveying data (including sketches with north arrows).
  - Changes in weather.
  - Rationale for critical field decisions.
  - Recommendations made to the client representative and GEI Project Manager.
  - Site sketch of conditions at the end of the day.
  - Summary of work completed/work remaining.
  - Allow time at the end of the day to complete entries in the notebook.

3. References

New Jersey DEP Field Sampling Procedures Manual, August 2005.

ASFE Daily Field Report for Geotechnical Field Observation, 2nd Edition (2001), ASFE, Inc.

4. Attachments

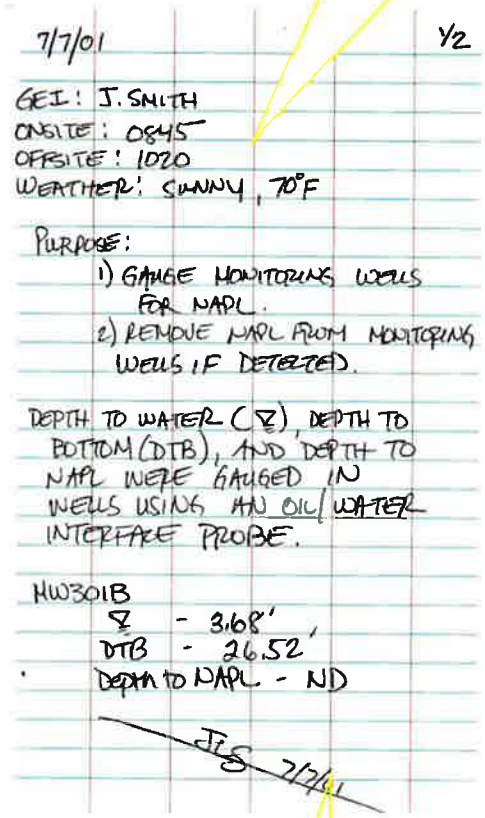
Attachment A - Example Field Notes

5. Contact

Melissa Felter
Leslie Lombardo

SOP FD-001

Attachment A – Example Field Notes



7/7/01 Y2

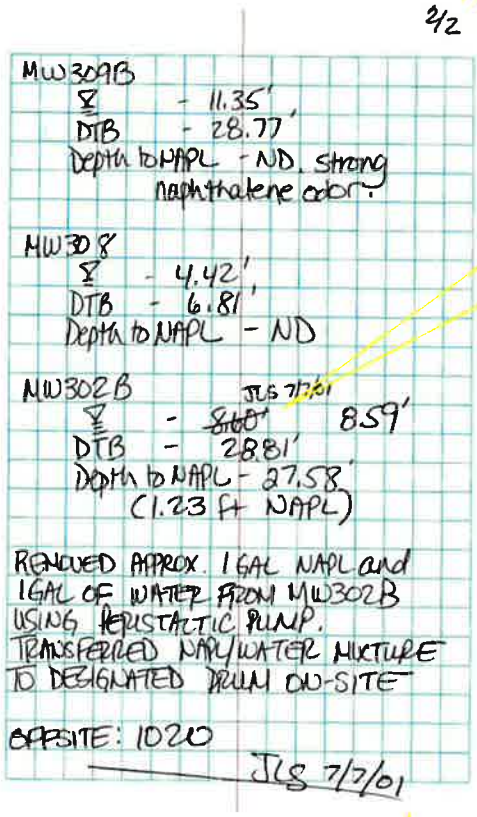
GEI: J. SMITH
ONSITE: 0845
OFFSITE: 1020
WEATHER: SUNNY, 70°F

PURPOSE:
1) GAUGE MONITORING WELLS FOR NAPL.
2) REMOVE NAPL FROM MONITORING WELLS IF DETECTED.

DEPTH TO WATER (▽), DEPTH TO BOTTOM (DTB), AND DEPTH TO NAPL WERE GAUGED IN WELLS USING MN OIL/WATER INTERFACE PROBE.

MW301B
▽ - 3.68'
DTB - 26.52'
DEPTH TO NAPL - ND

JLS 7/7/01



2/2

MW309B
▽ - 11.35'
DTB - 28.77'
DEPTH TO NAPL - ND. Strong naphthalene odor.

MW308
▽ - 4.42'
DTB - 6.81'
DEPTH TO NAPL - ND

MW302B
▽ - ~~8.60'~~ JLS 7/7/01 8.59'
DTB - 28.81'
DEPTH TO NAPL - 27.58'
(1.23 ft NAPL)

REMOVED APPROX. 1 GAL NAPL and 1 GAL OF WATER FROM MW302B USING PERISTALTIC PUMP. TRANSFERRED NAPL/WATER MIXTURE TO DESIGNATED DRUM ON-SITE

OFFSITE: 1020

JLS 7/7/01

Start of each day includes:
- Date
- Project Number
- People on site
- Purpose of Work
- Weather Conditions

Each page is numbered

Errors are single line crossed out and initialed

Blank Space crossed out and initialed

Bottom of each page signed and dated

GEI Consultants

STANDARD OPERATING PROCEDURE

FD-002 Field Observation Report

1. Objective

Describe methods to generate a Field Observation Report.

The Field Observation Report is used to record a summary of activities, observations, and decisions made during the day's field work. The daily field observation report serves as a permanent record of the day's activity for the Project Manager (PM), In-House Consultant (IHC), and/or client.

2. Execution

- If required, at the close of the day's field work, a Field Observation Report should be prepared by the individual responsible for the field notebook. This report should be completed before leaving work for the day. Contents of the report should include, at a minimum, the following information:
    - A record of person(s) present at the site, time of arrival, departure times (e.g., GEI, contractor(s), client, etc.).
    - A record of the daily objective(s) and the activities performed (e.g., drilled five borings in the overburden).
    - A summary of deviation(s) from the field plan or objectives.
    - A summary of field decisions made, who made them, and the basis for such decisions.
    - A diagram, sketch, and/or map showing the location and extent of the work or other significant observation(s) made during the day.
    - Recommendations that may result from field observations and actions that may result from implementation of those recommendations.
    - A summary listing and field sketch showing location(s) of field activity.
- Submit a draft report to the PM/IHC for review. Complete any editorial changes, sign, date, and submit the report to PM/IHC for approval/signature. Field Observation Reports should be written neatly. They are not required to be typed unless specifically requested by the PM.

3. Limitations

- The Field Observation Report is not a substitute for the field notebook.
- Not all projects require daily Field Observation Reports.
- The Field Observation Report should be based primarily on factual information. Opinions, if necessary, should be identified as such. Any speculation should be clearly noted in the report as such.

- The Field Observation Report should never be released to anyone other than the PM/IHC prior to review and sign-off unless explicitly authorized by the PM/IHC.

4. References

New Jersey DEP Field Sampling Procedures Manual, August 2005

ASFE Daily Field Report for Geotechnical Field Investigations, 2nd Edition (2001), ASFE, Inc.

5. Attachments

Attachment A - Example Field Observation Report

6. Contact

Melissa Felter
Leslie Lombardo

FIELD OBSERVATION REPORT

Project :	Guard Booth Upgrades	**Date:**	November 8, 2006
Client :	ACME Industries	**Report No.**	1
Contractor:	ABC Contracting	**Page:**	1 of 2
Subcontractor:	NA	**GEI Proj. No.**	99999-0

SOP FD-002 - Attachment A – Example Field Observation Report

Time of Arrival: 0700 **Departure: 1440** **Weather: Overcast, Raining, 55^{0}F**

Persons Contacted, Company
Jane Doe, ABC Contracting

GEI Representatives
Bill Smith

Purpose of Site Visit: To observe excavation of soils for new guard booth and sidewalk.

Observations:

1. **Excavation**
   a. Areas for guard booth and sidewalk were laid out by ABC with stakes, string, and spray paint. Locations were between the pavement and wetland area; no excavation occurred in the wetland area.
   b. Staging area for soil stockpile was located to the west of the excavation, along the fenceline; polyethylene sheeting was placed beneath the pile.
   c. HDPE membrane delivered to site; stored in garage area through the inside fence.
   d. ABC crew began hand digging area for sidewalk and guard booth. Sidewalk area measured 22 feet long by 4 feet wide by 4 inches deep. Guard booth area measured 12 feet long by 10 feet wide by 9 inches deep. Utility pole and bollard locations started today.
   e. Rain continued to get worse in the afternoon; ABC covered the entire excavation and soil stockpile with poly sheeting and secured the sheeting with grade stakes.

2. **Subgrade Preparation**
   a. Subgrade preparation for the sidewalk and guard booth areas at the site is complete.

3. **Dewatering**
   a. No dewatering occurred today.

4. **Air Monitoring**
   a. During excavation, I monitored the breathing zone of the workers with an organic vapor meter (OVM). No headspace readings were measured in soil samples S-1 through S-8.

GEI

FIELD OBSERVATION REPORT

Project :	Guard Booth Upgrades	**Date:**	November 8, 2006
Client :	ACME Industries	**Report No.**	1
Contractor:	ABC Contracting	**Page:**	2 of 2
Subcontractor:	NA	**GEI Proj. No.**	99999-0



Picture 1: Sidewalk excavation and bollard layout

By: Bill Smith	**Reviewed By:**

GEI

STANDARD OPERATING PROCEDURE

FD-003 Sample Management and Chain of Custody

1. Objective

Describe methods to label sample containers, manage the samples, and prepare Chain of Custody documentation for the samples. Sample transport is also addressed.

2. Project Setup

When setting up a sampling event, inform the recipients of the samples (laboratories) and recipients of laboratory results (data group and project managers). Discuss with the laboratory the sampling media, turnaround times, and reporting limits for appropriate regulatory criteria for the site. Include the data group on correspondence so that turnaround times, data validation, and project deliverable schedules can be tracked successfully.

- Laboratory - Number of samples, analyses needed: bottle orders and holding times, turnaround times needed, reporting limits needed for regulatory criteria.
- Data group - Number of samples, analyses requested, turnaround times and reporting limits requested, data validation needed, regulatory criteria to use for tabulating results, deliverables needed, and project name and number.
- Schedule - Inform the laboratory and Data Group of schedule delays, changes to analyses, and expediting.

3. Sampling Execution

- Review the work plan prior to sampling to determine the following:
  - Sample matrix and sampling method.
  - Required analysis and sample volumes.
  - Sample container type and preservative requirements.
  - Required analysis methods and/or report formats.
  - The turnaround time required by the project.
  - If the data will be sent directly from the laboratory to the data validator, Project Manager, or Data Group.
  - Holding time restrictions for sampling media and analytical methods.
  - Sample naming convention used for this project site.
- Sample labels should be filled out using a waterproof or permanent marker or pen. Required information includes:
  - Sample ID.
  - Date and time (military time) of sample collection.
  - Project number.
  - Sample preservatives.
  - Sampler's initials.
  - Laboratory analytical methods.

- Place the label on the jar or bottle, not on the cap. Sample custody begins at this time.
- Record the above information in the field notebook.
- Individually wrap sample jars with packing material, if needed. See SOP SC-002 for guidance on packaging samples for shipment to the laboratory by way of common carrier. Place samples in a cooler with bagged ice or freezer packs (blue ice) immediately after collection. Add sufficient ice or freezer packs to cool samples to approximately 4°C.
- Complete a chain of custody (COC) for the samples as described below. GEI or laboratory COCs may be used as long as they contain fields for all required sample information as described in Section 2.1.

3.1. Chain-of-Custody (COC) Completion

- Fill out COC neatly and in permanent ink. Alternatively, an Excel version of the GEI COC is available and can be filled out electronically.
- Certain analyses (i.e. air analysis by TO-15) require specialized, laboratory issued COCs. Make sure any specialized COCs are available before sample collection.
- Record the project name and number, the sampler's name(s) and the state where the samples were collected.
- For each sample, enter the sample identification number, date and time (military time) collected, the number of sample containers, and any additional information to fulfill project, client or regulatory requirements.
- Record the type of analysis (including laboratory method; e.g. EPA-SW846 Method XX) requested and the preservative (if appropriate) in the vertical boxes.
- Field duplicates should be anonymous to the laboratory, but must be recorded for use by the Data Group. To keep track of this information, link the field duplicate with the proper sample in the field notebook. If required by the Project Manager or Data Group, also document this information on or attach a note to the GEI copy of the COC.
- Trip blanks for large sites should be named similar to the samples they are collected with so that there are not two of the same sample name for the same site. For example, "OU1TB-122509" and "OU3TB-122509" would avoid any mistakes.
- Strike incorrect entries on the COC with a single line, followed by the initials of the person making the correction, the date, and the correct entry.
- When sample custody is ready to be relinquished, complete the bottom of the form with date and time (military time) and signatures of relinquisher and receiver of samples as indicated. The sample collector is always the first signature while the analytical laboratory is the final signature. Theoretically, all individuals handling the samples between collection and laboratory should sign the form; however, if a common carrier (i.e., Federal Express, UPS) is used for shipping, GEI must identify the carrier in the 'Received by' box on the

COC. If the sampler hand delivers the samples to the laboratory, the received box must be signed by the laboratory.

- If the samples are placed in a designated secure area (e.g. GEI sample fridge), note this location in the "Received by" box on the COC.
- GEI uses both single sheet and triplicate COCs. If using the triplicate COCs (white, yellow, and pink copies), the pink copy should be retained by the sampling personnel and provided to the Data Group for proper filing. The white and yellow copies should accompany the samples to the laboratory.
- If you are using the single sheet COC, make a copy of the COC after it has been signed by the lab courier and forward it to the Data Group.
- Prior to sample shipment by common carrier, the COC must be placed inside the cooler in a Ziplock bag or other watertight package.
- If a common carrier such as FedEx is used to transport the samples to the laboratory, include the carrier tracking number and identify the carrier in the "Received by" box on the COC.
- If a courier is used to transport samples to the laboratory (lab courier or GEI personnel), the courier signs the COC in the "Received by" box.
- Place a custody seal on the cooler if shipping via common carrier.
- Transport samples to the laboratory as soon as possible. It is preferable to transport the samples directly to the laboratory from the field. Samples brought back to the office for storage prior to submission to the laboratory must be kept cold (4° C).
- Unused sampling containers/media that are sent back to the lab should be included on a separate COC.
- After the samples are sent to the laboratory, the GEI copy of the COC must be forwarded to the Data Group: datagroup@geiconsultants.com.

4. Limitations

- Keep the number of people involved in handling samples to a minimum.
- Where practical, only allow people associated with the project to handle the samples.
- Always document the transfer of samples from one person to another on the COC.
- The COC should always accompany the samples.
- Give samples positive identification at all times that is legible and written with waterproof or permanent ink.
- When sending samples via a common carrier, use one COC per package.
- Where practical, avoid sending samples from more than one site with separate COCs in a single package.

5. References

New Jersey Department of Environmental Protection, Field Sampling Procedures Manual, August 2005.

Connecticut Department of Environmental Protection, Guidance for Collecting and Preserving Soil and Sediment Samples for Laboratory

6. Attachments

Attachment A - Example Chains of Custody
Attachment B - Shipping Info Pics

7. Contact

Leslie Lombardo

Chain of Custody Record

Example COC

STL Connecticut
128 Long Hill Cross Road
Shelton, CT 06484
Tel: 203-929-8140

SEVERN TRENT **STL**
Severn Trent Laboratories, Inc.

STL-4124 (0901)

Client: GEI	Project Manager: Dave Terry	Date: 12-31-07	Chain of Custody Number: 00452
Address: 455 Winding Brook Dr	Telephone Number (Area Code)/Fax Number: 860 368 5300 / 860 368 5307		Lab Number:
City: Glastonbury / State: CT / Zip Code: 06033	Site Contact: M. Felter	Lab Contact: Paul Hobart	Page 1 of 1
Project Name and Location (State): Carroll Gardens NY	Carrier/Waybill Number: FedEx 9383 7603 0879		
Contract/Purchase Order/Quote No.			

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil	Containers & Preservatives: Unpres.	H_2SO_4	HNO_3	HCl	NaOH	Zn Ac/ NaOH	Analysis: VOC 8260B	SVOC 8270C	TO-15 + NAPHTHALENE	Special Instructions/ Conditions of Receipt
CGSB-01 (0-2)	12-31-07	1130				X	X						X	X		
CGSB-02 (3-4)	12-31-07	1250				X	X						X	X		
CGSB-02 (3-4) MS	12-31-07	1250				X	X						X	X		
CGSB-02 (3-4) MSD	12-31-07	1250				X	X						X	X		
CGSB-XX (5-6)	12-31-07	0800				X	X						X	X		
CGTB-123107	12-31-07	1400				TB				X			X			
CGGW-01	12-31-07	1430		X			X			X			X	X		
CGSG-01	12-31-07	0700-1500	X												X	CANISTER # 2613 REGULATOR # 779

BY NEW JERSEY: "CLP data package deliverables"

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☒ Unknown

Sample Disposal
☐ Return To Client ☒ Disposal By Lab ☐ Archive For _____ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required
☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☒ Other see contract

QC Requirements (Specify) NYS Cat B ASP deliverable send to Lorie Mackinnon

Send EDD to datagroup@geiconsultants.com

	Date	Time		Date	Time
1. Relinquished By: Melissa J Felter	12-31-07	1600	1. Received By: FedEx WAYBILL 923117-4432	12-31-07	
2. Relinquished By			2. Received By		
3. Relinquished By			3. Received By		

Comments
USED FLOW CONTROLLER FOR AIR SAMPLE INCLUDED

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

EXAMPLE COC

Chain-of-Custody Record

Laboratory: Accutest

Laboratory Job # (Lab use only)

GEI Consultants
400 Unicorn Park Dr.
Woburn, MA 01801
PH: 781.721.4000
FX: 781.721.4073

Project Information

Project Name: MWRA - Low Service Storage Tank
Project Location: Stoneham, MA
Project Number: 093400
Project Manager: D. Aghjayan

Send Report to: rseigener@geiconsultants.com
Send EDD to: labdata@geiconsultants.com

MCP PRESUMPTIVE CERTAINTY REQUIRED – YES NO

If Yes, Are MCP Analytical Methods Required? YES NO NA
If Yes, Are Drinking Water Samples Submitted? YES NO NA
If Yes, Have You Met Minimum Field QC Requirements? YES NO NA

Lab Sample Number	GEI Sample ID	Collection Date	Collection Time	Matrix	No. of Bottles	Sampler(s) Initials	Preservative	Analysis: PCBs	VPH Fractions Only	EPH Fractions Only	SVOCs	VOCs, % Solids**	Conductivity	RCRA 8 Metals*	TPH by GC/FID DRO
								None	MeOH	None	None	MeOH	None	None	None
	093400-LS6-S5(19'-21')	12/29/2009	9:30	SO	3	JMR			x			x			
	093400-LS6-COMP (FILL)	12/29/2009	9:30	SO	1	JMR		x		x	x		x	x	x
	093400-LS6-COMP (NATIVE)	12/29/2009	15:00	SO	1	JMR		x		x	x		x	x	x
	093400-LS8-COMP	12/29/2009	14:00	SO	1	JMR		x		x	x		x	x	x
	093400-LS9-S4 (8'-8'-5")	12/30/2009	14:30	SO	3	JMR			x			x			
	093400-LS9-COMP	12/30/2009	15:00	SO	1	JMR		x		x	x		x	x	x

Sample Handling

Samples Field Filtered
YES NO NA

Sampled Shipped With Ice
YES NO

Sample Specific Remarks

MCP Level Needed: GEI requires the most stringent Method 1 MCP standard be met for all analytes whenever possible.

Relinquished by sampler: (signature)	Date:	Time:	Received by: (signature)
1. Joseph M. Reynolds	12/30/09	16:30	1. GEI FRIDGE
Relinquished by: (signature)	Date:	Time:	Received by: (signature)
2. GEI FRIDGE	1/4/10	1310	2. Naomi Gleyzer
Relinquished by: (signature)	Date:	Time:	Received by: (signature)
3. Naomi Gleyzer	1/4/10	1310	3. [illegible]
Relinquished by: (signature)	Date:	Time	Received by: (signature)
4.			4.

Turnaround Time (Business days):

Normal _X_ Other ____
10-Day ____ 7-Day ____
5-Day ____ 3-Day ____

Before submitting rush turnaround samples, you must notify the laboratory to confirm that the TAT can be achieved.

Additional Requirements/Comments/Remarks:

Please use MA Landfill List

* Please run TCLP analysis for RCRA 8 Metals results that exceed the 20 times rule.

** Please use % solids sample for VOC and VPH analysis of 093400-LS6-COMP (FILL), 093400-LS6-COMP (NATIVE), 093400-LS8-COMP, and 093400-LS9-COMP

Chain-of-Custody Record

Laboratory:

Laboratory Job #
(Lab use only)

GEI Consultants

455 Winding Brook Drive, Suite 201
Glastonbury, CT 06033
PH: 860.368.5300
FX: 860.368.5307

Project Information

Project Name/Number:

Project Location:

Project Contact:

Phone Number:

Page __ of __

Send Report to:

Send EDD to: datagroup@geiconsultants.com

Preservative

Analysis

Sample Handling

Samples Field Filtered

YES NO NA

Samples Shipped With Ice

YES NO

Deliverables:

If Yes, Have You Met Minimum Field QC Requirements? YES NO NA

Lab Sample Number	GEI Sample ID	Collection		Matrix	No. of Bottles	Sampler(s) Initials	Sample Specific Remarks
		Date	Time				

Relinquished by sampler: (signature)	Date:	Time:	Received by: (signature)
1.			1.
Relinquished by: (signature)	Date:	Time:	Received by: (signature)
2.			2.
Relinquished by: (signature)	Date:	Time:	Received by: (signature)
3.			3.
Relinquished by: (signature)	Date:	Time:	Received by: (signature)
4.			4.

Turnaround Time (Business days):

Normal ____ Other ____

10-Day ____ 7-Day ____

5-Day ____ 3-Day ____

Before submitting rush turnaround samples, you **must** notify the laboratory to confirm that the TAT can be achieved.

Additional Requirements/Comments/Remarks:

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

PACKING SAMPLES FOR SHIPMENT BACK TO THE LABORATORY



A. Line cooler with bubble wrap and large plastic bag. Use absorbent pad inside the bag if bottles contain preservatives.



B. Wipe outside of bottles and put glass in individual bubble bags & seal. Place bottles & the temperature blank into cooler. Leave room for ice in between bottles & on top.



C. Place double bagged or loose ice randomly around bottles throughout the cooler.



D. Place large bag of ice or loose ice on top of the bottles. In warm weather, the cooler should be packed with as much ice as possible.



E. Close outer bag, compress excess air out of bag, twist top and knot. If necessary, use more bubble wrap to fill the dead air spaces. Place chain of custody (COC) and other paperwork in plastic bag and seal. Place on top of cooler.



F. Close cooler, place signed and dated Custody Seals over opening. Tape over the Custody Seal and seal cooler securely. Fill out overnight shipping waybill and attach to the top or handle of the cooler. Attach Saturday delivery stickers if needed. Ship according to DOT regulations.

Rev 011209

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

PACKING SAMPLES FOR SHIPMENT BACK TO THE LABORATORY



A. Line cooler with bubble wrap and large plastic bag. Use absorbent pad inside the bag if bottles contain preservatives.



B. Wipe outside of bottles and put glass in individual bubble bags & seal. Place bottles & the temperature blank into cooler. Leave room for ice in between bottles & on top.



C. Place double bagged or loose ice randomly around bottles throughout the cooler.



D. Place large bag of ice or loose ice on top of the bottles. In warm weather, the cooler should be packed with as much ice as possible.



E. Close outer bag, compress excess air out of bag, twist top and knot. If necessary, use more bubble wrap to fill the dead air spaces. Place chain of custody (COC) and other paperwork in plastic bag and seal. Place on top of cooler.



F. Close cooler, place signed and dated Custody Seals over opening. Tape over the Custody Seal and seal cooler securely. Fill out overnight shipping waybill and attach to the top or handle of the cooler. Attach Saturday delivery stickers if needed. Ship according to DOT regulations.

Rev 011209

STANDARD OPERATING PROCEDURE

FD-004 Photo Documentation

1. Objective

Describe methods to document and retain photographic records.

Keeping a record of photographs taken is crucial to their validity as a representation of existing conditions.

2. Execution

- Photographs of a site, individual samples, or other observations should be taken using a digital camera.
- Set the camera to record the time and date for each photograph.
- All photographic records, along with the following information, should be recorded in the field notebook (SOP FD-001).
    - If applicable, the compass direction describing the direction the photograph was taken (e.g. looking southeast). This may not apply to photographs of individual samples.
    - Brief description of what the photograph is intended to show.
- The field notebook should note who took the photographs.
- The photographs should be electronically backed up on a computer or other data storage device.
- If photographs will be used in a report, memo, or letter, they should be placed on a photograph record template and the relevant information describing the photograph should be inserted into the caption section for each photograph.

3. Limitations

- Some clients and regulatory agencies require photographs of every subsurface soil sample collected. These photographs typically include a "whiteboard" which indicates the site, the boring ID, and the depth of the sample, while logging details are recorded in the field notebook. Under these circumstances, it is not necessary to include compass directions or descriptions.

4. References

New Jersey Department of Environmental Protection, Field Sampling Procedures Manual, August 2005.

5. Attachments

Attachment A – Example of Photo Documentation Template

6. Contact

Melissa Felter
Leslie Lombardo

Attachment A – Example of Photo Documentation Template
GEI Consultants, Inc.

Project: Project Name

Location: Project Location



Photographer: K. Barber
Date: 10/25/07
Photo No.: 1
Direction: N

Comments:
Entrance of site with tree mulching operations.



Photographer: K.Barber
Date: 10/25/07
Photo No.: 2
Direction: W

Comments:
On-site building built in 1936.

STANDARD OPERATING PROCEDURE

FD-006 Handheld Global Positioning Receiver Operation

1. Objective

Use handheld global positioning system (GPS) receivers to locate sample points and site features with "Mapping-Grade" accuracy.

Use handheld GPS receivers to "stake out" proposed sample point locations within the limits of "Mapping Grade" accuracy.

2. Execution

- Handheld GPS receivers provide a low-cost and user-friendly method for locating sample points and site features with a fair degree of horizontal accuracy.
- In simplistic terms, GPS works by measuring the distance from numerous orbiting satellites to a point on the earth surface. Individual satellites broadcast their real-time location in terms of x,y and z coordinates, and the distance from each satellite is measured as a function of the length of time that a time-stamped signal takes to reach the receiver. Built-in GPS software derives new points by intersecting the distances from known orbital locations – in much the same way that points are located by intersecting tape-measured distances from building corners or other pre-existing site features.
- Late-model handheld GPS receivers utilize a real-time differential correction technique called WAAS (Wide Area Augmentation System). This system was designed to provide greater confidence and reliability in using GPS data for commercial aircraft landing approaches, and the additional correction improves all GPS operations.
- Handheld GPS receivers display navigational information on a variety of standard pages. Although each manufacturer uses slightly different formats, all receivers toggle back and forth between the following visual presentations:
- A "satellite" page displays the relative orbital location of all GPS satellites that are currently being tracked by the receiver. The display may include information on the real-time geometrical strength of the solution: satellite intercepts that cross at right angles provide more accurate solutions than intercepts that cross at acute or obtuse angles.
- A "track" page that displays the travel path of the receiver while it is turned on, along with the relative location of recorded points. Many GPS models have a "track-back" function that will guide the user on the same path back to the starting point
- A "navigation" page that displays instantaneous location and the real-time direction and velocity of travel. Some units provide two pages to display this information in different formats. Most units will report the overall "course

made good" (straight-line bearing and distance from the starting point) at any point.

- A "waypoint" page that allows users to "Go To" a created point or previously recorded point by providing a straight-line bearing and distance to the point. The information is instantaneously updated as the user moves along; some units display a pointing arrow that directs the user to the direction of travel. Be careful of go-to lines that lead through swamps or over cliffs – if you will be travelling in difficult terrain have a paper copy of the USGS quadrangle and a compass on hand for navigation.
- Signal strength degrades significantly next to buildings and underneath tree canopy. Most GPS receivers have an "averaging" function to improve the accuracy of shielded locations. GPS users can also improve precision by locating points three times, at different times of the day. Two of the solutions will generally be closer to each other than to the third and can be averaged for a more reliable fix.
- Most GPS receivers default to latitude and longitude, but data is more accurate and easier to input and when expressed in UTM coordinates to the nearest meter. The handheld GPS setup will have a function somewhere to change to UTM. Most of Connecticut is in UTM Zone 18 but the easternmost parts are in Zone 19.
- Consult "Corpscon" the datum translator available from the National Geodetic Survey website. Corpscon translates instantly from latitude/longitude to UTM coordinates to state plane coordinates and provides tools to identify UTM Zones. Also consult the Trimble, Garmin and Magellan websites for technological improvements and discussion of advanced techniques.

3. Limitations

- Handheld GPS receivers operating in unobstructed locations are currently reckoned to provide 2-5 meter accuracy, meaning that the true location of measured points lie within an "error ellipse" with axes of 2-5 meters centered on the measured location. In other words, even under the best of conditions a real-time GPS solution may be as much as 20 feet off the true horizontal location of a point.
- Due to geodetic restrictions, vertical locations (elevations) have less than half the accuracy of horizontal locations, meaning that even under the best of conditions, a surface elevation displayed on a handheld GPS receiver may be off by more than 50 feet.
- Horizontal and vertical data derived from handheld GPS receivers should never be considered more than relatively accurate, and this level of uncertainty should be identified in any discussion of positional tolerance.

4. References

Trimble Website: .trimble.com
Garmin Website: .garmin.com

Magellan Website: .magellangps.com
National Geodetic Survey: ://www.ngs.noaa.gov/

5. Contact

Matt O'Neil

Section 4

Drilling Methods (DM)

STANDARD OPERATING PROCEDURES

DM-001 General Guidance on Determination of Appropriate Drilling Methods

1. Objective

There are multiple drilling methods which can be employed based on the type of stratum (e.g. overburden or bedrock) and the end use of borehole. End uses include geotechnical investigation, subsurface soil sampling, and monitoring well installation or a combination thereof.

The following text describes different methods of drilling with considerations for their use to collect groundwater and/or subsurface soil samples. Profiles of subsurface conditions encountered and well installation details must be recorded on logs. Procedures for field documentation are provided in Section 4 - Field Documentation.

2. Hollow-Stem Augers (HSAs)

Borings can be installed in unconsolidated formations using solid-stem or hollow-stem augers (HSAs). The augers are advanced by rotation and the drill cuttings are brought to the surface by travelling up the outside of the auger flights in a screw-like manner. HSAs have the advantage of allowing the well to be installed inside the hollow stem of the auger, which prevents the borehole from collapsing. Upon reaching the planned well depth, the casing and screen are placed inside the HSAs and the flights are individually removed while the annular space around the well is filled with the filter pack and grout, as appropriate. Conversely, solid-stem augers must be completely removed from the borehole before well installation, which can lead to collapse of the borehole. For this reason, solid stem augers are seldom used for installation of monitor wells.

HSAs come in a variety of sizes and allow collection of soil samples utilizing split spoons or Shelby tubes. Samples are collected ahead of the augers for determining soil/sediment type, stratigraphy, depth to the water table, and for collecting soil samples for chemical analysis. During this process, the standard penetration test (SPT, ASTM Method D 1586) can also be performed. The HSA method also has an advantage over mud-rotary drilling techniques in that drilling mud is not used. Drilling mud can contaminate the soil samples and potentially reduce the yield of the wells.

A disadvantage of the method is that HSAs cannot be used to drill into competent bedrock or through large boulders. Also, "heaving or running sands" can be forced up inside the augers as a result of strong vertical groundwater gradients, which can hamper efforts to collect soil samples or complete well installation. Furthermore, the maximum depth achievable using HSAs, which is generally shallower than other methods, is dependent not only on the ability of the rig (e.g., horsepower, rig-torque, weight of augers etc.), but also the lithology of the material drilled.

3. Rotary Drilling

Rotary drilling methods include both direct rotary and reverse-circulation rotary. Direct rotary is more commonly used in environmental investigations, whereas reverse-circulation rotary is used in drilling large-diameter water supply wells. In direct rotary drilling the borehole is advanced by rotating the drill pipe (rods) and bit to produce a cutting action. The cuttings are removed from the borehole by continuous circulation of a drilling fluid. The fluid or "mud" is pumped down the inside of the drill pipe and is circulated back to the surface on the outside of the pipe. The fluid removes the drill cuttings from the borehole and cools and lubricates the bit. Mud used during direct rotary consists of additives (e.g., bentonite), water, or air.

Reverse-circulation rotary drilling is similar to direct rotary except the drill rigs are larger and the flow of the drilling fluid is reversed. The drilling fluid moves upward inside the drill pipes and circulates back to the borehole via settling pits. The drilling fluid returns to the borehole via gravity and moves downward in the annular space between the drill pipe and borehole wall. Drilling fluids for reverse-circulation rotary are generally water and any suspended particles picked up from the surrounding formations.

Mud-rotary methods can be used to drill in both unconsolidated and consolidated (bedrock) formations. In addition, drilling mud stabilizes the borehole and limits the potential for borehole collapse. Disadvantages of using the mud-rotary method include the difficulty in determining the depth to the water table, the potential for drilling mud to impact soil samples and dragging of contamination into deeper zones since the drill cuttings are re-circulated in the borehole. Wells installed using this method typically take longer to develop than wells installed using the HSA or air-rotary methods due to the invasion of mud filtrate into the formation.

In air-rotary drilling, compressed air is directed down the inside of the drill pipe. As in mud-rotary drilling, air removes the cuttings and lubricates the bit. However, since air has no viscosity, it cannot be used to stabilize a borehole therefore, casing must be advanced in unconsolidated formations to keep the borehole open. This is why air rotary methods are best suited for drilling in bedrock formations. The percussion-type air-rotary "hammer" bit provides the best penetration rate when drilling bedrock consisting of crystalline rock. However, when drilling above the water table, an air-rotary bit can grind the soil and bedrock to a fine powder which is blown out of the hole with air and which has the potential to be inhaled. Therefore, drilling above the water table using air-rotary methods requires the addition of potable water to the borehole for dust control. In addition, the air compressor should be of the oil-less variety, or have a filter to prevent any oil from entering the borehole.

A disadvantage of using rotary methods while drilling in unconsolidated formations is the requirement of pulling the drill pipe out of the hole each time a split-spoon soil sample is collected (and the SPT is performed). This adds up to considerable amounts of time when deep wells are being installed or when continuous split-spoon

sampling is being performed. As stated above, split-spoons used to collect soil samples can become contaminated when they are advanced down a mud-filled borehole.

A special type of rotary drilling is bedrock coring, wherein a special core bit and barrel are used to retrieve relatively undisturbed core samples of the bedrock. Coring allows better characterization of bedrock lithology and other features including orientation of fractures and bedding planes, which can control contaminant migration. Core barrels can either be unoriented or oriented. An oriented core is scribed with respect to magnetic north. Although more expensive than collecting an unoriented core, this method gives the true orientation of the features encountered in the core.

Drilling fluids are generally air (air-rotary) or bentonite and/or water (mud-rotary). Water added to a borehole must be of potable quality. The source of the potable water used during the installation (and development) of monitor wells should be documented (e.g., in the Remedial Investigation Report).

Bentonite is high swelling clay with sodium montmorillonite as its primary clay mineral. Bentonite is added to water to increase the viscosity of the drilling fluid so that drill cuttings can be removed from the borehole more effectively. At the same time, the viscosity must be low enough to allow cuttings and coarse-grained particles to settle out once they are circulated out of the hole. Bentonite also adds weight to the drilling fluid, which helps to maintain borehole stability.

4. Sonic Drilling

The method involves driving a core barrel using vibration, rotation, and a downward force to collect soil samples. A sonic drill rig looks and operates very much like a conventional top-drive rotary or auger rig. The main difference is that a sonic drill rig has a specially designed, hydraulically powered drill head or oscillator, which generates adjustable high-frequency vibrational forces. The oscillator uses two eccentric, counter-rotating balance weights or rollers that are timed to direct 100 percent of the vibrational energy at 0 and 180 degrees. There is an air spring system in the drill head that insulates or separates the vibration from the drill rig itself. The sonic head is attached directly to the drill pipe or outer casing, sending the high-frequency vibrations down through the drill pipe to the bit.

A core barrel is advanced using vibration, rotation, and downward force to collect continuous soil cores up to 20 feet in length. The bit at the end of the core barrel contains carbide teeth allowing the core barrel to be advanced through most overburden, soft bedrock, and minor obstructions such as bricks and boulders. Once the core barrel has been advanced, a secondary or "over-ride" casing is advanced down to the same depth as the inner core barrel. The over-ride casing keeps the borehole from collapsing while the inner core barrel is removed. Once the core barrel is removed, the soil core is pushed out of the core barrel through the use of

vibration and either air or water pressure. Soil core diameters are dependent on the size of core barrel used and range from 3 to 12 inches. The use of multiple over-ride casings of increasing diameter allows the borehole to be telescoped down through multiple confining units. The setup used in sonic drilling makes this drilling method amendable to collecting soil cores and installing wells in angled boreholes. With only the bottom of the inner and outer core barrel exposed to the aquifer at any given time, determining the location of the water table can be difficult.

While this drilling method has the capability of drilling through and providing samples of coarse gravels, boulders, and tight clays, these situations will result in slow drilling or advancement of the core barrel. The result is a hotter core barrel and a longer contact time between the core barrel and the encased soil core. The aforementioned conditions will increase the probability that the sonic method will raise the temperature of the soil core and facilitate VOC and SVOC loss.

The ability to quickly install deep borings and wells, while generating a large-diameter continuous soil core, makes this drilling technique invaluable when continuous soil sampling is needed to assess deep or complex geological situations. However, sonic drilling's high cost, relative to other drilling methods, may be prohibitive for small projects or shallow boreholes. The higher cost of the drilling method should be weighed against the cost savings incurred due to its faster drilling rate and high quality of the soil core produced.

5. GeoProbe®-Direct Push

The method involves hydraulically pushing hollow rods into the subsurface for the purpose of collecting soil and/or groundwater samples (e.g., Geoprobe®). The method can be used to collect discrete soil samples or install small-diameter wells used to collect groundwater samples.

Advantages of the direct-push method include the relatively quick collection of groundwater samples and, when used along with a mobile laboratory, collection of data in "real" time. The method allows for collection of multiple samples in a day with the potential for achieving contaminant delineation in one mobilization of the field equipment. The data can also be used to select locations of permanent monitor wells.

Disadvantages of the method include the fact that the data quality achieved is often suitable only for screening purposes. Direct-push methods typically result in very turbid samples since an oversize borehole is not produced and a filter pack is not used. Turbid samples can produce higher metal concentrations in groundwater samples since metals are typically adsorbed onto soil particles. Use of direct-push methods can also cause cross-contamination since contamination from shallow zones may be driven down to deeper zones. Due to the narrow diameter of the direct-push rods, samples are often collected with peristaltic pumps. When samples are collected for volatile organic compounds (VOCs) using peristaltic pumps, some

of the volatiles may be lost due to the pressure drop produced by the suction lift. In such cases, the VOC data must be qualified accordingly. For this reason, use of the peristaltic pump for collecting groundwater samples for VOC analysis is not recommended and approval for its use should first be obtained from the project manager or geologist.

Another disadvantage of using direct-push technology for collecting groundwater samples is the potential to breech confining units. To prevent this, soil sampling using direct-push technology or conventional split-spoon sampling techniques should first be performed to identify the presence, depth and lateral extent of confining units. Pushing through confining units should be avoided if the presence of dense, non-aqueous-phase liquid (DNAPL) or very soluble compounds such as Methyl Tertiary Butyl Ether (MTBE) are suspected or the contaminant plume appears to be diving in the aquifer.

6. Contact

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STANDARD OPERATING PROCEDURE

DM-002 Hollow-Stem Auger

1. Objective

Describe standard operating procedures for drilling of overburden soil borings using hollow-stem augers.

2. Execution

- Confirm that the appropriate measures have been taken for clearance of potential subsurface utilities. The responsibility for clearance may vary, depending on the client.
- Inspect the drilling rig to make sure it is clean and that the down-hole equipment has been steam-cleaned or pressure-washed. Record observations in the field notebook (See SOP FD-001).
- Observe that the augers are vertical when the first section is advanced into the ground.
- Use a 140-lb hammer to drive the sampler, unless conditions necessitate using a 300-lb hammer (see SOPs SM-001, *Split-Spoon Sampling* and SM-0003, *Soil Classification,* for details). Count and record the number of blows per 6-inch increments, confirming blow counts with driller if necessary).
- Decontaminate the split-spoon sampler after each use (see *Equipment Decontamination,* SOP QA-001) or use another decontaminated split-spoon sampler.
- Ensure that the drillers advance the augers only after they have inserted the auger plug (to prevent soil from entering the augers while advancing to the next sample interval).
- Request that the drillers remove the auger cutting bit/plug and insert the split-spoon sampler into the interior of the augers. Measure the stick-up of the rods attached to the sampler to ensure that the nose of the spoon is in virgin soil below the augers.
- Watch for signs of a soil strata change at depth during drilling (i.e., change in blow counts, change in soil color, soil wetness, soil contamination, bouncing of the drill rig, etc.). If important to the investigation, stop drilling and collect a soil sample.
- If subsurface soil samples are being collected with split-spoon samplers, ensure that the drillers use a 30-inch drop of the 140-pound hammer. The number of blow-counts for each 0.5 foot penetration provides important geotechnical data.
- Repeat until the borehole has been drilled to the desired depth.
- If a monitoring well is not installed in the soil boring, fill the boring with either cement/bentonite grout or properly-tamped and hydrated bentonite. Check with Project Manager and/or the appropriate regulatory personnel before using drill cuttings to backfill the boring.

- If a monitoring well will be installed, refer to SOP DM-007.
- Complete boring log and, if necessary, well installation logs (SOP SM-003, *Soil Classification*).
- Record boring locations on a site map and in a field notebook sketch. If the boring location will not be surveyed, measure each location from on-site reference points and record the information in the field notebook so that the location can be plotted on site figures.

3. Limitations

- In areas of significant soil contamination, hollow-stem augers may cross-contaminate upper soil layers as contaminated cuttings move up the auger flights. The potential also exists for contaminated augers to carry contamination to deeper soil strata
- If significant unanticipated contamination is encountered during drilling, stop drilling to confer with the project manager and evaluate health and safety conditions. If the borehole is to be advanced below the contaminated strata, use telescoping techniques (see SOP DM-008 *Monitoring Well Telescoping Techniques*) to avoid cross-contaminating underlying geologic strata.
- When drilling below the groundwater table in fine to medium sands, the potential exists for the phenomenon of "running sands" or "blow in" to occur. Frequent measurements inside the hollow-stem augers after the drill bit/plug is removed will indicate if running sands are present. If sands start to flow into the auger, pour clean water into the augers and keep the augers filled during sampling.
- If necessary, arrange for the storage of contaminated soil cuttings and water in drums or other appropriate containers in a secure place at the site. Containers should be labeled.
- Plan the drilling program to drill borings from the least- to most-contaminated areas. Be prepared in advance and know where alternative drilling locations are in the event that problems are encountered at each planned soil boring location. Alternative locations will need to have utility clearance.
- Down-hole drilling equipment should be steam cleaned or pressure-washed between holes unless otherwise directed by the project manager.
- Record when standard operating procedures are deviated from. The drilling inspector should also record any detected odor from the boring and depth encountered.

4. References

Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers (October 1990), American Society for Testing and Materials [ASTM] D5092-90

Nielsen, D.M. (1993), "Correct Well Design Improves Monitoring," Environmental Protection, July, pp. 38-49

Standard References for Monitoring Wells (April 1991), Commonwealth of Massachusetts Department of Environmental Protection, WSC-310-91

5. Attachments

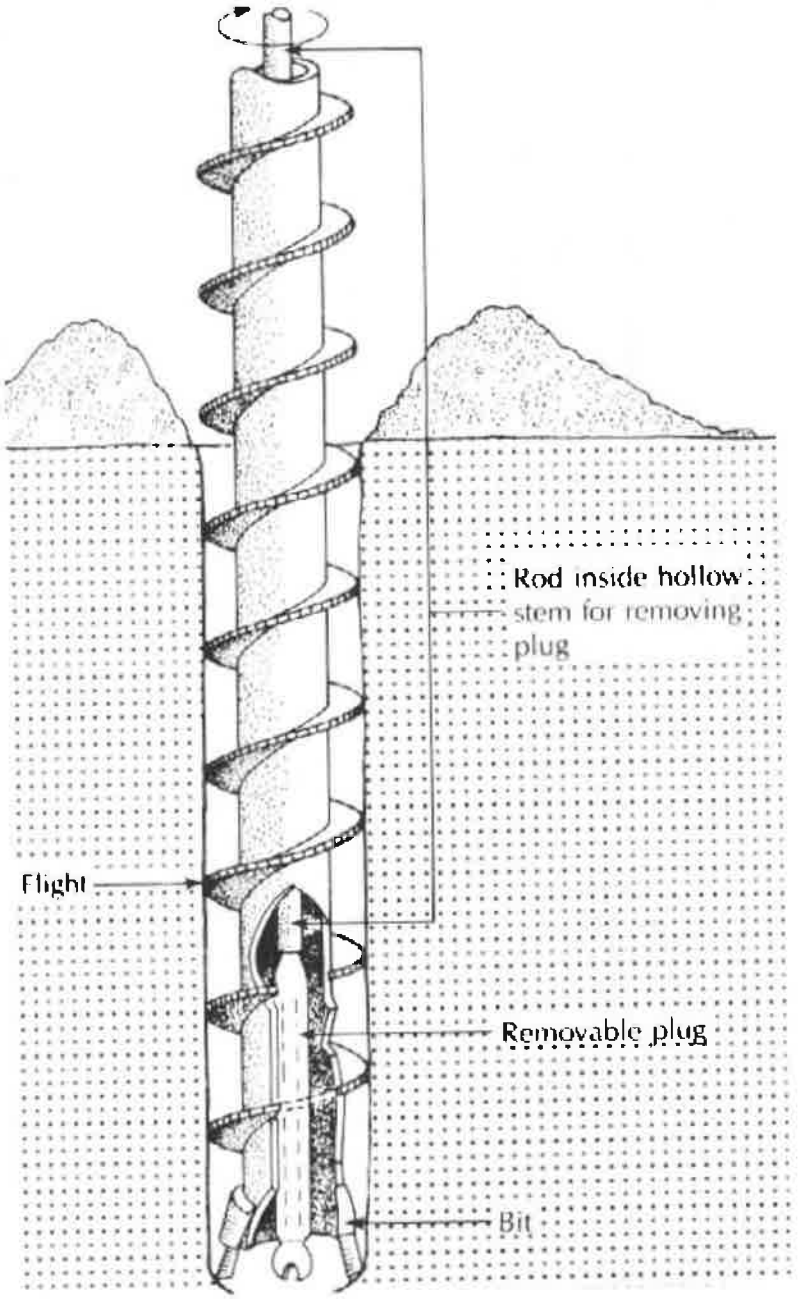
Attachment A – Hollow-Stem Auger

6. Contact

Cathy Johnson

SOP DM-002

Attachment A – Hollow Stem Auger



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STANDARD OPERATING PROCEDURE

DM-004 Sonic Drilling

1. Objective

Describe common sonic drilling procedures.

Prior to drilling confirm that utility clearance has been completed and that the drilling rig has been appropriately decontaminated.

2. Execution

- Collect soil cores in runs of 5 to 10 feet. Some sonic rigs can collect a 20 foot sample, but the process generates a significant amount of heat that may degrade sample quality.
- Classify and sample the soil located within the liner.
- Excess soil should be placed in a 55-gallon drum for disposal.
- The core barrel should be cleaned with tap water following each use.
- The core barrel is then advanced within the isolation casing to collect the next soil core interval.
- Add water between the inner core barrel and the outer override casing. This will reduce friction between the casings and adsorb heat.
- Maximize drilling advance rate. The faster the core barrel is advanced, the less likely the core barrel will heat up. Drilling with a 3-inch diameter core barrel and a 5-inch diameter override casing, instead of the standard 4-inch core barrel and 6-inch over-ride casing, may increase advance rates and reduce the potential for soil core heating.
- If a significant decrease in drilling advance rate is observed, stop drilling and remove soil that has accumulated in the core barrel. Resume drilling through the resistant material (gravel, boulder, hard clay, etc.). When the resistant material has been penetrated and the drilling advance rate increases, stop drilling and remove what material has accumulated in the core barrel.
- Wash down the core barrel with cool water to cool the core barrel and associated casing, and resume drilling.
- If a well is to be installed in the borehole, the sandpack and grout are placed as the core-barrel and over-ride casing(s) are selectively vibrated out of the ground. The vibratory action should facilitate settlement of the sandpack and grout. Upon completion, no casing is left in the ground other than the well casing and screen.

3. Limitations

- Disturbance of the soil core is most likely to occur during removal of the soil core from the core barrel. The soil cores are usually vibrated out of the core barrel into plastic bags approximately 5 feet in length. As the plastic bags are

a little larger than the soil core itself, fragmentation of the soil core may occur as the core is extruded into the bag or while the bagged core is being moved in an unsupported manner. Soil conditions that are prone to disturbance include wet or dry zones that contain little or no fines, and well graded sands that contain significant volumes of water.

- If integrity of the soil core is of concern, the following procedures should be implemented:
  - Measures should be taken to ensure that the core, from the time it is extruded from the core barrel, is rigidly supported through the use of some type of cradle or carrying device.
  - The core should not be removed from its cradle until all sampling of the core has been completed. Acrylic liners are available for some core sizes and can be used to hold the core together upon removal from the core barrel.
  - If the soil is to be sampled for volatile organic compounds (VOCs), acrylic liners must be used.
  - Sampling of the soil core for VOCs or semi-volatile organic compounds (SVOCs) must be approved on a case by case basis. Proposals for VOC or SVOC soil core sampling must include provisions to minimize core fragmentation and heat generation, such as:
    - Acetate liners in the core barrel so that the soil core does not have to be extruded out of the core barrel.
    - Limit the length of soil core generated during a given downhole run.
    - Implement practices to reduce the residence time of the soil core in the core barrel.
- For the analysis of SVOCs, the use of the acetate liners is not required.
- The large diameter of the core barrel enables ground water sampling equipment to be placed inside the core barrel so that discrete depth groundwater samples can be collected during borehole advancement.

4. References

Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers (October 1990), American Society for Testing and Materials [ASTM] D5092-90

5. Contact

Melissa Felter

STANDARD OPERATING PROCEDURE

DM-006 Geoprobe® Direct Push Boring

1. Objective

Describe standard operating procedures (SOP) for drilling of overburden soil borings using Geoprobe® and MacroCore® technologies.

2. Execution

- Confirm that appropriate measures have been taken for clearance of potential subsurface utilities. The responsibility for clearance may vary, depending on the client.
- Inspect the drilling rig to make sure it is clean and that the down-hole equipment has been decontaminated (QA-001). Record condition of all down-hole drilling equipment.
- Make sure the sampler is fitted with a piston rod assembly to block the sample tube until the desired subsurface sample interval is attained. Upon reaching the target sample depth, the piston tip will be released and the discrete sampler device is then advanced to collect the representative sample. This reduces the volume of slough that is collected.
- When the sampler is brought to the ground surface, it should be opened immediately, and the length of recovery should be measured and recorded.
- Log the soil sample using USCS procedures (SOP SM-003). Collect analytical samples if necessary (SOP SM-001).
- Decontaminate the cutting shoe if necessary (SOP QA-001 Equipment Decontamination) and have driller reassemble the parts with a new liner.
- Repeat the procedure described above until refusal or the boring is terminated.
- Periodically verify that depths cited by drillers are accurate.

3. Limitations

- If significant unanticipated contamination is encountered during drilling, stop drilling to confer with the project manager and re-evaluate health and safety conditions.
- Arrange for the storage of contaminated soil cuttings and water in drums or other appropriate containers in a secure place at the site (see SOP SC-003, *Investigation Derived Waste Management*).
- If possible, plan the drilling program to drill borings from the least to most contaminated areas. Be prepared in advance and know where alternative drilling locations are in the event that problems are encountered at soil boring locations. These locations must also have been cleared by the state or local utility service prior to drilling.

4. References

ASTM D6001-05 Guide for Direct Push Water Sampling for Geoenvironmental Investigations, April 2005

Geoprobe Systems, "Geoprobe MacroCore MC-5 1.25-inch Light Weight Center Rod Soil Sample System SOP", Technical Bulletin No. MK 3139, November 2006

5. Attachments

Attachment A – Geoprobe® with Macrocore® Sampler Assembly

6. Contact

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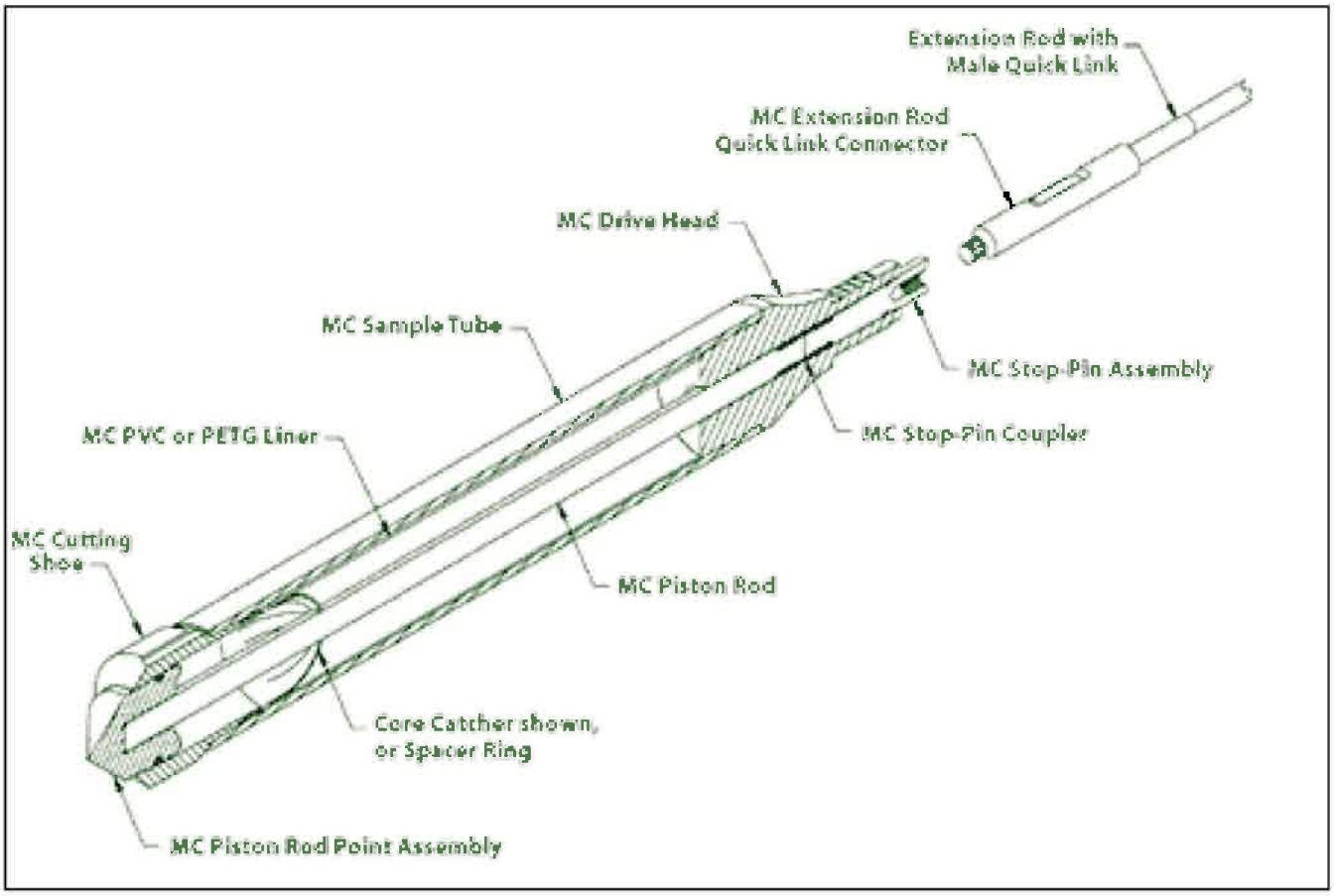
SOP DM-006

Attachment A – GeoProbe® with Macrocore® Sampler Assembly



Above: Diagram of a Macrocore® sampler

Right: A track-mounted GeoProbe ® Rig



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STANDARD OPERATING PROCEDURE

DM-007 Monitoring Well Construction and Installation

1. Objective

Describe installation procedures for overburden monitoring wells screened across or below the groundwater table.

Well dimensions (well diameter, screen length, and screen slot-diameters) will be specified in the Work Plan. This SOP assumes the monitoring wells will be constructed of flush-joint PVC pipe and the screened section will have factory-slotted openings.

2. Execution

Attachment A provides a diagram of typical shallow, intermediate, and deep groundwater monitoring well construction detail. A Groundwater Monitoring Well Installation Log is in Attachment B.

- Measure and record the depth of the completed soil boring before beginning the well installation.
- If possible, measure the depth to groundwater in the borehole over a 10 to 15 minute period to ensure that the groundwater elevation has approximately stabilized. Compare the saturated soil depth estimated from split-spoon samples to the measured water level in the borehole. If drilling water has been used during boring advancement, pump the water out of the borehole to the static water depth, based on examination of the soil samples, and monitor the recovery of groundwater until the level has stabilized.
- If it is not possible to accurately measure the depth to groundwater in the borehole due to low permeability in the formation, use the saturated soil depth observed in the collected samples or measured water depth in a nearby existing monitoring well to estimate the depth to water in the borehole.
- For shallow monitoring wells, select the monitoring well screen and riser lengths so that the slotted section of the screen intersects the groundwater table. Screen lengths of 15 feet or less are preferred and 10 foot screens are most common. If the water table is seasonally high or low or if the well is in a location where the water table is likely to be tidally influenced, appropriately place the screened section to allow for the screen to intersect likely future water tables.
- For intermediate or deep wells screened entirely below the water table, select the monitoring well screen and riser lengths as described in the Work Plan. Screen lengths of 10 feet or less are preferred.
- If the borehole is deeper than the desired well depth or the bottom of the well is close to a change in soil strata, then fill the base of the borehole with bentonite. Keep in mind that bentonite swells when hydrated, and that filter

sand should be placed at the bottom of the borehole above the bentonite before installing the well.

- Prevent well materials from contacting foreign substances during installation. Precautions may include requiring the driller to wear clean gloves while handling well materials and requiring that well materials not be placed onto the ground or pavement without a protective barrier such as polyethylene sheeting being present
- Confirm that the driller installs a minimum one-inch sump with a bottom cap to the bottom of the well screen. See the Work Plan for locations that may require larger sumps.
- Monitoring wells can be constructed of either 1, 1.5, 2 or 4 inch inner diameter (ID) Schedule 40 threaded flush-jointed PVC. Refer to the work plan for the site-specific requirements. Flush-threaded well materials should be used. Do not allow the driller to use glues, as they typically contain solvents that could affect on groundwater quality.
- Stainless steel well materials may be used if required in the Work Plan. Select slot size based on grain size of the formation and on requirements in the Work Plan.
- Confirm that the driller places at least 12 inches of clean uniformly graded medium quartz filter sand pack into the base of the borehole, if required in the Work Plan.
- The driller should remove the drilling casing/augers from the borehole slowly, at a maximum of 2-foot intervals, at the same time that filter sand is added. The drillers should take frequent measurements of the depth to sand.
- Confirm that the driller has added adequate sand to surround the area around the slotted section. The filter sand should extend at least 2 feet above the top of the slotted section.
- The driller should place a bentonite seal above the filter pack. If the seal is above the water table, use at least 5-gallons of potable water to hydrate the bentonite before grouting the remaining annular space, or otherwise backfilling the remaining annular space as discussed with the Project Manager. Tamp seal. It should extend 1 to 2 feet above the filter sand.
- If required by the Work Plan, the driller should use bentonite-cement and grout the annular space from the top of the bentonite seal to the ground surface. Bentonite cement grout should be placed using tremie methods. Grout should be mixed in approximately the following proportions: 7.5 gallons water to one 94-lb bag of cement to 2-4 lbs of pulverized bentonite. The grout must be mixed using a pump (such as one on the rig) to ensure proper mixing.
- The drillers should cut the monitoring well riser at an angle or make "V"-notch in the riser pipe as a benchmark for surveying and groundwater measurements. The driller should cut the well riser so that the top of the well will be approximately 3 inches below the top of protective casing. The top of

the riser should be close enough to the top of the surface casing to allow reading of depth markings on a water level indicator tape.

- The protective surface casing is either a flush-mounted roadbox or a steel "stick up" pipe. The base of either type of casing should extend at least 1 foot into the grout below the ground surface (below the frost line) whenever possible.
- The protective casing should be set by placing cement in the annular space between the protective casing and the borehole up to the ground surface. If possible, the driller should slope the cement radially away from the protective casing at the ground surface to promote surface water runoff.
- In areas of high traffic or areas of parking lots and/or roadways where plowing occurs, set the roadbox flush with the ground surface to avoid damage to the well.
- If the well is installed in a high-traffic area and is completed with a steel "stick up" pipe, additional protection such as steel pole bumpers around the steel "stick up" pipe may be necessary.
- If possible a locking cap should be placed on the steel "stick up" pipe. If the surface casing is flush mounted, a locking expansion plug should be placed, if possible, inside the top of the well riser pipe.
- All well locations should be photodocumented in accordance with SOP FD-004 Photodocumentation.
- Label the outside of the protective well casing with a paint pen. If the well is not going to be surveyed, measure the location to nearby landmarks so that the well may be located in the future and plotted on figures. Make sure to enter this information in the field notebook). If possible, place a brightly colored stake or other identifier adjacent to the well.
- Develop the well (see SOP DM-009, *Monitoring Well Development*).

3. Limitations

- Do not screen across different hydrostratigraphic units (for example, outwash sands, confining layers or till) unless specified in the Work Plan or approved by the Project Manager.

- If the formation is composed of a material that is uniformly coarser than the filter sand, the grain size of the filter sand should be increased. Consideration should also be given to changing the slot size on the well screen. Differences in average grain size should generally not be greater than a factor of two to four times.

- Do not use drill cuttings to backfill during monitoring well installation unless specified by the work plan or project manager.

4. References

Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers (October 1990), American Society for Testing and Materials [ASTM] D5092-90

Nielsen, D.M. (1993), "Correct Well Design Improves Monitoring," Environmental Protection, July, pp. 38-49

Standard References for Monitoring Wells (April 1991), Commonwealth of Massachusetts Department of Environmental Protection, WSC-310-91.

5. Attachments

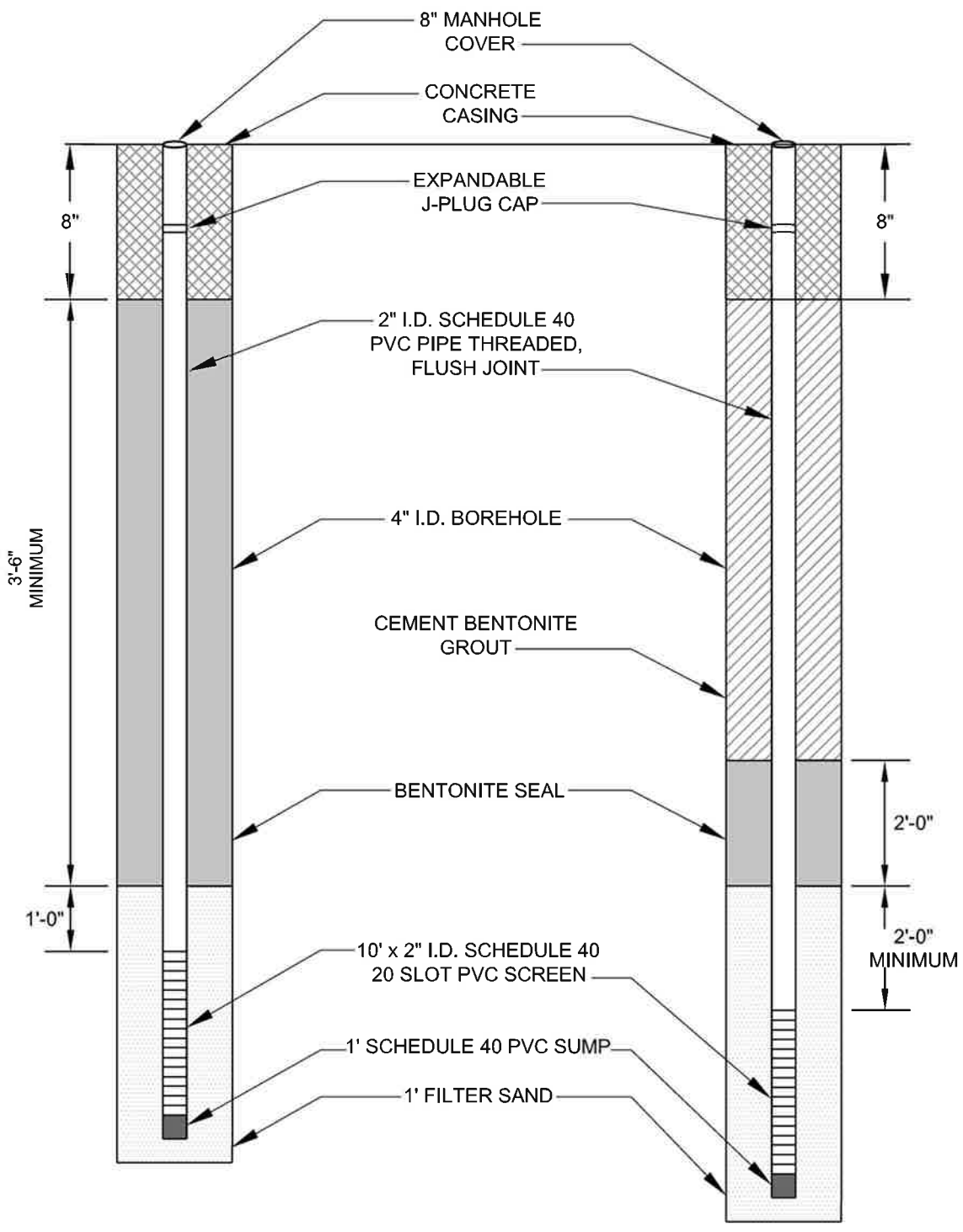
Attachment A – Typical Shallow, Intermediate, and Deep Groundwater Monitoring Well Construction Detail

Attachment B – Groundwater Monitoring Well Installation Log

6. Contact

David Terry
Anne Leifer

Attachment A - Well Detail



NOT TO SCALE

GEI Consultants

TYPICAL SHALLOW, INTERMEDIATE AND DEEP GROUNDWATER MONITORING WELL CONSTRUCTION DETAIL

June 2008

I:\GEI\SOPs\ Well Detail.dwg \Jun 10, 2008

Groundwater Well Installation Log

Well ID

Project _____ **GEI Proj. No.** _____

City / Town _____ **Location** _____

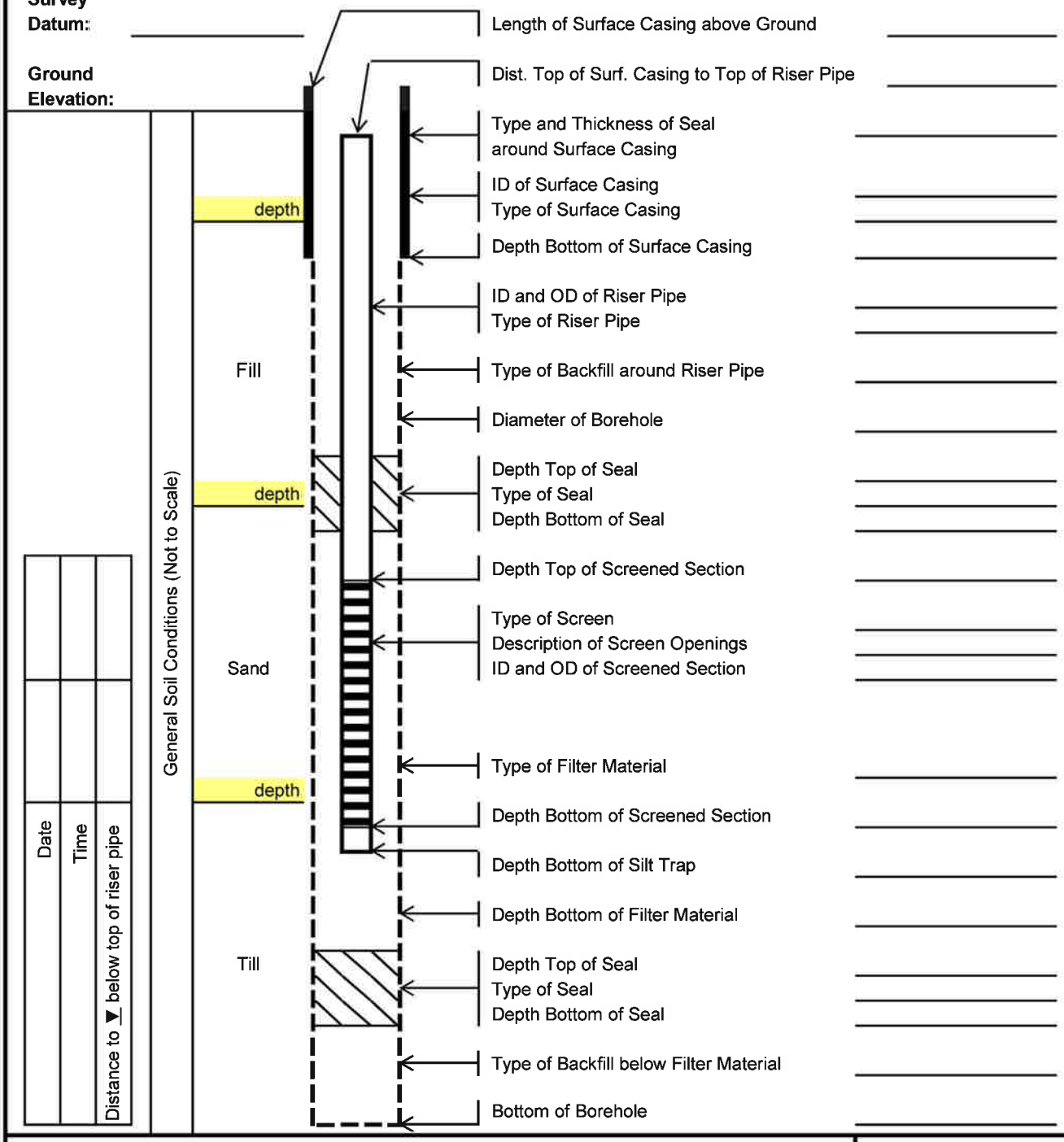
Client _____ N _____

Contractor _____ E _____

Driller _____ **GEI Rep.** _____ **Install Date** _____

Survey Datum: _____

Ground Elevation: _____



Notes:

GEI Consultants

STANDARD OPERATING PROCEDURE

DM-009 Monitoring Well Development

1. Objective

Describe standard procedures to remove fluids from monitoring wells (introduced during drilling) and maximize the movement of groundwater into the well by removing fine particles in the well and sand pack around the screen.

2. Execution

To prevent cross contamination between monitoring wells, use dedicated equipment and/or appropriately decontaminated equipment to perform monitoring well development. See SOP QA-001 Equipment Decontamination and the Work Plan for more information.

For deep or large diameter monitoring wells, it may be necessary to use a re-usable pump system, such as a Grundfos pump, to develop monitoring wells.

- Calculate the volume of water in the monitoring well (one well volume) using the following table:

Well diameter (inches)	Volume (gal/ft)
1	0.04
1.5	0.09
2	0.16
3	0.36
4	0.65
6	1.50

The equation used to establish these volumes is presented in Section 4.

- Calculate or estimate the amount of water introduced to the borehole during drilling. At a minimum, this is the amount of water that should be removed during development. Removing less water than was introduced and allowing additional time for the surrounding formation to clear of injected drilling fluids may be considered as an alternative if the volume of introduced water was large.

- Record the volume of water purged in the field notebook or on the Monitoring Well Sampling Form (Attachment A).

- Collect a sample of water from the monitoring well with the selected submersible pump (e.g. 12-volt whale pump or Grundfos pump), a bailer, or a

Waterra system. Record the physical properties (color, turbidity, odors, etc.) of the sample.

- The volume of water that should be removed will depend on the work plan, local regulatory guidance, and/or the volume of water that was introduced during drilling and well installation. Typical guidance for the removal volume includes:
    - Ten well volumes.
    - The volume of fluid added during drilling.
    - The volume required to remove enough suspended particles so that the turbidity of the water is less than 50 nephelometric turbidity units.

If needed, pump the ground water into a 5-gallon pail so that the volumetric flow rate and total water volume from the pump or bailer can be calculated.

Measure the groundwater level in the well during development to assess if the pumping rate is sufficient to create a drawdown in the well.

Observe the groundwater every few well volumes during the pumping and record the physical properties (color and turbidity).

If required by the Work Plan, conduct surging in the monitoring well. See the Work Plan for the method of well surging to be used. If surging is necessary, do so only after initial pumping at the well has occurred and fine sediments have been removed.

Slowly move the surge block up and down in the well. Periodically remove the surge block and purge the groundwater until it is relatively clear again. Start at a slow pace and progress to a faster surging action through time.

3. Limitations

Always remove groundwater with fine particles from the well before surging. The fine particles may be forced into the well screen by the surging action. They may also damage the pump.

If the ground water in the monitoring well is contaminated, the water removed during well development may need to be placed in a properly-labeled drum and disposed of in accordance with local, state, and federal regulations (see SC-003 Investigation Derived Waste).

If the soils around the well screen are composed of fine-grained silts and clays, over-pumping and mechanical surging is not recommended since these more vigorous

techniques can cause mixing of the fines into the filter pack. To develop these wells, use of a bailer is recommended.

There are occasions when the turbidity of groundwater cannot be meaningfully reduced. On these occasions, a minimum of ten volumes should be removed, and the Project manager should be consulted.

Sampling of groundwater should generally not occur within one week after development. In some regions or regulatory jurisdictions, a minimum of two weeks may be required before sampling. If no water was introduced to the formation during drilling, this waiting period may be shortened if required by the project. See the Work Plan for additional information.

4. References

Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers (October 1990), American Society for Testing and Materials [ASTM] D5092-90.

Nielsen, D.M. (1993), "Correct Well Design Improves Monitoring," Environmental Protection, July, pp. 38-49.

"The Methods & Mechanics of Well Development, Part 2 of 5," National Drillers Buyers Guide, March 1993, p. 17.

Massachusetts Department of Environmental Protection, "WSC-310-91Standard References for Monitoring Wells, Section 4.5 Decommissioning of Monitoring Wells", January 1991

U. S. EPA Environmental Response Team Standard Operating Procedure SOP: 2044 ," Monitor Well Development" REV: 0.1, 10/23/01

5. Attachments

Attachment A - Monitoring Well Sampling Form

6. Contact

Anne Leifer

GEI Consultants

MONITORING WELL SAMPLING RECORD

PID Reading _____ Job Name _____

Job Number _____ By _____ Date _____

Location _____ Measurement Datum _____

Well Number _____

Pre-Development Information Time (start) _____

Water Level _____ Total Depth of Well _____

One Purge Vol _____ Three Well Volume _____

Water Characteristics

Color _____ _____ Clear _____ Cloudy

Odor _____ None _____ Weak _____ Moderate _____ Strong

Any films or immiscible material _____

Volume (gal)	Time	pH	Temp (°C)	Spec. Conductance (µS/cm)	Turbidity (NTU)	DO Conc. (mg/L)	ORP (mV)	TDS

Total Volume Removed (gal) _____ pH _____

Temperature (°C) _____ Specific Conductance (µS/cm) _____

DO Concentration (mg/L) _____ ORP (mV) _____

TDS _____

Post Development Information Time (Finished) _____

Water Level _____ Total Depth of Well _____

Approximate Volume Removed (gal) _____

Water Characteristics

Color _____ _____ Clear _____ Cloudy

Odor _____ None _____ Weak _____ Moderate _____ Strong

Any films or immiscible material _____

Comments

STANDARD OPERATING PROCEDURE

DM-010 General Guidance on Monitoring Well Abandonment

1. Objective

Describe methods to abandon a monitoring well.

The goal of monitoring well abandonment is to seal the borehole so it cannot act as a conduit for movement of contaminants or liquids from the ground surface to the water table or between aquifers.

General procedures for well abandonment are provided below but do not supersede state or local regulations. Make sure all well abandonment procedures adhere to appropriate regulations.

2. Execution

The following methods for abandoning unconsolidated (overburden) and consolidated (bedrock) monitoring wells should be performed by a licensed drilling contractor, if required by law or regulatory authorities. The following listed methods are general guidance for abandoning monitoring wells. The Work Plan and state and local requirements should be reviewed for additional requirements.

2.1 Unconsolidated (overburden) Monitoring Wells

Unconsolidated (overburden) monitoring wells should be abandoned in the following manner, see the Work Plan for additional requirements:

- Remove the protective casing and concrete pad.
- If possible, overdrill the monitoring well casing and sand pack using hollow-stem augers or casing to at least one foot below the depth of the boring/well as indicated in the soil boring log.
- If possible, remove the monitoring well riser, sand pack, bentonite seals and grout.
- Once the well materials have been removed, add cement/bentonite grout using tremie methods starting at from the bottom of the borehole as the augers or casing are removed.
- If the well materials cannot be removed by overdrilling, the riser should be cut off at a depth of between two and five feet below the ground surface and the remaining well materials may be filled with grout using tremie methods. The grout mixture will be as specified for the well installation (see SOP DM-001 General Guidance on Determination of Appropriate Drilling Methods)
- Add grout to the point where the riser was cut off or to a depth of approximately two feet below the ground surface. From that point up to ground surface, backfill with native soil material surrounding the boring/well.

2.2 Consolidated (bedrock) Monitoring Wells

Consolidated (bedrock) monitoring wells or open holes will be abandoned in the following manner. See the Work Plan for additional requirements:

- Remove the protective casing and concrete pad;
- Remove the monitoring well materials from the hole. If the materials cannot be removed, cut off the well riser between two feet to five feet below grade. If feasible, cutting off the riser at five feet is optimal.
- Add cement/bentonite grout via tremie methods from the bottom of the well up to the ground surface. The grout mixture should be as specified for the well installation SOP DM-001 General Guidance on Determination of Appropriate Drilling Methods
- Add grout to the point where the riser was cut off or to a depth of approximately 2 feet below ground surface. From that point up to ground surface, backfill with native soil material surrounding the boring/well.

3. References

Environmental Protection Agency, Region 4, "Environmental Investigation Standard Operating Procedures and Quality Assurance Manual, Chapter 6 – Design and Installation of Monitoring Wells," November 2001.

Massachusetts Department of Environmental Protection, "313 CMR 3.00, Registration of Well Drillers and Filing of Well Completion Reports".

Massachusetts Department of Environmental Protection, "Standard References for Monitoring Wells, Section 4.6 Decommissioning of Monitoring Wells", January 1991

New York State Department of Environmental Conservation, DEC Policy "CP-43: Groundwater Monitoring Well Decommissioning Policy", November 2009.

4. Contact

Anne Leifer

Section 5

Sample Collection and Field Screening (SC)

STANDARD OPERATING PROCEDURE

SC-001 Environmental Sample Types and Sampling Strategies

1. Objective

Describe types of samples and strategic approaches to sample locations.

Refer to Attachment A for guidance on compatible sampling materials.

2. Sample Types

Grab Samples

A grab (or discrete) sample is a single aliquot (part of the sampled media) collected from a single location at a specific time.

Surface soil samples are typically "grab" samples. Volatile organic samples are always grab samples because the least amount of sample disturbance is necessary.

Composite Samples

Composite samples are non-discrete samples composed of more than one aliquot collected from different sampling locations and/or at different points in time. Analysis of composite samples produces an average value.

Composite samples are frequently collected to characterize waste soil that has been stockpiled for eventual disposal. Several grab samples are collected from the stockpile and are blended together into a single sample.

Screening Samples

Screening samples may be grab or composite in nature. However, they offer potential advantages such as rapid results and low cost. The trade-off is that they may only provide results within a range and/or they may have elevated detection limits. Screening samples are most often used to evaluate presence/absence and/or indications of the potential magnitude of impacts.

3. Sampling Strategies

Generally, there are three sampling strategies: random, systematic, and judgmental sampling.

- Random sampling involves collection of samples in a non-systematic fashion from the entire site or a specific portion of a site.
- Systematic sampling involves collection of samples based on a grid or a pattern which has been previously established.
- Judgmental sampling is the collection of all other samples. This sampling might be from areas most likely to be contaminated, areas most likely to be clean, or areas where information is lacking.

Often, a combination of these strategies is the best approach depending on the type of the suspected/known contamination, the uniformity and size of the site, the level/type of information desired, etc.

4. Attachments

Attachment A - General Guidelines for selecting equipment

5. Contacts

Ryan Hoffman

General Guidelines for selecting equipment on the basis of construction material and target analyte(s)

[✔, generally appropriate for use shown; Si, silica; Cr, chromium; Ni, nickel; Fe, iron; Mn, manganese; Mo, molybdenum; CFC, chlorofluorocarbon; B, boron]

Construction material for sampling equipment		Target analyte(s)	
Material	**Description**	**Inorganic**	**Organic**
		Plastics[1]	
Fluorocarbon ploymers[2] (other varies available for differing applications)	Chemically inert for most analytes	✔ (potential source of fluoride)	✔ (Sorption of some organics)
Polypropylene	Relatively inert for inorganic analytes	✔ (not appropriate for Hg)	**Do not use**
Polypropylene (linear)	Relatively inert for inorganic analytes	✔ (not appropriate for Hg)	**Do not use**
Polyvinyl chloride (PVC)	Relatively inert for inorganic analytes	✔ (not appropriate for Hg)	**Do not use**
Silicone	Very porous. Relatively inert for most inorganic analytes	✔ (potential source of Si)	**Do not use**
		Metals	
Stainless steel 316 (SS 316)	SS-316-metal having the greatest corrosion resistance. Comes in various grades. Used for submersible pump casing.	✔ (Potential source of Cr, Ni, Fe, and possible Mn and Mo) **Do not use** for surface water unless encasted in plastic.	✔ Do not use if corroded[3]
Stainless steel 304	Similar to SS-316, but less corrosion resistant	**Do not use**	✔ Do not use if corroded[3]
Other metals: brass, iron, copper, aluminum, galvanized and carbon steels	Refrigeration-grade copper or aluminum tubing are used routinely for collection of CFC samples	**Do not use**	✔ Routinely used for CFCs Do not use if corroded[3]
		Glass	
Glass, borosilicate (laboratory grade)	Relatively inert. Potential sorption of analytes	✔ **Do not use** for trace element analyses. Potential source of B and Si	✔

[1]Plastic used in connection with inorganic trace-element sampling should be uncolored or white. Tubing used for trace metal sampling should be cleaned by soaking in 5-10 percent HCl solution for 8-24 hours, rinsing with reagent water (metals free) and allowed to air dry in mercury-free environment. After drying, the tubing is doubled-bagged in clear polyethylene bags, serialized with a unique number, and stored until used.

[2] Fluorocarbon polymers include materials such as Teflon™, Kynar™, and Tefzel™ that are relatively inert for sampling inorganic or organic analytes. Only fluoropolymer should be used for samples that will analyzed for mercury because mercury vapors can diffuse in or out of other materials, resulting in either contaminated or biased results.

[3] Corroded/weathered surfaces are active sorption sites for organic compounds.

STANDARD OPERATING PROCEDURE

SC-002 Environmental Sample Handling

1. Objective

Describe appropriate environmental sample handling procedures.

The procedures include collection and transport of environmental samples to a laboratory for chemical analysis. Appropriate sample handling should ensure that samples are properly:

- labeled and documented;
- preserved;
- packaged; and
- transported

2. Execution

- Prior to mobilizing to the field, select a shipper or arrange for a courier for sample delivery to the laboratory. If using a shipper (i.e., FedEx or UPS) determine the time constraints for pickup requests, the location and hours of the nearest shipping office, and any size/weight restrictions.
- A waterproof or permanent ink pen should be used for all labels. The label should have an adhesive backing and be placed on the jar or bottle, not on the cap. In addition, clear packing tape can be placed over the sample label to secure it to the bottle as moisture from the samples can loosen the label adhesive.
- Record the following information on the label and in the field notebook (See SOPs FD-001 and FD-003):
    - Project number
    - Sample identification (i.e. MW-201 or SS-2)
    - Date and time (military time) of collection
    - Sampler's initials
    - Analysis methods
    - Preservative, if present
- Pre-preserved laboratory jars are preferable and should be used whenever practicable. If sample jars are not pre-preserved, add preservative as appropriate.
- At each sampling location, samples should be collected in order of volatility, most volatile first. Samples collected for volatile analysis should be placed in sample containers immediately upon retrieval of the sample.
- Aqueous samples for volatile analysis should be collected without air bubbles.
- The collection and preservation method of soil samples for volatile analysis may depend on project, client, or state regulatory requirements. Check with your Project Manager and/or SOPs SM-001 and SM-002 where appropriate.

- Care must be taken to avoid getting soils on the threads of sample jars, which can cause a faulty seal.
- If compositing samples in the field, specify the basis for composite (i.e. volume, weight, spoon recovery, etc.) and record in the field book the procedure for compositing the sample.
- Once samples have been collected and labeled, place samples in a cooler with sufficient bagged ice or freezer packs (blue ice) (if allowed) to chill samples to 4°C. If using ice, use double-bagged ice.
- Complete the chain-of-custody (COC) (SOP FD-003).
- If transporting the samples by way of a shipper:
    i. The sample cooler should have water drains securely sealed with duct tape, both on the inside and outside of the cooler.
    ii. Place a layer of packing material on the bottom of the cooler as a cushion.
    iii. Individually wrap each sample bottle with bubble packing or suitable packing material and place the wrapped bottles upright in the cooler with sufficient packing material between samples to avoid breakage.
    iv. Methanol preserved samples for volatiles analysis should be packed so they remain upright with the soil completely covered by the methanol during transport.
    v. Place a layer of packing material on top of the sample bottles.
    vi. Place bagged ice or freezer packs on top of the packing material. Fill the remaining space in the cooler with packing material to eliminate the possibility of vertical movement of samples.
    vii. Place the completed and signed chain-of-custody form in a sealable plastic bag and place on top of the packing material in the cooler, or tape it to the inside lid of the cooler.
    viii. Fill out the appropriate shipping or courier forms and attach to the top or handle of the cooler. If necessary, place the proper shipping labels on the cooler. Have the courier sign the COC form (or write pickup by FEDEX, UPS, etc. with date and time). Place a signed and dated custody seal on the cooler.
- All samples should be submitted to the laboratory as soon as possible. In many cases, same day shipping will be required by the client or the project manager. Be clear on this before beginning the field work.
- A copy of the waybills should be kept by the field supervisor to track shipments if necessary.

3. Limitations

- If samples are shipped on a Friday, call the laboratory ahead of time to confirm that personnel will be at the laboratory to receive and log-in the samples.
- During warm weather, make sure to use plenty of ice in the shipping container.

- Field personnel should be aware of analyses which have short hold times and schedule sampling events and shipping accordingly. Shipment of samples for analyses with short hold times must be arranged for in advance. Refer to the project work plan, quality assurance project plan, or state/federal regulations for holding time and preservative information. Contact the laboratory ahead of time when shipping samples with short hold time to ensure the lab is prepared for these analyses.
- For glassware containing preservatives (e.g., HCl, HNO_3), take care not to overfill the container, thus flushing the preservative out of the bottle.
- Never composite samples for VOCs in the field. Collect individual aliquots and direct the laboratory to perform compositing, if needed.
- Collection of aqueous samples should not be performed over the opening of a monitoring well. Preservatives from overfilling, a marker pen or other objects could fall into the well.
- If the recharge volume for a monitoring well is low, completely fill all volatile vials and then collect the minimum sample volume required for each remaining analysis.
- During subsurface soil sampling, if the recovery from the split-spoon sample is inadequate, if appropriate, resample the bottom of the borehole to obtain proper sample volume.
- Laboratories will homogenize and test the contents of the sample container, unless directed otherwise. Samples should not contain rocks, twigs, leaves, etc… unless these materials are of interest.

4. References

New Jersey Department of Environmental Protection, Field Sampling Procedures Manual, August 2005.

Connecticut Department of Environmental Protection, Guidance for Collecting and Preserving Soil and Sediment Samples for Laboratory

Preservation Techniques for Volatile Organic Compound (VOC) Soil Sample Analyses, WSC#99-415. Massachusetts Department of Environmental Protection.

5. Contacts

Leslie Lombardo

STANDARD OPERATING PROCEDURE

SC-003 Investigation Derived Waste

1. Objective

Describe characterization and management of Investigation Derived Waste (IDW) resulting from site investigation activities.

IDW is solid and/or aqueous waste generated during environmental site investigations.

2. Execution

- Determine the suspected contamination type and impacted media based on previous investigations, available analytical data, and/or site history.
- Consider the following when selecting IDW management option(s):
    - Anticipated volume of IDW to be generated during on-site activities
    - Potential contaminants and their concentrations
    - Proximity to population centers and the potential for unauthorized site access
    - Potential exposures to workers
    - Potential for environmental impacts
    - Community concerns
    - Potential storage areas
    - Regulatory constraints
    - Potential on-site treatment options
    - Duration of storage
    - Client concerns or requirements
- Review IDW Management Options summarized in Attachment A for each media suspected of contamination.
- Select IDW Management Option(s) prior to the commencement of field activities that will generate waste materials.
- Include the selected IDW Management Option(s) in the Field Plan or other project documents.

Considerations and guidelines for IDW management for specific field tasks are provided below.

2.1. Test Pit Excavation

- Segregate contaminated soil from uncontaminated soil using visual and/or field screening methods.
- Use appropriate barrier (such as two layers of 6-ml plastic sheeting) for temporary stockpiling of contaminated soil adjacent to test pit.

- Backfill test pits with uncontaminated soil, unless otherwise directed by project manager.
- If directed by the Project Manager to return contaminated soil to the test pit, backfill soil in the same order as the soil was excavated from the test pit.

2.2. Boring/Monitoring Well Installation

- For auger borings, segregate contaminated soil (determined by visual and/or field screening methods) from uncontaminated soil during drilling. Segregate residual contaminated soil from split-spoon sampling.
- Auger cuttings or sediment generated by drive and wash may be spread around the ground surface at the boring location if it is acceptable to the client and the governing regulatory agency. If not, IDW may be placed in an appropriate area or container pending characterization and appropriate disposal. (A useful rule of thumb is to assume generation of one 55-gallon drum of cuttings for each 20 feet drilled with 7-¼-inch-I.D. augers).
- Segregate contaminated drilling fluid from uncontaminated fluid for rotary wash borings.
- Drilling fluid management options include pouring the drilling fluid on the ground near the boring location, if acceptable to the client and governing regulatory agency, or containerizing the fluid in drums or tanks.

2.3. Well Development/Sampling

Contaminated groundwater removed from wells by pumping or bailing for the purpose of well development and sampling may be poured on the ground near the well, if it is acceptable to the client and the governing regulatory agency. Otherwise, it should be containerized in drums or tanks.

2.4. Decontamination Fluids

Decontamination fluids may be poured on the ground in the vicinity of the well if approved by the project manager. Alternatively, the fluids may be containerized in drums or tanks.

2.5. Disposable Personal Protective Equipment

Disposable personal protective equipment (PPE) should be managed like any other IDW. However, with the clients' and project manager's approval, it may be removed from the site and disposed of as ordinary rubbish if it has not come into contact with contaminated materials.

3. Limitations

- The simplest IDW management option is to return the IDW to its source location.
- However, the selected IDW management options must meet state/federal regulations and have the client's approval. Consult with state/federal policies for IDW-related matters.

- The client is responsible for the disposal of IDW, should disposal be necessary.

4. References

Guide to Management of Investigation - Derived Wastes (April 1992), United States Environmental Protection Agency, Publication 9345.3-03FS.

Standard References for Monitoring Wells, Massachusetts Department of Environmental Protection, Publication No. WSC-310-91.

5. Attachments

Attachment A - Summary of Investigation Derived Waste Management Options

6. Contacts

David Terry
Leslie Lombardo

Attachment A: - SUMMARY OF IDW MANAGEMENT OPTIONS
GEI Consultants, Inc. Standard Operating Procedures
Management of Investigation - Derived Waste

Type of IDW	Generation Processes	Management Options	Remarks
Soil	Boring/monitoring well installation Test pit excavation Soil sampling	Return to source location immediately after generation	Acceptable, if authorized by the client, the governing regulatory agency, and the project manager.
		Spread around boring, test pit, or original source location	Acceptable, if authorized by the client, the governing regulatory agency, and the project manager.
		Containerize and temporarily store on site	Can temporarily store in stockpiles or covered containers (i.e. drums, roll-off containers). Stockpiles must be underlain by plastic sheeting and covered with plastic sheeting. Plastic sheeting must be secure. Storage consistent with state/federal regulations.
		Send to off-site, treatment or disposal facility within appropriate timeframes	Requires proper shipping documents (i.e. manifest, Bill of Lading, etc.), analytical characterization
		Store for future treatment and/or disposal.	Storage consistent with state/federal regulations. If a RCRA hazardous waste, must meet RCRA Container/Waste Pile/Tank requirements (see notes)
		Store temporarily awaiting laboratory analysis.	Storage consistent with state/federal regulations. Can temporarily store in stockpiles or covered containers (i.e. drums, roll-off containers). Stockpiles must be underlain by plastic sheeting and covered with plastic sheeting. Plastic sheeting must be secure.
Sediment/Sludge	Sludge pit sampling Sediment sampling	Return to source immediately after generation	Acceptable, if authorized by the client, the governing regulatory agency, and the project manager.
		Store temporarily on site.	Storage consistent with state/federal regulations.
		Send to off-site facility within 90 days	Requires manifests, analytical characterization
		Store for future treatment and/or disposal.	Storage consistent with state/federal regulations. If a RCRA hazardous waste, must meet RCRA Container/Waste Pile/Tank requirements (see notes)

Attachment A: - SUMMARY OF IDW MANAGEMENT OPTIONS
GEI Consultants, Inc. Standard Operating Procedures
Management of Investigation - Derived Waste

Type of IDW	Generation Processes	Management Options	Remarks
Aqueous liquids (groundwater, surface water, drilling fluids, other wastewater)	Well installation/development Well purging during sampling Ground water discharge - pump tests Surface water sampling	Pour onto ground close to well	Non-hazardous liquids only. Should not exhibit a sheen or separate phase product. Do not discharge to the ground up-gradient of the source location. Ensure that it is permissible by local, state, and Federal regulations Is acceptable to the client, the governing regulatory agency, and the project manager.
		Store temporarily on site	If a RCRA hazardous waste, must meet RCRA Container/Waste Pile/Tank requirements (see notes)
		Send to off-site commercial treatment unit within appropriate timeframes	Refer to State regulations for appropriate timeframe. Requires appropriate shipping documents (i.e., manifest, Bill of Lading), analytical characterization
		Send to POTW	Obtain appropriate discharge permit(s)
		Store for future treatment and/or disposal.	Storage consistent with state/federal regulations. Consistent with final remedial action
		Discharge to surface water	OK if it complies with state and federal regulations. Obtain appropriate discharge permit(s).
Decontamination fluids	Decontamination of PPE and equipment	Store temporarily on site	If a RCRA hazardous waste, must meet RCRA Container/Waste Pile/Tank requirements (see notes)
		Send to off-site facility within appropriate timeframes	Requires manifests, analytical characterization
		Store for future treatment and/or disposal. Storage consistent with state/federal regulations.	Consistent with final remedial action
Disposable PPE	Sampling, drilling, and test pit excavation observation, other on-site activities	Store temporarily on site	Dispose of appropriately after characterization
		Place in on-site industrial dumpster	Project-specific determination required – must be acceptable to client and project manager
		Send to off-site facility within 90 days	Project-specific determination required
		Store for future treatment and disposal.	Storage consistent with state/federal regulations. Project-specific determination required

Notes:

1) PPE - personal protective equipment
2) POTW - publicly owned treatment works
3) Generation processes listed here are provided as examples.
   IDW may also be generated as a result of other site activities.
4) RCRA Container/Waste Pile/Tank requirements:
   Containers; 40 CFR 264 Subpart I and 265 Subpart I
   Waste Piles; 40 CFR 264 Subpart L and 265 Subpart L
   Tanks; 40 CFR 264 Subpart J and 265 Subpart J

STANDARD OPERATING PROCEDURE

SC-004 Headspace VOC Screening

1. Objective

Describe methods to obtain site-specific measurement of the total volatile organic compound (VOC) concentrations present in the headspace of a jar containing soil.

This information can be used for several purposes:

- Segregate soil based on degree of contamination.
- Identify samples for quantitative analysis of VOCs.
- Evaluate the presence or absence of VOCs in soil.

2. Execution

- A photoionization detector (PID) or flame ionization detector (FID) instrument is used to measure VOCs in jar headspace (JHS) screening.
- Select the appropriate instrument, lamp, and calibration gas for the site-specific contaminants. Calibrate the instrument in accordance with the manufacturer's instructions before JHS screening begins. Record the type of calibration gas, detector, lamp, and results of calibration in the field notebook.
- Note the highest VOC concentration that the instrument measures in air in the work area before performing JHS screening. Record this as the initial background concentration.
- Half-fill a clean, glass jar with the soil. Quickly cover the open top with one or two sheets of clean, aluminum foil and screw on the cap to tightly seal the jar. Label the jar with the sample location and sample depth.
- Allow headspace development for at least 10 minutes at an ambient temperature of 50°F or greater. Vigorously shake the jar for 15 seconds at the beginning and end of the headspace development period. When ambient temperatures are below 50°F, place the jar in a heated vehicle or building during the headspace development period.
- After headspace development, remove the screw cap to expose the foil seal. Quickly puncture the foil seal with the instrument's sampling probe and insert it to a point at about one-half of the headspace depth.
- Record the highest VOC concentration that the instrument displays as the JHS concentration. The highest concentration should occur between 2 and 5 seconds after probe insertion.

3. Limitations

- The instruments may work poorly in the rain and in freezing temperatures. Under such conditions, operate the instrument in a heated vehicle or building if possible.

- Prevent water and soil particles from entering the tip of the instrument probe. Use a filter on the instrument's probe.
- Measure background VOC conditions and perform JHS screening away from non-site-related VOC sources, such as vehicle and heavy equipment exhaust.
- The VOC concentration on the instrument's display may vary when the air contains high VOC concentrations or high moisture.
- JHS screening is a guide that helps the screener to segregate soils into broadly defined categories. JHS screening results may differ by orders of magnitude from laboratory testing results.
- Note that states may have specific procedures for field monitoring. In Massachusetts, the Massachusetts Department of Environmental Protection (DEP) requires that screening of gasoline-contaminated soil be performed in accordance with Attachment II of the DEP's policy #WSC-94-400 Interim Remediation Waste Management Policy for Petroleum Contaminated Soils. Consult this procedure or any relevant guidance documents for assistance.

4. References

Interim Remediation Waste Management Policy for Petroleum Contaminated Soils. (April 1994), Massachusetts Department of Environmental Protection, Policy #WSC-94-400.

5. Contacts

Leslie Lombardo

Section 6

Solid Matrix Sampling (SM)

STANDARD OPERATING PROCEDURE

SM-001 Soil Sampling Techniques Including Split-Spoon

1. Objective

Describe standard procedures for the collection of surface and subsurface soil samples.

The definition of "surface" soil varies considerably between regulatory organizations. Surface soils may be classified as soils between the ground surface and 2 inches below ground surface, ground surface and 6 inches below ground surface, and even as much as ground surface and 24 inches below ground surface.

The definition of subsurface soil will vary in relation to the definition of surface soil. In general, subsurface soil is everything deeper than surface soil.

Refer to state-specific regulations for the definitions of surface and subsurface soils.

2. Execution

2.1. Surface Soil Sampling

Collection of surface soil samples can be accomplished with tools such as spades, shovels, trowels, scoops, etc. A flat, pointed mason trowel to cut a block of the desired soil is helpful when undisturbed profiles are required.

- Carefully remove the top layer of soil or debris to the desired sample depth with a pre-cleaned spade.
- Using a decontaminated stainless steel scoop, plastic spoon, or trowel, remove and discard a thin layer of soil from the area which came in contact with the spade.
- If volatile organic compound (VOC) analysis is to be performed, transfer the sample directly into an appropriate labeled sample container with a stainless steel lab spoon, small diameter core device, or equivalent and secure the cap tightly.
- Place the remainder of the sample into a decontaminated stainless steel, plastic, or other appropriate container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval.
- Either place the sample into appropriate labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval or location into the container and mix thoroughly.
- When compositing is complete, place the sample into appropriate labeled containers and secure the caps tightly.

2.2. Sampling with Hand Augers and Thin Wall Tube Samplers

Several types of augers are available; these include: bucket type, continuous flight (screw), and post-hole augers. Bucket type augers are generally better for direct sample recovery because they provide a large volume of sample in a short time. When continuous flight augers are used, the sample can be collected directly from the flights. The continuous flight augers are satisfactory when a composite of the complete soil column is desired. Post-hole augers have limited utility for sample collection as they are designed to cut through fibrous, rooted, swampy soil and generally cannot be used below a depth of approximately three feet.

2.2.1 Auger Sampling

- Clear the area to be sampled of any surface debris (e.g., twigs, rocks, litter). It may be advisable to remove the first three to six inches of surface soil for an area approximately six inches in radius around the drilling location.
- Attach the decontaminated auger bit to a drill rod extension, and attach the "T" handle to the drill rod.
- Begin augering, periodically removing and depositing accumulated soils onto a plastic sheet spread near the hole. This prevents accidental brushing of loose material back down the borehole when removing the auger or adding drill rods. It also facilitates refilling the hole, and avoids possible contamination of the surrounding area.
- After reaching the desired depth, carefully remove the auger from the hole. When sampling directly from the auger, collect the sample after the auger is removed from the hole.

2.2.2 Thin-Walled Core Sampling

- Remove auger tip from the extension rods and replace with a pre-cleaned thin wall tube sampler. Install the proper cutting tip.
- Carefully lower the tube sampler down the borehole. Gradually force the tube sampler into the soil. Do not scrape the borehole sides. Avoid hammering the rods as the vibrations may cause the boring walls to collapse.
- Remove the tube sampler, and unscrew the drill rods.
- Remove the cutting tip and the core from the device.
- Discard the top of the core (approximately 1 inch), as this may represent material knocked down from the sides of the boring and not the layer of interest. Place the remaining core into the appropriate labeled sample container.

One type of thin-wall sampler is depicted in Attachment A (this is typically used with a mechanical drill rig).

For either method, If VOC analysis is to be performed, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, small diameter core sampler, or equivalent and secure the cap tightly. VOC samples should be collected first to minimize the potential for losing volatiles prior to sample collection.

Place the remainder of the sample into a stainless steel, plastic, or other appropriate container and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the container and mix thoroughly.

When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

If another sample is to be collected in the same hole, but at a greater depth, reattach the auger bit to the drill and assembly, and follow previous steps, making sure to decontaminate the auger and tube sampler between samples.

Abandon the hole according to applicable state regulations. Generally, shallow holes can simply be backfilled with the removed soil material.

2.3. Sampling at Depth with a Split-Spoon (Barrel) Sampler

Split-spoon sampling is generally used with a mechanical drill rig to collect undisturbed soil cores of 18 or 24 inches in length. A series of consecutive cores may be extracted with a split-spoon sampler to give a complete soil column profile, or an auger may be used to drill down to the desired depth for sampling. The split-spoon is then driven to its sampling depth through the bottom of the augured hole and the core extracted. A diagram of the split-spoon sampler assembly is provided as Attachment A.

When split-spoon soil sampling is performed to gain geologic information, work should be performed in accordance with ASTM D1586-08a, "Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils". The following procedures are used for collecting soil samples with a split-spoon:

- Select the size (length and diameter) of split-spoon sampler based on the amount of soil that is needed for characterization. The ASTM standard for N-values is 1 3/8 - inch I.D (2-inch O.D.). Specify spoon size and basket type to driller prior to mobilization to the site. Split spoon samplers are typically available in 1 3/8 – and 3 – inch I.D. sizes. A larger barrel may be necessary to obtain the required sample volume. Note on the boring log where larger split spoon barrels are used because the ASTM standard penetration test does not apply when driving split spoons larger than 1 3/8 I.D. (2-inch O.D.).

- Select a soft or stiff basket for the spoon (a softer basket generally works better for loose or soft material).
- Prior to hammering the split spoon to collect the sample, verify that the split-spoon is seated at the beginning of the desired sample interval. If it is seated above the interval, have driller clean out the hole prior to sampling. Record all depth measurements relative to ground surface.
- Assemble the sampler by aligning both sides of barrel and then screwing the drive shoe on the bottom and the head piece on top. See diagram in Attachment A.
- Place the sampler in a perpendicular position on the sample material.
- For all soil samples, use a 140-lb hammer falling 30 inches to drive the sampler, unless conditions necessitate using a 300-lb hammer.
- Record in the site fieldbook or on field data sheets the length of the tube used to penetrate the material being sampled, the split-spoon inside and outside diameters, and the hammer weight,
- Count and record the number of blow counts per 6-inch increments (confirming blow counts with driller if necessary).
- Withdraw the sampler, and open by unscrewing the bit and head and splitting the barrel. The length of recovery and soil type should be recorded on the boring log. If a soil sample is desired, a decontaminated stainless steel knife or spatula should be used to divide the tube contents in half, longitudinally. If possible, avoid collecting soil that has come in contact with the walls of the spoon, and soil at the top of the spoon.
- Without disturbing the core, transfer it to appropriate labeled sample container(s) and seal tightly.
- Note any material in the nose (shoe) of the spoon.
- Immediately collect a sample for VOCs (if required by the site-specific field sampling plan) by collecting soil from the entire length of the split spoon, unless otherwise specified by the project manager. When the most impacted interval is sampled for laboratory analysis, screen the spoon with the field instrument first, then collect the soil sample for VOC analysis from the appropriate interval.

3. Limitations

- Weather conditions (e.g., frozen ground) may prevent the collection of samples and should be considered prior to sample collection.
- Tools plated with chrome or other materials should not be used.
- Be aware of local laws regarding subsurface utility clearance prior to conducting subsurface investigations. Contact DigSafe or local utility companies as required.
- Be aware of the length of the drill string, the sample depth, and the required stickup of the drill string to ensure accurate sample interval measurement.
- If drilling with hollow-stem augers, the removal of the drill string from the hole, prior to attaching the split-spoon sampler, may cause soils to be sucked up

into the augers (blow-in running sands). Upon recovery, determine if there is blow-in in the split spoon sampler. In general, blow-in is more unconsolidated than the rest of the sample and lacks stratification (do not include blow-in for recovery of sample collection).

- If soils consist of loose sands or soft clay, the drill string and sampler may advance slightly under its own weight, giving a false depth for soil collection.
- Never sample more than two spoons consecutively without advancing the augers unless material is tight. Do not let the split spoon penetrate more than it can hold.
- In many instances, groundwater will fill the auger and the split-spoon.

4. References

ASTM D1586-08a, "Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils". 2008.

United States Environmental Protection Agency, SOP 2012 "Soil Sampling", Revision 0.0, February 18, 2000.

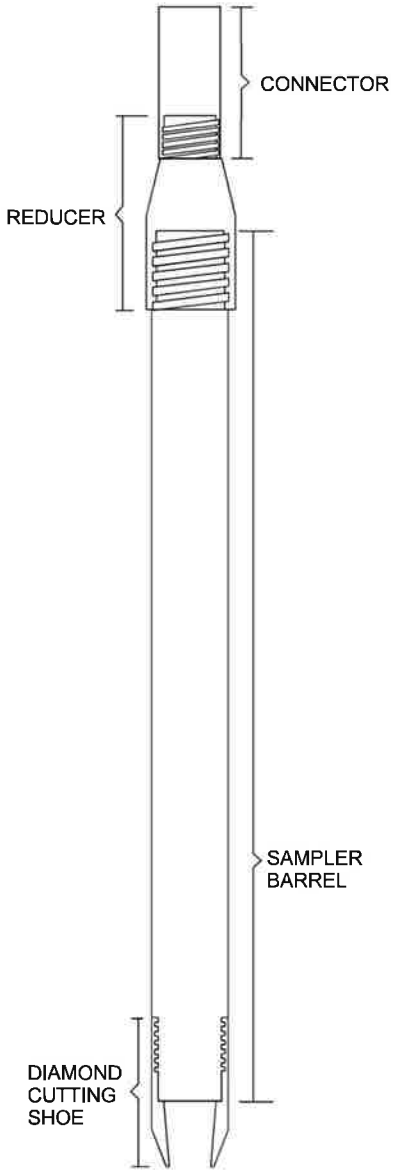
5. Attachments

Attachment A - Sampler Design Assembly

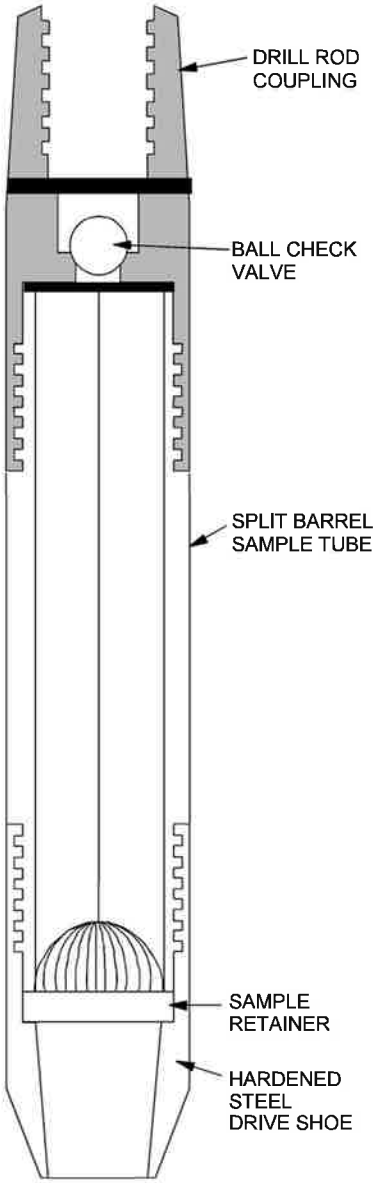
6. Contacts

Matt Glunt
Chris Pray

THIN WALL HQ CORE SAMPLER
(2" width x 60" length)



SPLIT-SPOON SAMPLER
(2" width x 24" length)



STANDARD OPERATING PROCEDURES SM-001	GEI Consultants	**THIN WALL AND SPLIT-SPOON SAMPLERS**
NEW ENGLAND AND ATLANTIC REGIONS	June 2011	Attachment A

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STANDARD OPERATING PROCEDURE

SM-003 Classification of Soil Samples in the Field

1. Objective

Describe methods to classify soil samples collected in the field in a consistent manner.

2. Execution

- Describe soil samples according to *ASTM D2488-09a, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) and* Attachments A and B. This standard is the basis for the Unified oil Classification System.
- Identify and record the soil in terms of the major and minor constituents (i.e., sand gravel, silt, clay), Unified Soil Classification Symbol, sample structure, plasticity and dilatancy for fine-grained soils, color, local or geologic name if known (e.g., Boston Blue Clay or glacial till), odor, presence of iron or other staining, and presence of organic matter, shells, debris, or other unusual characteristics of the same.
- If a soil split-spoon sample contains more than one soil type (for example, the upper portion is silty sand and the lower portion is clay) describe each type separately.
- Record sampler type, blow counts, soil description, etc. on the boring log (see Attachment C).
- GEI consistently applies one modification to the ASTM standard: Use "widely graded" and "narrowly graded" instead of "well-graded" and "poorly graded," respectively.

3. Limitations

Certain projects or clients will require the use of other classification systems. Other classification systems should not be used unless specifically required by the client. If the client requires that we use the Burmister method, obtain the details from the client. An example breakdown is shown below, but some clients (MassDOT, for example) have their own breakdown.

- "and" = 35-50%
- "some" = 20-35%
- "little" = 10-20%
- "trace" = 1-10%

- Describing soil samples is often difficult during cold or wet weather. Make sure your field notes describe these conditions. When possible, collect archive samples and verify sample descriptions in the office.

- The ASTM Standard Practice for Classification of Soils for Engineering Purposes (D2487) may be used in conjunction with the Visual-Manual Method to confirm the soil classification. D2487 includes laboratory testing.

4. References

ASTM D2487-06e1, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System), ASTM, 2006.

ASTM D2488-09a, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), ASTM, 2009.

Field Guide for Soil and Stratigraphic Analysis, Midwest Geosciences Group Press, 2001-2005.

Coarse-Grained Soils Visual-Manual Descriptions, GEI Consultants, Soil Description Chart.

Fine-Grained Soils Visual-Manual Descriptions, GEI Consultants, Soil Description Chart.

5. Attachments

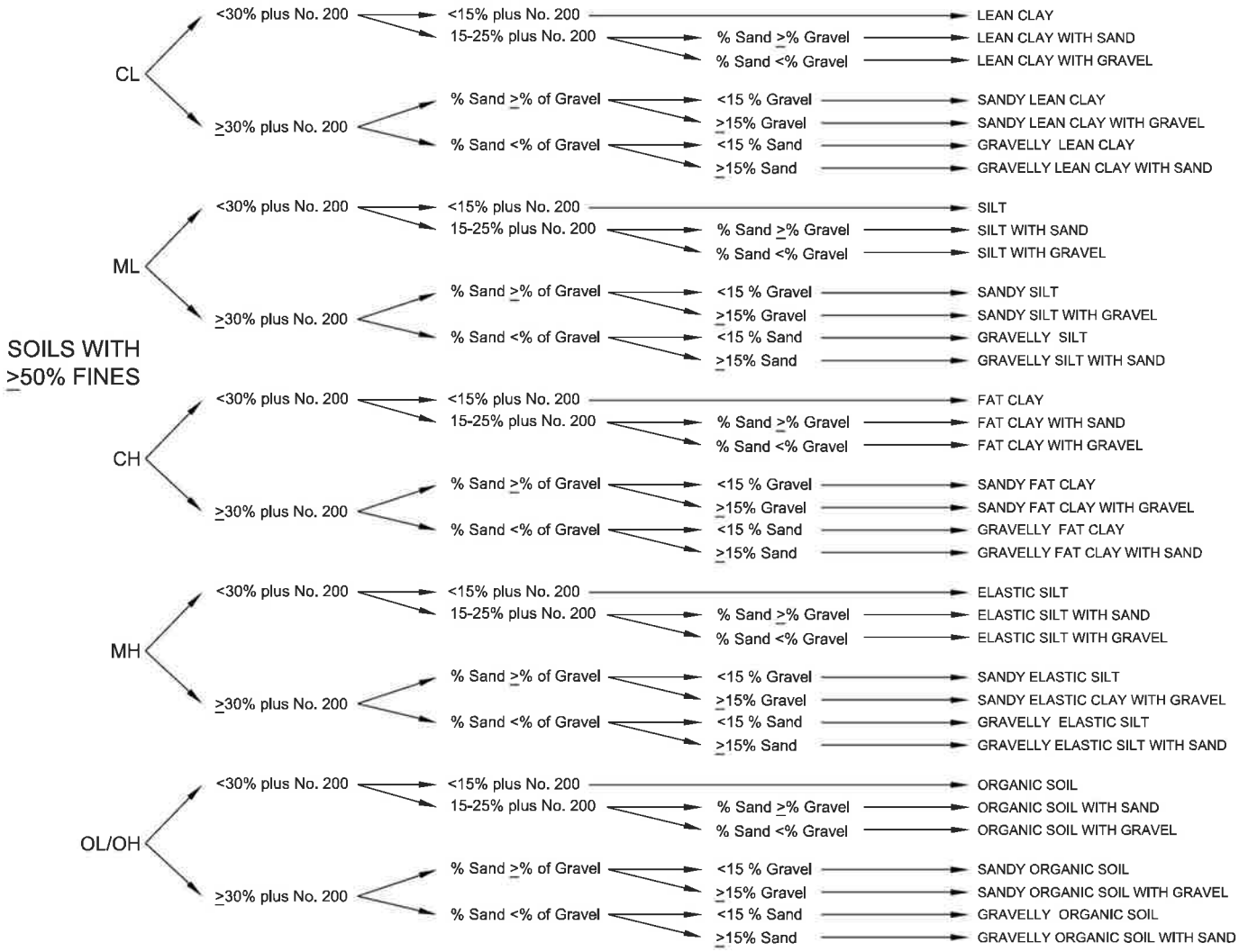
Attachment A – GEI Soil Description Charts (2007)
Attachment B – Visual Manual Descriptions with example boring log
Attachment C – Describing the Plasticity of Soil Samples

6. Contacts

Cathy Johnson

GEI Consultants

FINE-GRAINED SOILS
VISUAL-MANUAL DESCRIPTIONS



ID OF INORGANIC FINE SOILS FROM MANUAL TESTS

Symbol	Name	Dry Strength	Dilatancy	Toughness*
ML	Silt	None to low	Slow to rapid	Low or thread cannot be formed
CL	Lean Clay	Medium to high	None to slow	Medium
MH	Elastic Silt	Low to medium	None to slow	Low to medium
CH	Fat Clay	High to very high	None	High

1. GROUP NAME and (SYMBOL)
2. Describe fines, sand, and gravel components, in order of predominance. Include plasticity of fines. Include percentages of sand and gravel.
3. Color
4. Sheen, odor, roots, ash, brick, cementation, torvane and penetrometer results, etc.
5. "Fill," local name or geologic name, if known

PEAT

Peat refers to a sample composed primarily of vegetable matter in varying stages of decomposition. The description should begin: PEAT (PT) and need not include percentages of sand, gravel or fines.

CRITERIA FOR DESCRIBING PLASTICITY

Description	Criteria
Nonplastic ML	A 1/8-in. (3 -mm) thread cannot be rolled at any water content
Low Plasticity ML, MH	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit *
Medium Plasticity MH, CL	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit
High Plasticity CH	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit

* Toughness refers to the strength of the thread near plastic limit. The lump refers to a lump of soil drier than the plastic, similar to dry strength.

COARSE-GRAINED SOILS

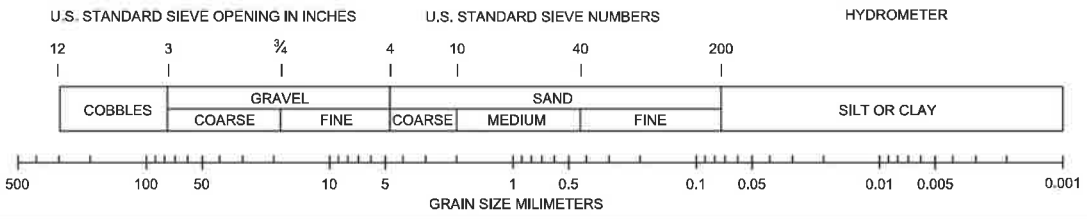
VISUAL-MANUAL DESCRIPTIONS

GEI Consultants

TYPICAL SOIL COLORS

- YELLOW
- OLIVE
- LIGHT BROWN
- BROWN
- REDDISH BROWN
- RED
- GRAY
- BLACK

			GROUP SYMBOL	GROUP NAME
GRAVEL: % Gravel > % Sand	≤5% Fines	WIDELY GRADED	GW	<15% Sand → WIDELY GRADED GRAVEL
				≥15% Sand → WIDELY GRADED GRAVEL WITH SAND
		NARROWLY GRADED	GP	<15% Sand → NARROWLY GRADED GRAVEL
				≥15% Sand → NARROWLY GRADED GRAVEL WITH SAND
	~10% Fines	WIDELY GRADED, Fines = ML or MH	GW-GM	<15% Sand → WIDELY GRADED GRAVEL WITH SILT
				≥15% Sand → WIDELY GRADED GRAVEL WITH SILT AND SAND
		WIDELY GRADED, Fines = CL or CH	GW-GC	<15% Sand → WIDELY GRADED GRAVEL WITH CLAY
				≥15% Sand → WIDELY GRADED GRAVEL WITH CLAY AND SAND
		NARROWLY GRADED, Fines = ML or MH	GP-GM	<15% Sand → NARROWLY GRADED GRAVEL WITH SILT
				≥15% Sand → NARROWLY GRADED GRAVEL WITH SILT AND SAND
		NARROWLY GRADED, Fines = CL or CH	GP-GC	<15% Sand → NARROWLY GRADED GRAVEL WITH CLAY
				≥15% Sand → NARROWLY GRADED GRAVEL WITH CLAY AND SAND
	≥15% Fines	Fines = ML or MH	GM	<15% Sand → SILTY GRAVEL
				≥15% Sand → SILTY GRAVEL WITH SAND
		Fines = CL or CH	GC	<15% Sand → CLAYEY GRAVEL
				≥15% Sand → CLAYEY GRAVEL WITH SAND
SOILS WITH <50% FINES				
SAND: % Sand ≥ % Gravel	≤5% Fines	WIDELY GRADED	SW	<15% Gravel → WIDELY GRADED SAND
				≥15% Gravel → WIDELY GRADED SAND WITH GRAVEL
		NARROWLY GRADED	SP	<15% Gravel → NARROWLY GRADED SAND
				≥15% Gravel → NARROWLY GRADED SAND WITH GRAVEL
	~10% Fines	WIDELY GRADED, Fines = ML or MH	SW-SM	<15% Gravel → WIDELY GRADED SAND WITH SILT
				≥15% Gravel → WIDELY GRADED SAND WITH SILT AND GRAVEL
		WIDELY GRADED, Fines = CL or CH	SW-SC	<15% Gravel → WIDELY GRADED SAND WITH CLAY
				≥15% Gravel → WIDELY GRADED SAND WITH CLAY AND GRAVEL
		NARROWLY GRADED, Fines = ML or MH	SP-SM	<15% Gravel → NARROWLY GRADED SAND WITH SILT
				≥15% Gravel → NARROWLY GRADED SAND WITH SILT AND GRAVEL
		NARROWLY GRADED, Fines = CL or CH	SP-SC	<15% Gravel → NARROWLY GRADED SAND WITH CLAY
				≥15% Gravel → NARROWLY GRADED SAND WITH CLAY AND GRAVEL
	≥15% Fines	Fines = ML or MH	SM	<15% Gravel → SILTY SAND
				≥15% Gravel → SILTY SAND WITH GRAVEL
		Fines = CL or CH	SC	<15% Gravel → CLAYEY SAND
				≥15% Gravel → CLAYEY SAND WITH GRAVEL





1. GROUP NAME and (SYMBOL)
2. Structure , if any. (stratified layer thicknesses, lenses, varves, gradational changes)
3. Describe sand, gravel and fines components, with percentages, in order of predominance. Include max gravel size. For test pits give percent cobbles and boulders, by volume, and include max size.
4. Color
5. Sheen, odor, roots, ash, brick, cementation, reaction with HCL, etc.
6. "Fill," local name or geologic name, if known

Describing the Plasticity of Soil Samples

M. Paster – November 2008

References ASTM D 2487 – Soil descriptions – lab
ASTM D 2488 – Soil descriptions – field
ASTM D 4318 – Atterberg limits testing

GEI Practice for Boring and Test Pit Logs

Describe the fines as:

Non-plastic
Low plasticity (The GEI laminated sheets incorrectly use "slightly plastic" for "low plasticity.")
Medium plasticity
High plasticity

Example: ~25% low plasticity fines

Toughness and dry strength:

You should use these tests to help decide how plastic the fines are. Record the results in the remarks column of the field log, but not in the soil description and not necessarily in the typed log.

On final logs, if Atterberg limits tests have been performed:

Do not use the descriptive terms non-plastic, low plasticity, etc. for samples on which Atterberg limits tests have been run. Instead, just give the percentage of fines and then report the actual Atterberg limits at the end of the description.

For example, the end of a silty sand description might be:

. . . ~25% fines, ~10% gravel max size ½ inch, gray. PL=23, LL=35.

(Atterberg limits tests are performed on the fraction of the sample finer than the No. 40 sieve, not just the fines. So the Atterberg limits data applies to the sample, not just to the fines.)

Hints:

High plasticity soils are rare in New England. If you think it's high plasticity, it's probably medium. Some Boston blue clay and some Connecticut River varved clays are high plasticity, but if you think you've found some, check with the project manager.

In New England, if ~10% fines or more, generally stick with GM, SM, ML, and CL. Occasionally GC, SC, CH. Don't use MH unless you have Atterberg limits data.

Estimating plasticity in the field, GEI guidance based on ASTM D 2488:

Plasticity	1/8-inch thread	Dry strength	Toughness
non	Cannot be rolled at any water content.	Dry specimen crumbles when handled.	Only slight pressure needed to roll thread near plastic limit.
low	Thread can barely be rolled.	Dry specimen crumbles with some finger pressure.	Slight to medium pressure needed to roll thread near plastic limit.
medium	Thread is easy to roll. Not much time needed to reach plastic limit.	Dry specimen crumbles with considerable finger pressure.	Medium pressure needed to roll thread near plastic limit.
high	Takes considerable time rolling and kneading to reach plastic limit.	Dry specimen cannot be broken with finger pressure.	Considerable pressure needed to roll thread near plastic limit.

Non-plastic vs. low plasticity:

ASTM D 2488 (soil descriptions - field) defines non-plastic and low plasticity based on the 1/8-inch thread as shown in the table above.

ASTM D 4318 (Atterberg limits testing) indicates that a sample should be called non-plastic for either of the following cases:

- The liquid limit test (dropping the cup) or the plastic limit test (rolling out the thread) cannot be performed because the plasticity is too low.
- The plastic limit is greater than or equal to the liquid limit.

Unfortunately, there are some soils that are low plasticity based on D 2488 (a thread can be rolled), but are non-plastic based on D 4318 (the liquid limit cannot be measured or PL≥LL).

GEI considers these soils to have low plasticity, because that is how they "look" and "feel." We want to document this information so that other people will have a better feel for what the soil looks like and how it behaves. So, if the soil was low plasticity based on D 2488, but non-plastic based on D 4318, that should be explained in the letter or report, and possibly in a note on the log.

BORING LOCATION Maple Ave Sidewalk
GROUND ELEVATION (NGVD) _____
GROUNDWATER EL. _____ DATE _____

DATE START/FINISH 2/14/07 - 2/15/07
DRILLED BY Geologic: M. Costigan
LOGGED BY T. Kahl/M. Yako TOTAL DEPTH (FT) 25

B101

PG. 1 OF 1

EL. FT.	DEPTH FT.	SAMPLE TYPE and NO.	SAMPLE BLOWS PER 6 IN.	SAMPLE PEN IN.	SAMPLE REC IN.	PID JAR HS / REMARKS	GRAPHIC LOG	SOIL AND ROCK DESCRIPTIONS
	0						FILL	4" pavement
		S1	13-9 17-14	24	0	0.5 ppm		S1: Redrove 0.5 to 3.5 ft. Recovery 11": WIDELY GRADED SAND (SW) ~85% sand, ~10% gravel to 1", <5% nonplastic fines, brown. Contains brick fragments and ash. Fill.
	2.5					hard drilling 3 to 4 ft, possible boulder		
	5	S2	7-7 11-13	24	8	2.0 ppm		S2: NARROWLY GRADED SAND WITH SILT AND GRAVEL (SP-SM) ~65% mostly fine sand, ~25% gravel to 3/4 inch ~10% non-plastic fines, brown. Fill.
	7.5	S3	9-10 2-1	24	16	0.0 ppm	ORGANICS	S3 (0-10"): Similar to S2.
	10							S3 (10"-16"): ORGANIC SILT (OL) ~100% slightly plastic fines, dark gray, organic odor, contains white shell fragments.
	12.5	S4	WOH 1-2 1	24	15	0.0 ppm		
	15					hard drilling at 15.5 ft		S4: Similar to S3, bot 6".
	17.5	S5	20-35 50/3"	15	8	Top of rock ~19 ft. Roller bit to 20 ft.	TILL	S5: SILTY SAND WITH GRAVEL (SM) ~60% mostly fine sand, ~25% slightly plastic fines, ~15% gravel to 1/2 inch, olive. Glacial Till.
	20							
	22.5	C1	RQD 70%	60	54	lost ~10 gallons drill fluid from 23 to 25 ft	ROCK	C1: SCHIST, hard, slight weathering at joint surfaces, joints at ~30 degrees from horizontal and generally parallel to foliation, gray. Marlborough Formation.
	25							Bottom of Boring 25 ft
	27.5							Truck-mounted drill rig. 4-inch casing to 19 ft. Safety-hammer with rope and cathead for SPT. Backfilled with drill cuttings.
	30							

BLOWS PER 6 IN.–140 LB. HAMMER FALLING 30 IN. TO DRIVE A 2.0 IN. OD SPLIT SPOON SAMPLER
PEN–PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC–RECOVERY LENGTH OF SAMPLE
RQD–LENGTH OF SOUND CORES > 4 IN./ LENGTH CORED, %
S–SPLIT SPOON SAMPLE
U–UNDISTURBED SAMPLES, UF–FIXED PISTON UO–OSTERBERG
▽ GROUNDWATER

NOTES:
1: Groundwater at 10 ft depth at start of day 2/15/07.

PROJECT 07999-0
DATE

GEI Consultants

EXAMPLE SOIL DESCRIPTIONS

SANDY SILT (ML) ~60% slightly plastic fines, ~40% mostly fine sand, 1" thick layer of fine to medium sand with <20% fines, gray.

LEAN CLAY (CL) ~90% moderately plastic fines, ~10% fine sand, olive. Boston Blue Clay. Sv = 0.5, 0.5, 0.8 tsf, Qp = 1.0, 1.5, 1.6 tsf

Stratified CLAYEY SAND (SC) and WIDELY GRADED SAND (SW) SC layers 1 to 2 inches thick consist of fine sand with ~30% moderately plastic fines, gray. SW layers 1 to 4 inches thick consist of fine to coarse sand, ~10% gravel to 1/2 inch, <5% fines, brown. Hydraulic Fill.

EXAMPLE ROCK DESCRIPTIONS

(0-9"): GRANITE, hard, one piece, joint surface slightly weathered, pink.
(6-60"): PHYLLITE, joints ~ 45° generally parallel to foliation, 9" to 44" moderate to severe jointing and joint weathering. 44" to 60" single piece, green-gray.

ARGILLITE, medium hard, moderately weathered joints, gray. Cambridge Argillite.

GEOPROBE AND ROTOSONIC

When SPTs are not performed, note sample density (sands) or stiffness (clays) in description.

CRITERIA FOR DESCRIBING DILATANCY OF FINE-GRAINED SOILS

Description	Criteria
None	No visible change in the specimen
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.

SPT: Standard Penetration Test

30-inch drop with 140-lb hammer
1 3/4 to 2 1/4 turns around cathead
2-inch O.D. split spoon sampler

ENV'L TERMINOLOGY FOR SOIL DESCRIPTIONS

- **Ash -** Typically silt-size to medium sand-size.
- Do not use the term "cinders." This is not a technical term. Instead, use "ash," "burnt wood," "burnt material," or a similar term.
- **Coal-like material** - If it looks like coal but you aren't sure.
- **Clinker -** Vitrified (glass-like) or heat-fused material. Often burned impurities in coal. Often looks like pumice, but heavier.
- **Slag** - Similar to clinker, but normally refers to residue from metal ore processing.

- **Sheen -** Iridescent petroleum-like sheen. Not to be used for a "bacterial sheen," which can be distinguished by its tendency to break up on the water surface at angles. Petroleum sheen will be continuous and will not break up.
- **Stained -** Use with a color ("brown-stained") to indicate that the soil is stained a color other than its natural (unimpacted) color.
- **Coated -** Soil grains are coated with NAPL (oil, tar, etc.). There is not enough NAPL to saturate the pore spaces. ("Split spoon sampler coated with brown oil." "Soil grains coated with gray substance with slight gasoline-like odor.")
- **Saturated -** The entire sample pore space is saturated with NAPL. If you use this term, be sure it is not water saturating the pore spaces. Depending on viscosity, the NAPL may drain from a soil sample. ("Sample saturated with green, sticky substance.")
- **Blebs -** Discrete sphericals of NAPL in a soil matrix that was not visibly coated or saturated. ("Occasional blebs of reddish-brown tar.")
- **Oil -** Exhibits a petroleum odor, different from MGP odors.
- **Tar -** Exhibits an MGP odor (e.g. naphthalene-like odor).

- **Odors -** Use terms such as "naphthalene-like odor" or "petroleum-like odor." Use modifiers (strong, moderate, slight) to indicate odor intensity.

STANDARD OPERATING PROCEDURE

SM-004 Test Pit Excavation

1. Objective

Describe methods for excavating test pits and documenting findings.

The test pit is used to characterize geologic strata, subsurface conditions and provide access for collection of representative soil samples from these strata.

2. Execution

- Before digging begins, proper permits and notifications must be obtained, in accordance with applicable rules or regulations.
- Make sure that utility clearance has been conducted. Contact the property owner to determine the location of underground utilities. Verify, with the contractor that local/regional utility clearance service has been contacted. Ask subcontractor to provide local/regional utility clearance service authorization number and record this in the field notebook. Show the contractor the approximate excavation area, and have the contractor confirm that the area is suitable for excavation. Clearance may require marking of subsurface explorations prior to contacting utility clearance service.
- Have contractors pressure wash or steam clean equipment before beginning field activities, if necessary.
- Observe the contractor excavating the designated area.
- If contamination is suspected, have the contractor place excavated material on plastic sheeting.
- During excavation, monitor ambient air for contaminants of concern identified in the site-specific Health and Safety Plan. Record readings in field notebook (see SOP FD-001 Field Notebook).
- Record in a field book or test pit log:
    - Test pit dimensions,
    - Soil classifications (see SOP SM-003 Soil Classification)
    - Visual and olfactory indications of contamination
    - Subsurface structures
    - Obstructions to excavation
    - Any other observations relevant to the project objectives
    - Take photographs of excavation and completed test pit walls, etc. (SOP FD-004 Photodocumentation).
- Record technical information on a PDA, test pit log form, or a field book.
- Label sample bottles (see SOP SC-002 Sample Handling).
- Screen soil samples for contaminants of concern and record results in the field notebook or test pit log.
- Collect soil samples from the test pit as designated in the work plan including sidewalls and bottom at designated depths, at strata changes, or based upon

field screening using remote sampling equipment (backhoe bucket, stainless steel remote sampler, etc.). Do not enter a test pit unless side slopes satisfy Occupational Safety and Health Administration (OSHA) regulations and other health and safety concerns have been addressed.

- Transfer soil samples to the appropriate glassware according to soil sampling SOPs (SOP SM-002 VOC Soil Collection and Preservation Method, etc.).
- Store samples on ice in a cooler (see SOP SC-002 Sample Handling and SOP FD-003 Chain-of-Custody).
- Backfill excavation as soon as possible with material as described in the field plan. Place the excavated material back in the excavation in approximately the same strata it came from.
- Segregate contaminated soil as necessary (see SOP SC-003 IDW). Properly identify segregated material and secure as described in the work plan.
- Measure dimensions of excavation and record in the field notebook or test pit log. If sampling locations are to be surveyed, mark the corners and provide surveyor with location ID.
- Sketch dimension and location of the test pit relative to a site reference point and record in the field notebook. Note the sample locations by number on a cross-section sketch and plan view sketch.

3. Limitations

- Never enter the excavation unless it is shored or the sidewalls are sloped in accordance with OSHA regulations and all proper personal protective safety precautions have been considered and implemented.
- Terminate excavation if the flow of groundwater into the excavation adversely affects the stability of the excavation (i.e., slumping). Make sure to note in the field notebook or test pit log the depth to ground water.
- Terminate excavation if drums, tanks, or other potential sources of contamination are observed. Record visible drum markings, labels, and any other pertinent information on the test pit log and in the field notebook. Photograph drums and materials. Consult with the project manager before filling the excavation.
- Do not leave an open test pit unattended.

4. References

Earth Manual (1968), United States Department of the Interior, Bureau of Reclamation, United States Government Printing Office, Washington, D.C., pp. 134-139.

OSHA Standards for Excavations, Department of Labor, Federal Register, 29 CFR Part 1926, Aug. 9, 1994.

5. Contacts

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Field Descriptions of Samples at Urban Impacted Sites

The intent of this document is to provide field personnel guidelines for logging soil conditions and observed impacts in a consistent and factual manner. This guidance recognizes that prejudging field conclusions regarding the potential source(s) or nature of a particular impact should be avoided and instead conclusions should be based on multiple lines of evidence (field observations, laboratory physical and chemical analyses, historic site uses, location of observed impacts, etc.).

SOIL LOGGING

- All soils are to be logged using the **Unified Soil Classification System** (ASTM D 2488 field descriptions).
- A photograph of the entire sample core should be taken. Additional photographs may be necessary to document impacted material.
- A calibrated **PID** (Photoionization Detector) should be used to screen all soil samples. PID readings should be taken every 6 inches of recovery and the interval reading should be included on the boring logs.
- The soil sample core should be scored or cut along the long axis so that the all of the soil lithology can be observed, when practical.
- **Moisture terms**: dry, moist and wet.
- **Color terms** –Color terms should be used to describe the "natural color" of the sample as opposed to staining caused by contamination (see below).
- **Representativeness** – Soil logs should include specific notes if the field representative believes that there is a possibility the soil sample being described is not representative of the interval sampled or is indicative of multiple sources of contamination.
- **Intervals for Description** – the field description should be for discrete intervals within the sampler, specifically pointing out small-scale units and changes within each sample interval. The description should also include the amount of sample recovered and note other conditions (such as a change in drilling conditions, etc.), as well as consistently adjusting the sample interval described (i.e. – identify the percentage of sample actually recovered and note any potential causes of the loss if possible) and note other conditions (such as a change in drilling conditions, etc.).

DESCRIPTION OF CONTAMINANTS

Visual Contamination Descriptors

- **NAPL** (Non Aqueous Phase Liquid) – a separate phase liquid that may be lighter than water (LNAPL) or denser than water (DNAPL). NAPL arises from a variety of industrial sources and can have varying consistency (viscosity) and can range from non-viscous to highly viscous (taffy-like). NAPL observations should be accompanied by applicable olfactory with smell for industrial sources (see descriptors below) and other visual observations (e.g., color and viscosity).

- **Sheen –** iridescent sheen. This is not to be used to describe a "bacterial sheen", which can be distinguished by its tendency to break up at angles on the water surface; whereas a non-bacterial sheen will be continuous and will not break up.

- **Blebs –** discrete, spherical shaped NAPL in or on the soil matrix. Include additional descriptors to the extent practicable such as the approximate size and quantity (number of blebs or qualitative estimate) to the extent practical.

- **Coated –** soil grains are coated with NAPL – there is not sufficient NAPL present to saturate the pore spaces. Use modifiers such as light, moderate or heavy to indicate the degree of coating.

- **Saturated –** the entirety of the pore space for a sample interval is saturated with NAPL. Care should be taken to ensure that the saturation described is not related to water in the sample. Depending on the viscosity, NAPL saturated materials may freely drain from a soil sample and should be documented accordingly.

- **Stained** – visible, unnatural discoloration of the soil, with no visible free product.

- **Solid NAPL –** NAPL that is in a solid or semi-solid phase. The magnitude of the observed solid NAPL should be described (discrete granules or a solid layer).

  Other Visual Impacts and Descriptors– Other visual impacts that are not naturally occurring should also be noted along with appropriate visual descriptors. These other visual observations could include the observation of debris, wood chips, staining, anthropogenic materials, or other notable visual characteristics and general observations characterizing common urban fill. The above impacts should be described using other visual descriptors as applicable. Descriptors may include, but not be limited to, color, consistency, thickness, etc.

Olfactory Descriptors

- Note odors similar to mothballs, driveway sealer, highway paving oil or other odors that are acrid, burnt, or sulfur-like, etc.
- Other odors that are not believed to be natural should also be identified with descriptors such as organic, ammonia, sweet, chemical etc., as applicable.
- Use modifiers such as strong, moderate or slight to indicate intensity of the observed odor.
- In instances where multiple odors are present, a combination of descriptors should be used to clearly identify where these co-mingled impacts are present.

DNAPL/LNAPL

- **Density of NAPL –** a jar shake test can be performed to preliminarily determine in the field whether observed NAPL is either denser or lighter than water. Care should be taken in recording and interpreting the results, as experience indicates that the apparent result immediately following the test may change with time. Laboratory testing for density of the NAPL is recommended to confirm results. The depth at which the NAPL is encountered on soil with respect to the groundwater surface is not diagnostic and should not be used a basis for identifying the density of NAPL in the field.

- **Viscosity of NAPL –** if NAPL is present a qualitative description of viscosity should be made. The following should be used:

  Highly Viscous (taffy-like)
  Viscous (No. 6 fuel oil or bunker crude-like)
  Low viscosity (No. 2 fuel oil-like or water-like)

GROUNDWATER SAMPLING OBSERVATIONS

- Any observations of sheen, blebs, NAPL, smearing or coating of the sampling equipment, odor, etc. made during groundwater sampling are to be included in the groundwater sample collection log.

COLOR CHART (ATTACHED) For Use in Cross-Sections, Extent Maps, and Similar Interpretative Depictions

The color chart attached is intended to help visually depict the nature and location of impacts observed during an investigation. The chart would be used for new sites or sites transitioning from the Site Characterization to the Remedial Investigation phase (or are in the early stages of the Remedial Investigation phase). The colors should be included in investigation summaries on cross sections to support an understanding of the nature and extent of impacts. In addition, the colors may also be placed on boring logs (although not a requirement) in the final report. In either case, the colors will be used in interpretive depictions of nature and extent once the lines of evidence support a determination of the appropriate color selection. Since the investigation of a site is dynamic, the use of a particular color or a combination of colors may change if other lines of evidence suggest such a change is appropriate.

In instances where multiple impacts are present, a combination of colors should be used (such as a color with cross hatching) to clearly identify where these co-mingled impacts are present.

Color Descriptions of Samples at Urban Impacted Sites

	RGB Color	Auto Cad Index
NAPL SATURATED	255,0,0	10
NAPL COATED MATERIAL	255,0,255	210
SOLID NAPL	129,64,0	34
NAPL BLEBS, GLOBS, SHEEN	255,191,0	40
STAINING, ODOR	255,255,0	50
INDUSTRIAL IMPACTS - (PETROLEUM OR OTHER UNNATURAL) SATURATION & SHEENS	0,191,255	140
INDUSTRIAL IMPACTS - (PETROLEUM OR OTHER UNNATURAL) STAINING & ODORS	170,234,255	141
WOOD CHIPS/BLUE DISCOLORATION/SULFER-LIKE ODOR	0,0,255	170
NO OBSERVED IMPACTS	0,165,0	92

Note: In instances where multiple impacts are present, a combination of colors should be used (such as a color with cross hatching) to clearly identify where these co-mingled impacts are present.

Section 7

Groundwater (GW)

STANDARD OPERATING PROCEDURE

GW-001 Water Level and NAPL Measurement

1. Objective

Describe procedures to measure the depth to water and non-aqueous phase liquid (NAPL) thickness in an open borehole, cased borehole, monitoring well or piezometer.

2. Equipment and Materials

Field forms and/or field notebook.

- Decontamination fluids
- Bailer
- Weighted cotton string
- Oil/Water interface probe
- Water level meter (if oil/water interface probe is not available)

Water level and NAPL measurements can be collected by a variety of methods. A water level meter is used to collect depth to water measurements however an oil/water interface probe or other methods must be used to gauge NAPL depths. An electronic oil/water interface meter, consists of a cable divided into incremental measurements of 0.01 feet, and probe that consists of an infra-red circuit that detects the presence of a liquid, and a conductivity circuit that differentiates between conductive liquid (water) and non-conductive liquid (LNAPL or dense non-aqueous phase liquid [DNAPL] product). Typically, a steady tone and light indicate a non-conductive liquid (e.g. product) and an intermittent tone and light indicate a conductive liquid (e.g. water). Refer to the manufacturer's instructions for details. Alternately, water level and NAPL measurements can be collected using a water level meter, clear bailer and weighted cotton string. Each method of data collection is described below.

3. General Information

- The water level in a monitoring well or piezometer should be allowed to stabilize for a minimum of 24 hours after development or construction before groundwater elevation and/or NAPL measurements are collected. The water level in a borehole can be measured during drilling; however, this should be noted in the field notebook.
- Water levels in multiple wells should be collected within the shortest timeframe practicable.
- Water and NAPL levels should be measured from the designated survey point as specified by the surveyor or highest point (or "V" notch) on the PVC. If the well is new, mark the datum point with an indelible marker and note reference location in

field book. Discuss with the project manager what reference point should be used to collect water measurements for specific sites.

- Water level and/or NAPL measurements should be made before any water is removed from wells because doing so may influence groundwater levels in the area of the investigation.
- Measurements should be made approximately three times to confirm the measurement. Each time a measurement is made it should be determined to the nearest one-hundredth of a foot (0.01).
- Water level and/or NAPL measurements should first be collected at the wells that are least contaminated and proceed towards the wells that are most contaminated. Decontaminate the water level meter or oil/water interface probe prior to initial use and after use at each location. If NAPL is encountered at a well where it was previously not observed, contact your project manager before continuing.
- Refer to the oil/water interface probe or water level meter instruction manual for guidance on indicator signals, as these may differ by manufacturer.

4. Execution

4.1 Water Level and NAPL Measurements Using Interface Probe

- Open wells to the atmosphere and allow them to equilibrate prior to collecting LNAPL depth measurements.
- LNAPL Depth (if present): Measure the LNAPL/air interface by slowly lowering the interface probe to the LNAPL surface. Be ready to stop as soon as the probe signals the LNAPL surface.
- Record the depth to LNAPL.
- Groundwater Depth: Continue slowly lowering the probe until it signals the presence of water.
- Record the depth to water.
- The LNAPL thickness is determined by subtracting the water depth from the LNAPL depth.

The depth and thickness of DNAPL can sometimes be determined by slowly lowering the interface probe past the LNAPL (if present) and water layers. Record the depth to the DNAPL layer. Finally, measure the depth to the well bottom.

The DNAPL thickness is determined by subtracting the DNAPL depth from the depth to well bottom.

- Decontaminate the interface probe and tape according to SOP QA-001.
- Dispose of any NAPL-impacted debris properly.
- Check with the Project Manager if you are uncertain of the appropriate disposal method.

4.2 LNAPL Measurements Using Clear Bailer

If LNAPL is suspected at a site, an oil/water interface probe should be used when gauging water level and NAPL measurements. However, a water level meter and a clear bailer may be used instead to estimate approximate LNAPL thickness if an oil/water interface probe is not available.

- Open wells to the atmosphere and allow them to equilibrate prior to collecting LNAPL depth measurements.
- Slowly lower the water level meter until contact with fluid is indicated by the meter.
- Record the depth to fluid measurement.
- Lower a clear bailer into the well and slowly into the LNAPL. Do not submerge the bailer.
- Slowly raise the bailer out of the well and measure LNAPL thickness in the bailer using a ruler or tape measure.

Calculating Depth to Groundwater

The depth to water can be calculated as follows:

DTW = DTF + PT
DTW = Depth to Groundwater
DTF = Depth to Fluid
PT = Measured Product Thickness

Calculating Corrected Depth to Groundwater

Once the LNAPL thickness is known and the depth to groundwater is known, the corrected depth to groundwater can be calculated.

Corrected DTW = Static DTW – (PT x G)
DTW = Depth to Ground Water
PT = Measured Product Thickness
G = Specific Gravity (density of free product / density of water)

4.3 DNAPL Measurements Using Weighted Cotton String

A weighted cotton string may be used to estimate approximate DNAPL thickness.

- Secure cotton string.
- Secure clean steel nuts and/or washers.

- Tie the string to the nuts/washers, so that there is adequate weight.
- Lower the weighted string into the well slowly, until a firm bottom is sensed.
- Remove the weighed string and measure the DNAPL coated portion of the string.
- Record the thickness.
- Dispose of any NAPL-impacted debris properly. Check with the Project Manager if you are uncertain of the appropriate disposal method.

5. Health and Safety Considerations

The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the site specific Health and Safety Plan (HASP). The collection and accumulation of NAPL presents the potential for significant hazards that need to be managed. A detailed job safety analysis (JSA) should be completed prior to the start of work.

6. Considerations

- Weak batteries in water level and oil/water interface meters frequently produce weak or gradual auditory and/or visual responses, making it difficult to accurately determine when the probe of the unit has come in contact with ground water or NAPL. As such, it is recommended that electronic ground water-level indicators be tested before they are brought out into the field.
- Electronic oil/water interface meters do not respond to distilled water. Do not use de-ionized water to test these units.
- Wells that are not vertical may result in probe contact with the side of the well casing providing a false measurement. Once the probe has come in contact with ground water in the well, water may be trapped by capillary action between the probe and the well casing. If this happens, the unit may continue to signal even after the probe has been raised above the ground water surface. The deeper the well, the more likely this problem may occur. To correct this, the cable should be raised several feet above the water and shaken to remove water from the probe. A new ground water-level measurement should then be collected. If the signals from the unit are not abrupt or reproducible, the probe and tape may need to be retrieved and dried off before trying again.
- Accumulation of sediment, organic material, or floating debris in the probe may also result in gradual or non-reproducible readings. Wells that are constructed with metal inner casings may lead to difficulties in collecting reproducible ground water-level measurements because the inner sides of the well casing are conductive.

- In some cases, a rubber grommet or metal centralizer may need to be placed on the probe so that it cannot contact the inner casing.
- Well gauging equipment should be properly decontaminated between wells and piezometers to avoid cross contamination.
- Water levels in wells may be influenced by changes in river stages, pumping of nearby wells, precipitation, tides, etc.
- Using a bailer to estimate LNAPL thickness can result in inaccuracies because successful use of the bailer is dependent upon the expertise of the operator and assumes the check valve does not leak upon retrieval.
- The optical sensor on interface probes may become damaged if solvents are used to clean NAPL from the probes.
- The optical sensor may become smeared when used to measure NAPL, rendering pinpoint accuracy to an estimate at best.
- Close attention to decontamination procedures will improve accuracy, operational life, and reduce the risk of cross contamination with other wells.
- LNAPL thickness can be affected by fluctuations in the water table. In some cases, an LNAPL's thickness may decrease when the water table rises, while its thickness increases as the water table drops. In other cases, fluctuating water tables may cause sudden appearances and disappearances of LNAPL layers.
- Monitoring points with LNAPL can pose a problem when measuring the level of groundwater. Floating LNAPL can depress the groundwater level in a monitoring well or piezometer and distort the measurement. Therefore, the Corrected Depth (CD) formula shown above should be applied to groundwater level measurements in monitoring points where LNAPL are present:
- Some interface probes are factory-calibrated based on an assumed conductivity of NAPL and water, both of which may vary. An interface probe that is functioning properly may not be able to discern different NAPLs at all sites.
- An interface probe may not successfully provide both LNAPL and DNAPL measurements in the same well because the probe is coated by LNAPL and loses its ability to detect DNAPL.
- DNAPL, in particular, may be only slightly heavier than water, or may be neutrally buoyant. As a result, it can be easily disturbed. Once it is disturbed, meaningful measurements can be difficult or impossible to obtain. As such, all tapes or probes used for measurements should be used slowly.

7. References

U.S. EPA Environmental Response Team Standard Operating Procedures SOP: 2043,"Water Level Measurement" REV: 0.0, 2/11/00

U.S. EPA Environmental Response Team Standard Operating Procedures SOP: 2044," Monitor Well Development" REV: 0.1, 10/23/01.

8. Contacts

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STANDARD OPERATING PROCEDURE

GW-002 Non-Aqueous Phase Liquid (NAPL) Recovery

1. Objective

Provide procedural guidance for routine recovery of non-aqueous phase liquids (NAPL).

2. Equipment and Materials

The following materials and equipment may be necessary for this procedure:

- SOP GW-001 Water Level and NAPL Measurement
- Oil/water interface probe
- Appropriate pump and required tubing/piping
- Double check valve bailers and string
- Drums or buckets for NAPL collection
- Proper personal protective equipment (PPE) including gloves and protective eyewear
- Drum labels
- Field data sheets or logbooks
- Decontamination supplies and plastic sheeting
- Additional equipment identified by site-specific work plan and health and safety plan (HASP)

3. General Information

Refer to SOP GW-001 and record the depth to NAPL and depth to water measurements If you are using an oil/water interface probe, first check to see if the unit is functioning correctly. Note: De-ionized water will not provide a correct reading. Check the interface probe battery and replace if necessary.

Interface probes usually distinguish between NAPL and water by sounding solid or intermittent tones. See the manufacturer's instructions for details.

4. Execution

4.1 General Measurement Procedures

Using an oil/water interface probe will provide a depth to water and a depth to NAPL in each monitoring well. Refer to probe manual to determine changes between liquid types (water, light non-aqueous phase liquid [LNAPL] and dense non-aqueous phase liquid [DNAPL]). To achieve accurate depth measurements, ensure the oil/water interface

probe is decontaminated (GEI SOP QA-001) prior to and between each measurement taken at each well.

To calculate the volume of NAPL in monitoring wells with well diameters specified below, use the following respective equations:

Light non-aqueous Phase Liquid (LNAPL) Volume

$$LNAPL\,V = (DTW - P_1) \times C$$

Dense Non-Aqueous Phase Liquid (DNAPL) Volume

$$DNAPL\,V = (TD - P_2) \times C$$

Where, V = Volume
DTW = Depth to Water
TD = Total Depth
P_1 = Depth to LNAPL
P_2 = Depth to DNAPL

Conversion factors (C) for wells based on well diameter size are noted in the table below.

Well Diameter (inches)	Conversion Factor (liters)	Conversion Factor (gallons)
2	0.6178	0.1632
4	2.4711	0.6528
6	5.561	1.469

Note: Well diameter sizes are noted for outer diameter. Conversion factors assume Schedule 40 PVC riser and screen, if well is constructed of different material appropriate conversion factors must be used to calculate accurate NAPL volume.

Once measurements have been taken and calculations have been made, collection of NAPL may commence.

4.2 NAPL Collection Procedures

Collection of NAPL shall be accomplished using common recovery techniques or technologies including:

- Peristaltic pump
- Bailer

Some projects require on-going NAPL recovery efforts. For these projects installation of dedicated recovery methods should be considered.

Special care shall be taken to prevent any recovered NAPL from spilling or coming into contact with the ground and sampling personnel. This includes the use of proper personal protective equipment (PPE), including gloves and protective eyewear (Tyvek® if necessary), along with plastic sheeting set beneath the pump, tubing, and collection

container (sealed top 55-gallon drum or 5-gallon bucket with lid), and the surrounding work area. A site-specific work plan, HASP and job specific job safety analysis need to be developed prior to the start of work. The specific operating procedures for common recovery methods are discussed in the following sections.

4.2.1 Sampling and Recovery via Peristaltic Pump:

LNAPL

- Take and record the required measurements prior to commencing pumping.
- Cut a length of poly tubing (T1) that is long enough to extend approximately 12-inches beyond the LNAPL layer. Cut an additional length of poly tubing (T2) that will be connected to the discharge side of the peristaltic pump silicone tubing that is long enough to extend from the pump to the NAPL collection container. Cut a length of silicone tubing (approximately 8-inches) for use in the peristaltic pump head.
- Insert the silicone tubing into the peristaltic pump head. Check the flow direction of the pump to ensure that the pump will be removing fluid and not pumping air into the well when removal begins.
- Insert T1 into the intake side of the silicone tubing. Lower the intake side into the well and secure in place just below the top of LNAPL.
- Insert T2 into the discharge side of silicone tubing and secure to the NAPL collection container with a clamp.
- Turn pump flow rate to lowest setting. Turn the pump on and slowly increase the pump rate to begin LNAPL removal from the well. Use the oil/water interface meter to measure the depth to LNAPL. Lower the intake tubing as necessary until all of the LNAPL has been recovered from the well.
- Once the LNAPL has been recovered from the well, collect and preserve a sample if required, in accordance with laboratory standards.
- Following completion of LNAPL recovery, disconnect the tubing from the pump, secure the well and road box, and clean/decontaminate the pump and oil/water interface probe, prior to moving to the next location.
- Impacted tubing will either be containerized for proper disposal or left in well for reuse.

DNAPL

- Take and record the required measurements prior to commencing pumping.
- Cut a length of poly tubing (T1) that is long enough to extend to the bottom of the well including additional length to attach to the pump intake. Cut an additional length of poly tubing (T2) that will be connected to the discharge side of the

peristaltic pump silicone tubing that is long enough to extend from the pump to the NAPL collection container. Cut a length of silicone tubing (approximately 8-inches) for use in the peristaltic pump head.

- Insert the silicone tubing into the peristaltic pump head. Check the flow direction of the pump to ensure that the pump will be removing fluid and not pumping air into the well when removal begins.
- Insert T1 into the intake side of the silicone tubing. Lower the intake side into the well and secure in place just above the bottom of the well.
- Insert T2 into the discharge side of silicone tubing and secure to the NAPL collection container with a clamp.
- Turn pump flow rate to lowest setting. Turn the pump on and slowly begin to remove DNAPL from the well. DNAPL removal will be complete when the pump begins to discharge water. Use the oil/water interface meter to check the DNAPL thickness during the removal process. Take care not to pump an excessive amount of water.
- Once the DNAPL has been purged from the well, collect and preserve a sample if required, in accordance with laboratory standards.
- Following completion of DNAPL recovery, disconnect the tubing from the pump, secure the well and road box, and clean/decontaminate the pump and oil/water interface probe, prior to moving to the next location.
- Impacted tubing will either be containerized for proper disposal or left in well for reuse.

4.2.2 Sampling and Recovery via Double Check Valve Bailer:

LNAPL

- Take and record the required measurements prior to commencing bailing.
- Ensure the work area is covered in plastic sheeting to avoid potential spills of water and/or NAPL.
- Tie the bailer to a piece of string that will allow the bailer to reach just below the LNAPL layer. Use the oil/water interface meter to determine the appropriate depth.
- Using slow and controlled motions while lowering (and raising) the bailer to the appropriate depth, commence bailing LNAPL out of the well and draining the bailer directly into collection container.
- Once the LNAPL has been purged from the well, collect and preserve a sample, if required, in accordance with laboratory standards.

DNAPL

- Take and record the required measurements prior to commencing bailing.
- Ensure the work area is covered in plastic sheeting to avoid potential spills of water and/or NAPL.
- Tie the bailer to a piece of string that will allow the bailer to reach the bottom of the well.
- Using slow and controlled motions while lowering (and raising) the bailer to the bottom, commence bailing DNAPL out of the well and draining the bailer directly into collection container.
- Once the DNAPL has been purged from the well, collect and preserve a sample, if required, in accordance with laboratory standards.

4.3 Waste Management and Disposal

Investigation derived waste should be managed in accordance with GEI SOP SC-003. DNAPL waste management and disposal should be evaluated on a site by site basis.

4.4 Troubleshooting Information

If there are any performance problems with the oil/water interface probe which result in inability to achieve the proper measurements presented in Section 5.1, or if there are any problems with the peristaltic pump, consult the appropriate section of the probe instruction manual for the checkout and self-test procedures. If the problem persists, consult the manufacturer's customer service department immediately for further instructions.

Lower temperatures can affect the ability to pump and/or bail NAPL. Weather should be taken into consideration when scheduling gauging and recovery sampling events.

4.5 Data and Records Management

All information pertaining to maintenance of the oil/water interface probe and the peristaltic pump shall be maintained in the project file. Field measurements (depth to water, NAPL, etc.) and all calculations (NAPL column length, volume of NAPL, etc.) shall be recorded on the appropriate field data sheets or in the logbook consistent with GEI SOP Section 5.

4.6 Limitations

- NAPL gauging and recovery can be challenging and requires adaptive thinking. A variety of measurement and collection techniques may be necessary to properly execute the work.
- Exposure to NAPL can accelerate the required maintenance/replacement intervals for tools and equipment.

5. Health and Safety Considerations

The health and safety considerations for the work associated with this standard operation procedure, including both potential physical and chemical hazards, will be addressed in the site specific Health and Safety Plan (HASP). The collection and accumulation of NAPL presents the potential for significant hazards that need to be managed. A detailed JSA should be completed prior to the start of work.

6. References

U.S. EPA. Ground Water Issue: Dense Non-aqueous Phase Liquids, EPA/540/4-91-002, March 1991.

7. Contact

Kathleen Slimon
Mike Quinlan

STANDARD OPERATING PROCEDURE

GW-003 Low Flow (Low Stress) Groundwater Sampling

1. Objective

Describe methods to collect groundwater samples most likely to produce results that represent aquifer conditions.

Low-flow purging is limited to wells that, with sustained pumping, exhibit no continuous drawdown.

2. Execution

- Prior to groundwater sampling consult with the project manager to confirm that the type of pump is appropriate and consistent with the approved work plan.
- Record activities in the field notebook (see SOP FD-001 Field Notebook) and on a Monitoring Well Sampling Record such as the examples in Attachment A. Use a separate form for each sampling location and event. You may forego the forms and record all information in the field notebook if the Project Manager approves.
- Calibrate pH, temperature, Specific Conductance (SC), turbidity, Dissolved Oxygen (DO), and Oxidation-Reduction Potential (ORP) on the meter(s). Use calibration methods provided by the manufacturer of the equipment. Note that appropriate calibration for dissolved oxygen requires a water saturated air environment, along with measured temperature and barometric pressure.
- Begin with the monitoring well believed to have the least contaminated groundwater and proceed systematically to the well with the most contaminated groundwater. Check the well, the lock, and the locking cap for damage or evidence of tampering.
- Slowly and gently measure the depth to water with a water level probe and/or oil-water interface probe. Do not measure depth to well bottom at this time (wait until sampling has been completed). Measure water level in accordance with SOP GW-001 Water Level Measurement.
- Attach new polyethylene or Teflon lined tubing to the sampling pump and the flow-through cell that contains the meter probes.
- Slowly and gently insert new polyethylene or Teflon lined tubing to the pump intake (or use dedicated tubing that remains in the well) and to the middle of the saturated screened interval or to the pre-determined sampling depth.
- The tubing intake should be kept at least two (2) feet above the bottom of the well to prevent disturbance or suspension of any sediment or Non-Aqueous Phase Liquid (NAPL) present in the bottom of the well. Record the depth of the pump intake.

- If possible, position your sampling equipment and tubing so that it is in the shade. The goal is to minimize the effect of sunlight raising the temperature of water being collected.
- Start the pump on the lowest setting and increase slowly until flow begins. Adjust the pumping rate so that drawdown in the well is minimal (0.3 feet or less, is desirable but not mandatory). Use a pumping rate between 100 to 1,000 milliliters per minute (mL/min) (or approximately 0.1 to 1 quarts per minute). Measure flow rate on the pump or using a graduated container every 3 to 5 minutes and record. The minimum purge volume will be twice the combined volumes of the sampling string (i.e. pump, tubing, and flow-through cell).
- While purging, record water levels every 3 to 5 minutes and monitor and record the water quality indicator parameters: pH, temperature, specific conductance (SC), dissolved oxygen (DO), and turbidity. If specified in the field sampling plan also include ORP.
- Purging is complete when, after three consecutive measurements, the water quality parameters have stabilized as follows:

    - pH (+/- 0.1 standard units)
    - temperature (+/- 3%)
    - SC (+/- 3%)
    - turbidity (+/- 10% if >5 NTU; if 3 values are <5 NTU, consider the values as stabilized)
    - DO (+/-10% if >0.5 mg/L; if 3 values are <0.5 mg/L, consider the values as stabilized)
    - ORP (+/- 10 mV)

- Dispose of purge water according to the field plan.

Sample Collection:

- Following purge, remove the discharge tubing from the flow-through cell. Do not disturb pump and tubing between stabilization and sample collection.
- Fill sample containers directly from the sampling device in order of decreasing volatility (i.e., Volatile Organic Compounds (VOC) samples are collected first; see SOP SC-002 Sampling Handling). Fill all containers from the discharge end of the tubing. Collect samples at a flow rate equal to the steady state purge rate.
- If not using a dedicated pump, remove sampling device and decontaminate (see SOP QA-001 Equipment Decontamination). Discard used tubing.
- Store samples in a cooler on ice for transport to the laboratory.
- Measure depth to bottom of well.

- Secure the well cap.

3. Limitations

- Prior to departure for the field, obtain available information on well construction for use in field investigation (i.e., screen and riser material, well diameter and depth, screened interval, optimum sampling depth, etc.).
- If possible, when using dedicated equipment, install equipment into well at least 24 hours before sample collection to minimize disturbance of the water column and/or suspension of sediments or NAPL on bottom.
- If water quality indicator parameters do not stabilize after removing 3 to 5 well volumes or 2 hours, contact the Project Manager. Three options will be available: 1) continue purging until stabilization; 2) discontinue purging and do not sample; or 3) discontinue purging and sample.
- The key indicator parameter for VOCs is DO. The key indicator parameter for all other samples is turbidity.
- Fill all sample containers with minimal turbulence by allowing the groundwater to flow from the tubing gently down the inside of the container.
- Consult with the project manager before field filtering samples for metals if using low-flow sampling.
- Be aware of any preservatives in the sample bottles and handle with care, in accordance with the Health and Safety Plan.

4. References

Standard Reference for Monitoring Wells (April 19, 1991), Massachusetts DEP, DEP Publication No. WSC-310-91.

Reproducible Well-Purging Procedures and VOC Stabilization Criteria for Ground Water Sampling (1994), M.J. Barcelona, H. A. Wehram, and M.D. Varljen, Ground Water, Vol. 32, No. 1, 12-22.

Low-Flow Purging and Sampling of Ground Water Monitoring Wells with Dedicated Systems (1995), R.W. Puls, and C.J. Paul, Groundwater Monitoring and Review, Summer 1995 116-123.

Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells (2010), EQASOP-GW 001 Low Stress (Low Flow) SOP, Revision 3, U.S. Environmental Protection Agency, Region I, January 19, 2010.

Ground Water Sampling Procedure Low Stress (Low Flow) Purging and Sampling, (1998), Ground-Water Sampling SOP, Final, U.S. Environmental Protection Agency, Region II, March 16, 1998.

RCRA Ground-Water Monitoring: Draft Technical Guidance, (1993), U.S. Environmental Protection Agency, EPA/530-R-93-001.

To Filter, or Not to Filter, That is the Question, (1997), Special Topics Subcommittee Letter Report EPA-SAF-EEC-LTR-97-011, April 29, 1997, Meeting, U.S. Environmental Protection Agency, Science Advisory Board Environmental Engineering Committee, September 5, 1997.

Should Filtered or Unfiltered Groundwater and Surface Water Samples be Collected for the Risk Assessment?, (1995), MCP Q&A: Subparts I and J, Special #4, Bureau of Waste Site Cleanup, Massachusetts Department of Environmental Protection (DEP), February, 1995.

5. Attachments

Attachment A - Monitoring Well Sampling Record

6. Contacts

Saskia Oosting

MONITORING WELL SAMPLING RECORD

PID Reading _____ Job Name _____

Job Number _____ By _____ Date _____

Location _____ Measurement Datum _____

Well Number _____

Pre-Development Information Time (start) _____

Water Level _____ Total Depth of Well _____

One Purge Vol _____ Three Well Volume _____

Water Characteristics

Color _____ _____ Clear _____ Cloudy

Odor _____ None _____ Weak _____ Moderate _____ Strong

Any films or immiscible material _____

Volume (gal)	Time	pH	Temp (°C)	Spec. Conductance (µS/cm)	Turbidity (NTU)	DO Conc. (mg/L)	ORP (mV)	TDS

Total Volume Removed (gal) _____ pH _____

Temperature (°C) _____ Specific Conductance (µS/cm) _____

DO Concentration (mg/L) _____ ORP (mV) _____

TDS _____

Post Development Information

Time (Finished) _____

Water Level _____ Total Depth of Well _____

Approximate Volume Removed (gal) _____

Water Characteristics

Color _____ ____ Clear ____ Cloudy

Odor ____ None ____ Weak ____ Moderate ____ Strong

Any films or immiscible material _____

Comments

Low-Flow Groundwater Sampling Form

Project number and name _____ Sampling personnel _____ Sample date _____ Well ID _____

Well location description: _____

Well Construction

Well diameter _____

Well measurement point _____

Roadbox condition _____

Well screen interval _____

Well depth _____

Sampling Information

Initial depth to water _____ Time: _____

Sample intake depth _____

Pump type and ID _____

Stabilized flow rate _____

Stabilized flow rate = flow rate with no further drawdown

Samples Collected

VOCs 8260	
SVOCs 8270	
VPH	
EPH	
Metals	
PCBs	
Other	

Field values at time of sample collection:

Time: _____ Depth to water: _____

Sp.Cond. _____ mS/cm

DO _____ mg/L

ORP _____ mV

pH _____ s.u.

Temp. _____ °C

Turb. _____ NTU

Cumulative Time (min.)	Volume (gal)	Water depth (ft)	Temp. (°C)	Sp.Cond. (mS/cm)	D.O. (mg/L)	pH (s.u.)	ORP (mV)	Turb. (NTU)
Typical Groundwater Values			5 to 15	0.05 to 5	0 to 4	5 to 7	-100 to +500	aim for <10

Notes: _____

Sample Information:

Sample ID _____

Sample Time: _____

Color: _____

Turbidity: _____

Field Filtered YES / NO Analyses: _____

Filter type: _____

Odor/Sheen/NAPL _____

Duplicate Collected YES / NO

If yes, duplicate ID: _____

Purge water disposal? to ground drummed other:

Well Volume Conversion:

Diam. (in)	Factor (gal/ft)
1	0.04
1.5	0.09
2	0.16
4	0.65
6	1.50

well volume =
3.14 x (r)^2 x 7.48 gal/ft
where r = 1/2 diameter in ft

Stabilization Criteria:
Sp.Cond. +/- 3%
DO +/- 10%
ORP +/- 10 mV
pH +/- 0.1 Std Units
Temp. +/- 3%
Turb. +/- 10% if values >1 NTU

Guidance:

1 Position tubing at midpoint of saturated screened interval

2 Minimize drop in water level and purge until parameters are stable

3 Disconnect flow thru cell during sampling

4 Call Project Manager if issues arise (e.g. stabilization takes more than 2 hrs, well goes dry, odd data).

5 For VPH and VOC samples, if stabilization flow rate is less than 200 ml/min, contact PM

STANDARD OPERATING PROCEDURE

GW-004 pH and Temperature Measurement

1. Objective

Describe methods for measuring the pH and temperature of liquids using a combination pH/temperature meter.

2. Execution

Calibration

- Calibrate the meter according to the equipment manufacturer's instructions at the beginning of each day of use. Calibration for pH shall be performed using at least two buffer solutions. Solutions chosen should be similar to the expected pH of the liquids tested (pH 7 and 4 buffer solutions are preferred in most cases for groundwater or surface water measurements).
- Check calibration at the end of the day by reading the two solutions used in calibration. Also perform additional field checks as needed based on observed readings (i.e., inconsistent readings). Record measurements and time of measurement in the field book or sample sheet. If the readings are outside +/– 0.2 pH units, recalibrate the meter.

Sample Measurement

- Immediately prior to testing a sample, decontaminate testing container and probe assembly with one rinse of distilled water. Do not use methanol to rinse the probe. Methanol rinses could damage the probe.
- Gently dry the probe with a paper towel and shake beaker to remove excess solution. Visually inspect the bottom of the probe to ensure that liquid or sediment is not trapped between outer casing and probe.
- Pour the sample into the testing container and insert both temperature and pH probe. Stir sample for 30 seconds using both probes. Let the probes equilibrate in the sample solution for another 30 seconds. Measure and record the temperature. Measure and record pH reading after stabilization or 60 seconds, whichever is sooner. A reading has stabilized if pH units have not changed +/– 0.1 pH units during a 30 second period.
- Record pH to the nearest 0.1 unit and temperature to the nearest whole number.

3. Limitations

- Coatings and particulates may affect the response of the probe; more thorough cleaning using a weak alconox solution and distilled water rinse

and gently wiping the probe surface with a paper towel may be required to clean the surface of the probe.

- Temperature affects both the response of the instrument to pH and the actual pH of the sample. The Automatic Temperature Compensation (ATC) function compensates for the variation in the response of the meter only. Therefore, the pH must always be reported with temperature.
- The probe is a fragile thin glass bulb surrounded on three sides by a plastic casing. Care must be taken in handling the probe to avoid breakage.
- Do not use buffer solutions past their expiration date.

4. References

Standard Methods for the Examination of Water and Wastewater, 18th Edition, Method 4500-H. American Public Health Association (1992).

5. Contacts

Saskia Oosting

STANDARD OPERATING PROCEDURE

GW-005 Turbidity Measurement

1. Objective

Describe calibration and use of a Hach nephelometer/turbidimeter.

The meter is used to measure turbidity of liquids by quantifying how much light passes through them. Turbidiity readings are required to be read using a portable (e.g Hach) instrument directly from the tubing before going through the flow-through cell.

This SOP is specific to a Hach turbidimeter. Follow manufacturer's recommendations for other meters.

2. Execution

i. Turn the meter "ON".
ii. Rinse the sample cell 3 times with distilled water.
iii. Fill the cell to the fill line with distilled water and then cap the cell.
iv. Wipe off excess water and streaks with a non-abrasive lint-free paper or cloth (preferably lens paper).
v. Open the cover and insert the cell (arrow to the front) into the unit and close the cover.
vi. Press "READ" and wait for the 'light bulb' icon to go off. Record the reading.
vii. Using the Gelex standards, repeat steps above. Record all measurements (note anomalies).
viii. Fill the cell with sample liquid to the fill line (about 15 mL) and replace the cap on the cell.
ix. Wipe off excess water and any streaks with a non-abrasive lint-free paper or cloth (lens paper).
x. Press "I/O" and the instrument will turn on. Place the meter on a flat, sturdy surface. Do not hold the instrument while making measurements.
xi. Insert the sample cell, arrow to the front, in the instrument. Close the lid.
xii. Select manual or automatic range selection by pressing the range key.
xiii. Use signal average mode if the sample causes a noisy signal (display changes constantly). Select signal averaging mode by pressing the "Signal Average" key.
xiv. Press Read. The display will show "---- NTU" and then the turbidity in NTU. Record the result after the lamp symbol turns off.
xv. Rinse the cell with distilled water.
xvi. Confirm the validity of the sample measurement by double-checking with one of the Gelex standards.

xvii. Periodically check the turbidity meter during the day by using the Gelex secondary standards provided.
xviii. Perform a post calibration at the end of the day and record all measurements.

3. Limitations

If the turbidity measurements are for National Pollutant Discharge Elimination System (NPDES) reporting purposes, all samples with values above 40 NTU must be diluted with turbidity free water (e.g. distilled water) and sample turbidity is calculated by multiplying the reading of the diluted sample by the dilution factor.

4. References

Standard Methods for the Examination of Water and Wastewater, 18th Edition, Method 4500-H. American Public Health Association (1992).

5. Contacts

Saskia Oosting

STANDARD OPERATING PROCEDURE

GW-006 Specific Conductance Measurement

1. Objective

Describe standard methods to measure conductivity of water using a field conductivity meter.

2. Execution

- Calibrate the meter according to equipment manufacturer's instructions at the beginning of each day of use. Calibration shall be performed using a standard KCl or other solution recommended by the manufacturer.
- Record the make, model, and serial or identification number of the instrument and calibration information in the field notebook.
- Check calibration at the end of the day by measuring the standard used in calibration and record in field book. Also perform additional field checks as needed based on observed readings (i.e., inconsistent readings). If the readings are outside +/- 0.02 mS/cm, the meter must be recalibrated. Initial calibration should be conducted under the same conditions (i.e., temperature, and location) of field testing.
- Immediately prior to testing a sample, decontaminate testing container and probe assembly with distilled water.
- Gently dry the probe with a paper towel and shake container to remove excess solution.
- Pour sample into the container and insert probe. Stir sample with the probe for approximately 10 seconds. Let the probe equilibrate in the sample solution for another 30 seconds. Measure conductivity and record in the field notebook.
- Record conductivity to the nearest whole number.

3. Limitations

- Oily coatings and particulates may affect the probe's response; more thorough cleaning using a weak alconox solution and distilled water rinse and gently wiping the probe surface may be required to clean the surface of the probe.
- If sample liquid is contaminated, (e.g. stained, conductance >0.75 mS/cm), rinse probe with distilled water immediately after measuring sample to minimize fouling of probe.
- Do not use calibration solutions past their expiration date.

4. References

Standard Methods for the Examination of Water and Wastewater, 18th Edition, Method 4500-H. American Public Health Association (1992).

5. Contact

Brian Conte
Saskia Oosting

STANDARD OPERATING PROCEDURE

GW-007 Dissolved Oxygen Measurement

1. Objective

Describe calibration and field use of dissolved oxygen meter.

2. Execution

- Place instrument in the intended operating position (vertical, tilted, or horizontal) before it is prepared for use and calibrated.
- Recalibration may be necessary when the instrument operating position is changed.
- Attach the prepared probe to the Probe connector of the instrument and adjust the retaining ring finger tight. Check that membrane is intact and check for presence of air bubbles under membrane. If bubbles are present or membrane is damaged, prepare probe again according to manufacturer's instruction.
- Place approximately 1/8 inch of water into the bottom of the calibration cup. Place the probe into the cup and engage only one thread of the calibration cup onto the probe to ensure that the DO probe is readily vented to the atmosphere. Make sure the DO and temperature probes are not in contact with the water. Wait approximately 10 minutes for the air in the calibration cup to become water saturated and for the temperature to equilibrate.
- Calibrate meter according to the procedures outline in the instrument manual. Calibrate probe to a zero oxygen solution provided by manufacturer, and water saturated air.
- The calibration procedure may require correction factors or input of site-specific barometric pressure and temperature. Correction factors can be found at:

  http://water.usgs.gov/owq/FieldManual/Chapter6/6.2_v2.1.pdf

- Otherwise, use appropriate instruments at the site to determine temperature and pressure.
- Perform Dissolved Oxygen Measurement using the following procedure:
  i. Submerge probe in flow-through chamber or water body.
  ii. Gently raise and lower probe in sample.
  iii. Allow sufficient time for probe to stabilize to sample temperature and dissolved oxygen.
  iv. Read and record the temperature and the value of the dissolved oxygen in mg/L.
  v. Document field analysis data and general observations in the field log book or groundwater sampling sheet.

3. Limitations

- Collect DO measurements in the field during sampling. Storing samples in containers will alter the DO concentration of the sample.
- Detection Limit (DL) = 0.1 mg/L for 0-10 mg/L range; do not record values less than Detection Limit: a zero reading is recorded < 0.1 mg/L.

4. References

Standard Methods for the Examination of Water and Wastewater, 18th Edition, Method 4500-H. American Public Health Association (1992).

5. Contacts

Saskia Oosting

STANDARD OPERATING PROCEDURE

GW-008 Temporary Groundwater Sampling Points

1. Objective

To define the procedures for installation of temporary groundwater sampling points (hereafter referred to as well point) for measuring depth to groundwater and collecting groundwater samples. Well points may aid in the placement of permanent monitoring wells.

A well point is a small diameter (1-2 inch) probe constructed of continuously wrapped stainless steel or wrapped stainless steel gauze screen over perforated carbon steel pipe. No filter or gravel pack is used in the installation.

Well point installations are not the only type of temporary monitoring wells. Alternative temporarily well constructions should be discussed with the project manager and may be more appropriate based on-site conditions.

2. Execution

2.1. Installation

- The well point can be placed with the use of a conventional hollow-stem auger rig, Geoprobe®, slide hammer, jack hammer, rotary hammer, or by hand.

- The well point may be driven through the unsaturated zone only in known "clean" soils. Driving the well point through contaminated soil may carry contamination downward with the point resulting in analytical sample results which are biased high. In areas with contamination above the desired screening zone, the well points should be installed with the aid of either hollow-stem augers or Geoprobe®, to “case off” contamination from the upper layer.

- If the well point is to be installed in an oversized (20% larger than the well point) pre-drilled hole, the hollow-stem augers or bull drive point must be advanced to a point which is just above the targeted sample zone. The well point is then placed in the hole and advanced beyond the bottom of the hole by hammering or pushing into place. The use of pre-drilled holes will reduce clogging of well point screens when driving.

- If the well point is used for piezometeric data, make a survey mark on top of the casing as a reference point for water level measurements.

- Caution must be used when using well points in areas of contaminated soil. Possible cross contamination may be introduced to the screen as it passes through the zone of contamination.

2.2. Sampling Procedures

Development of a well point is not required prior to sampling. Sampling of groundwater or collecting piezometric data must be performed by one of several recommended methods described in this manual.

After sample collection, (See Groundwater Sampling SOP) the well point is removed by back hammering or pulling the tool out with the rig hydraulics.

3. References

ASTM D6001 - 05 Standard Guide for Direct-Push Water Sampling for Geoenvironmental Investigations

Standard Methods for the Examination of Water and Wastewater, 18th Edition, Method 4500-H. American Public Health Association (1992).

Ground Water and Wells. Johnson Division, UOP Inc.; St. Paul, Minn. 1982. p277-294.

Ground Water Manual - A Water Resources Technical Publication; U.S. Dept. of Interior, Bureau of Reclamation. Government Printing Office, Washington DC 1977.

Standard References for Monitoring Wells (April 1991), Commonwealth of Massachusetts Department of Environmental Protection, WSC-310-91.

4. Contacts

Saskia Oosting

STANDARD OPERATING PROCEDURE

GW-010 Slug Tests

1. Objective

Describe methods to use slugs, pressure transducers, and data loggers to collect data that will support calculation of horizontal hydraulic conductivity of distinct geologic strata.

General Information

Slug tests are performed on single monitoring wells to estimate the hydraulic conductivity of the aquifer in which the well is screened. The test consists of adding or removing a known volume (slug) to or from the well to instantaneously change the water level. Subsequently, the recovery of the water level back to the static water level is measured. The resulting data are used to determine the hydraulic conductivity of the aquifer test zone using an appropriate analytical method.

Falling head tests can only be performed in fully-penetrating wells (well screened completely below the water table). Rising head tests can be performed in both fully- and partial-penetrating wells.

2. Execution

2.1 Setup

- Determine how water levels will be recorded. If the geologic materials in the test zone are expected to be slightly permeable (e.g., a glacial till or clay), then measurements may be recorded manually with an electronic water level indicator. If the geologic materials in the test zone are expected to be moderately- or highly-permeable (e.g., outwash sands), record measurements using a pressure transducer attached to an automatic data logger.

  The remainder of this SOP assumes that an automatic data logger is being used to measure water levels.

- Check to see if test equipment functions prior to leaving for the site.
- Decontaminate the transducer and cable using alconox and distilled water. Do not use methanol. Do not use transducer in wells containing non-aqueous phase liquid (NAPL).
- Make initial water level measurements
- Test wells in the following order: from the least contaminated to the most contaminated, and from low to high expected permeability, where possible.
- Measure the static water level (i.e., depth to water) in the well to be tested manually using an electronic water level indicator. Record all

measurements taken during the test in the field log book or on the attached log form.

- Install the pressure transducer as far below the deepest point of insertion of the slug bar or bailer as possible. Allow the transducer to thermally equilibrate for 15 to 30 minutes (to allow instrumentation wiring to expand/contract) before measurements are taken.
- Secure the transducer cable at ground surface with tape or weight to keep the transducer at a constant depth.
- Cover sharp edges of the well casing with duct tape to protect the transducer cables.
- Transducer measurement setup: For wells screened in sand and silty sand, a linear setting of one reading per second is generally used. In coarser soil where full recovery may occur over a few seconds, a linear setting for more frequent readings is necessary. If a transducer is used for silt and clay, a linear setting of one reading per minute, or a logarithmic setting, may be used to avoid risk of exceeding the memory capacity of the transducer.

2.2 Field Procedure – Rising Head Test

In this test, a slug is inserted in the well prior to the test and the water level is allowed to return back to static level. The test is then started by removing the slug from the well and immediately measuring rising water levels. In wells where recovery is slow, this test can be performed by pumping or bailing water from the well and immediately starting measurements.

- Record the initial water level and other setup information on the attached form.
- Fully submerge the slug bar or bailer into the water column of the well.
- Allow the water level in the well to return to static condition after both the slug and transducer have been inserted. The transducer readout should indicate the height of water above the transducer.
- When the water level in the well has returned to static condition, start the transducer ("Start Test" if using Win Situ software). Periodically view graphical data during the test, to confirm adequate data collection.
- Rapidly remove the slug bar or bailer from the water column and well. Avoid moving or pulling up the transducer cable when removing the slug.
- Continue recording water levels with the transducer until the water level has recovered to within 15 percent of the original static water level relative to the initial test displacement (85 percent recovery), or until one hour has elapsed. If less than 50 percent recovery has been achieved after one hour, continue to collect measurements every 10 to 20 minutes.
- Where possible, repeat the test to establish the repeatability of measurements and calculated hydraulic conductivity results.
- As soon as practicable, download data stored in the transducer and transfer data.

2.3 Field Procedure – Falling Head Test

In this test, a slug is inserted in the well at the start of the test and the falling water levels are measured immediately. In wells where recovery is slow, this test can be performed by adding water to the well and immediately starting measurements.

- Record the initial water level and other set up information on the attached form.
- Allow the water level in the well to return to static conditions after the transducer has been inserted. The transducer readout should indicate the height of water above the transducer.
- When the water level in the well has returned to a static condition, begin recording transducer readings ("Start Test" if using Win Situ software).
- Fully submerge the slug bar or bailer into the water column of the well.
- Periodically view graphical data during test, to confirm adequate data collection. The transducer should continue to record water levels until the water level has recovered to within 15 percent of the original static water level relative to the initial test displacement (85 percent recovery), or until one hour has elapsed. If less than 50 percent recovery has been achieved after one hour, continue to collect a measurement every 10 to 20 minutes.
- Where possible, repeat the test to establish the repeatability of measurements and calculated hydraulic conductivity results.
- As soon as practicable, download data stored in the transducer and transfer data.

3. Additional Information

- Do not perform hydraulic conductivity tests on wells that have not previously been developed and allowed to equilibrate.
- It is critical to either add or remove the slug to the well as quickly as possible and to start collecting depth-to-water measurements immediately.
- The early-time data is critical because the rate of recovery of head in the well is exponential. Collect measurements frequently at the start of all variable head tests.
- The time required for a slug test to be completed is a function of the volume of the slug, the hydraulic conductivity of the formation, and the type of well completion. The slug volume should be large enough that a sufficient number of water level measurements can be made before the water level returns to equilibrium conditions. Two bailers connected in series can be used to increase the slug volume, provided the water column is deep enough.
- Decontaminate all down well equipment before using it in the well.

- NAPL will damage the transducer. Gauge recovery manually in these instances.
- Where possible, take periodic water level readings manually during recovery. The manual data are used to check for transducer noise or movement.
- If using automatic data loggers, download the data as soon as possible. Batteries in the data loggers may run down and result in a loss of data.
- Be prepared to containerize water generated from rising head tests if the water is contaminated.
- Where possible, take more than one pressure transducer to site. This will provide backup and allow testing of multiple wells simultaneously.

4. Calculations

The simplest interpretations of piezometer recovery are Hvorslev (1951) and Bouwer and Rice (1976). The analyses assume a homogenous, isotropic medium in which soil and water are incompressible. Spreadsheets and software are available to calculate hydraulic conductivity from slug test data according to the methods below.

Hvorslev's expression for hydraulic conductivity (K) is:

$$K = \frac{r^2 \ln (L/R)}{2 L T_0} \qquad for\ L/R > 8$$

where:
K = hydraulic conductivity [ft/sec]
r = casing radius [ft]
L = length of open screen (or borehole) [ft]
R = filter pack (borehole) radius [ft]
T_0 = Basic Time Lag [sec]; value of t on semi-logarithmic plot of H-h/H-H_0 vs. t, where H-h/H-Ho = 0.37
H = initial water level prior to removal
of slug
H_0 = water level at t = 0
h = recorded water level at t > 0

(Hvorslev, 1951; Freeze and Cherry, 1979)

The Bouwer-Rice expression for hydraulic conductivity (K) is:

$$K = \frac{r^2 \ln (R_e/R) \ln(h_o/h_t)}{2 L t}$$

where:
r = casing radius [ft]
t = time of drawdown measurement since start of test [sec]

h = drawdown of water in well at time = t [ft]
h_o = drawdown of water in well at t = 0 (initial drawdown) [ft]
L = length of open screen (or borehole) [ft]
R_e = effective radius (radius of influence) [ft]
R = gravel pack radius [ft]

Both the Hvorslev and Bouwer-Rice methods can be applied for partially-penetrating wells. Hvorslev is generally applicable only to fully penetrating wells.

5. References

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Butler, James, J., Jr. "Improving the Quality of Parameter Estimates Obtained from Slug Tests", Ground Water, Vol. 34, No. 3, May-June 1996.

Butler, James J., Jr., "The Design, Performance, and Analysis of Slug Tests", Kansas Geological Survey, Lewis Publishers, 1997.
Chirlin, G.R. (1989), A Critique of the Hvorslev Method for Slug Test Analysis: The Fully Penetrating Well.

Fetter, C.W. (1994), Applied Hydrogeology, 3rd edition.

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Hvorslev, M.J., "Time Lag and Soil Permeability In Ground-water Observations," U.S. Army Corps of Engrs. Waterways Experiment Station Bulletin No. 36, 1951.

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U. S. EPA ENVIRONMENTAL RESPONSE TEAM STANDARD OPERATING PROCEDURES SOP: 2046,"Slug Tests" REV: 0.0, 10/03/94

6. Attachments

Attachment A – Slug Test Data Form

7. Contacts

Andy Adinolfi
Saskia Oosting

Attachment A. Slug Test Data Form

SITE ID: _____ SLUG TYPE (solid/bailer/pumped)

LOCATION/WELL ID _____ SLUG DIAMETER: _____

DATE: _____ SLUG LENGTH: _____

FIELD PERSONNEL: _____ METHOD:

_____ RISING HEAD _____

DATALOGGER TYPE: FALLING HEAD _____

_____

_____

COMMENTS:

_____

_____

==========

SETUP

Time _____
Depth to Water - Initial Static (before installing troll/slug) _____
Confirm well recovers to static after installing slug, or note otherwise

_____

==========

MANUAL CONFIRMATORY MEASUREMENTS

ELAPSED TIME (min.)	DTW	ELAPSED TIME	DTW
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Form based on:
USEPA, 1994; Sanders, 1998.

STANDARD OPERATING PROCEDURE

GW-011 Constant Head Permeability Testing

1. Objective

Describe procedures for performing constant head borehole permeability testing in granular soils. Constant head permeability testing is used when the soil permeability is sufficiently high for testing to be practical.

2. Execution

- All borehole permeability testing shall be performed below the static groundwater table. As the boring is advanced, attempt to determine the static groundwater level by:
  - Observing the water content of samples collected from the boring to identify the transition from moist to saturated soil.
  - For higher permeable soils, allowing the water level in the borehole to stabilize before performing the test.
  - If the borehole is left open overnight or for an extended period, measure the static groundwater level in the borehole at the beginning of the next day.
  - Measure the water level in nearby observation wells or piezometers.
  - If a well or piezometer is installed in the borehole, measure the water level in the well or piezometer after the water level has stabilized.
- Advance the drill casing to the top of the test zone and clean the borehole to the bottom of the casing.
- Obtain a split spoon sample in the test zone below the bottom of the casing.
- Advance the borehole 2 feet below the bottom of the casing using a side discharge roller bit. The roller bit should be only slightly smaller than the inside diameter of the casing. Record the diameter of the casing and the diameter of the roller bit. Avoid jetting the borehole walls or bottom during cleaning. Continue flushing the borehole until return water is clear.
- Measure the depth to groundwater in the borehole over a 10 to 15 minute period to observe if the groundwater elevation has approximately stabilized. Compare the saturated soil depth estimated from split-spoon samples to the measured water level in the borehole.
- Using a weighted tape, sound the bottom of the borehole to verify that the hole is cleaned to the correct depth and caving hasn't occurred. If more than 3 inches of wash remains in the borehole, lower the roller bit back to the bottom of the borehole and continue to clean the borehole.
- Measure and record the depth to the bottom of the borehole to the nearest 0.05 feet.
- Determine the length of the test zone (L = distance from the bottom of the casing to the bottom of the borehole) to the nearest 0.05 feet and record on the field form.
- Add clean water to fill the casing.

- Using a calibrated flow meter, adjust the flow rate into the casing so the water level remains within 0.5 inches of the top of the casing. Once the water level has stabilized, take a flow meter reading at the start of the test (time=0). Record the inflow volume at regular intervals (generally 1 minute) for a period of 10 minutes.
- Check the depth to the bottom of the borehole after completion of the test to check for caving.
- Record all measurements and observations on the Borehole Permeability Test Field Data Form.

3. Limitations

Site-specific conditions must be evaluated to determine appropriate test intervals. Test interval shall be determined by the Project Manager or their designee.

4. References

GEI Procedure No. 44, Borehole Permeability Testing in Granular Soils

U.S. Department of the Interior Bureau of Reclamation Ground Water Manual, Chapter 10: Permeability Tests in Individual Drill Holes and Wells.

5. Attachments

Attachment A - GEI Borehole Permeability Test Field Data Form – Constant Head

6. Contacts

Steve Hawkins

BOREHOLE PERMEABILITY TEST - CONSTANT HEAD
FIELD DATA FORM

PROJECT:	BORING :
LOCATION:	PROJ NO.:
CLIENT:	TEST NO.:
PERF'D BY: DATE:	PAGE NO.:
CALC'D BY: DATE:	GROUND
CHECKED: DATE:	SURF. EL.:

STANDPIPE/RISER DETAILS

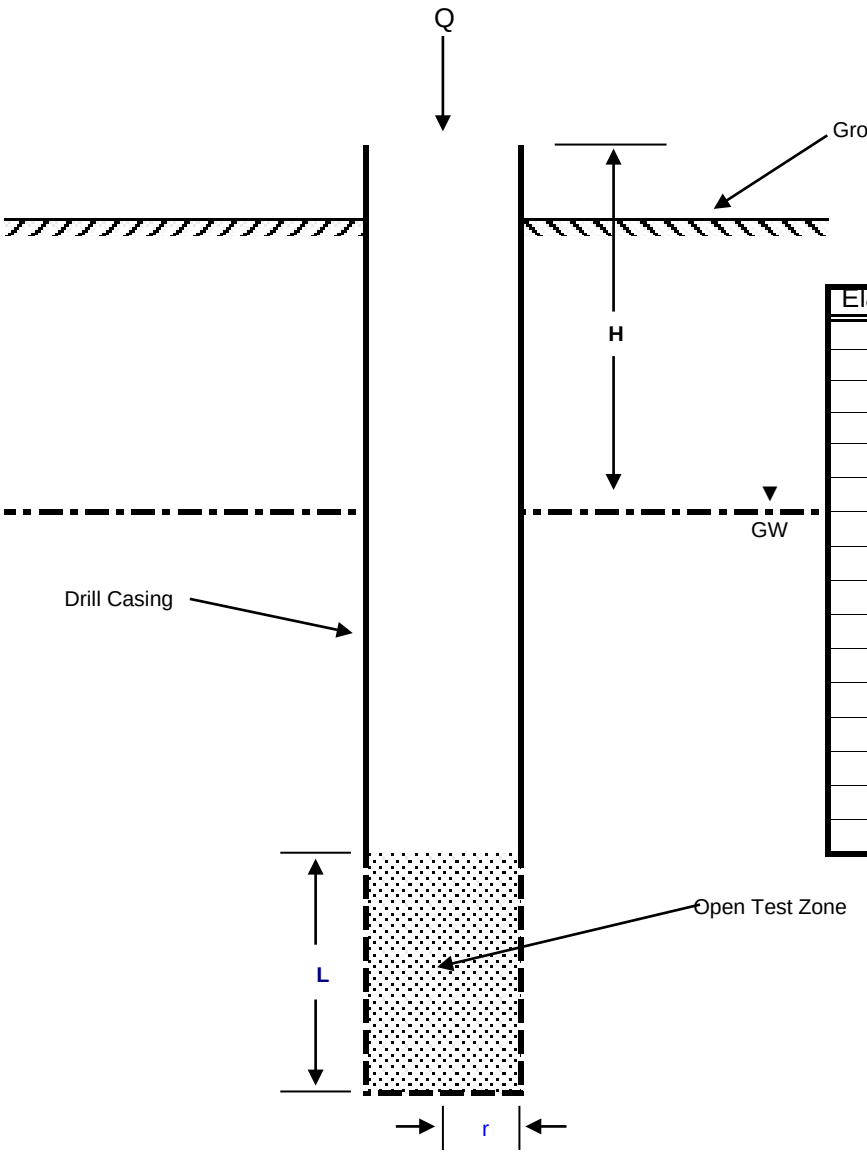
Riser inside diameter,d,inches: _____
Riser length, feet: _____
Riser stick up above ground surface, feet: _____
Groundwater depth below ground surface, H, feet: _____

Test Start Time: _____
Test End Time: _____

TEST INTERVAL DETAILS

Depth to bottom, feet (below ground surface): _____
Depth to top, feet (below ground surface): _____
Length, L, inches: _____

Water flow to achieve constant head, Q: _____ (volume/time)



Elapsed Time	Inflow	Overflow
0		

NOTES: 1. Based on the Constant Head Permeability Test SOP:
Created for the CT River Levee Projects, GEI Consultants
October 2008.

GEI Consultants

STANDARD OPERATING PROCEDURE

GW-014 Dense Non-Aqueous Phase Liquid (DNAPL) Measurement and Recovery

1. Objective

Provide procedural guidance for routine gauging and recovery of dense non-aqueous phase liquids (DNAPL) related to former manufactured gas plant (MGP) operations.

2. Execution

2.1 Equipment and materials

The following materials and equipment are necessary for this procedure:

- Oil/water interface probe
- Appropriate pump and required tubing/piping
- Double check valve bailers and string
- Drums or buckets for NAPL collection
- Proper PPE including gloves and protective eyewear
- Drum labels
- Field data sheets or logbooks
- Decontamination supplies and plastic sheeting
- Additional equipment identified by site-specific work plan and HASP
- Example specifications of DNAPL management equipment is included as Attachment A.

2.2 General Measurement Procedures

Using an oil/water interface probe will provide a depth to water and a depth to product in each monitoring well. Refer to probe manual to determine changes between liquid type. To achieve accurate depth measurements, ensure the oil/water interface probe is decontaminated (GEI SOP QA-001 prior to and between each measurement taken at each well.

To calculate the volume of product in monitoring wells with these specifications, take the following measurements:

- Total well length
- Depth to water
- Depth to product (s) – c1 and c2

Using the following equations, determine the length of the water column and the length of the product column:

[1] (a) – (b) = Water column length (d)
[2] (a) – (c1) = Product column length (e) dense non-aqueous phase liquid (DNAPL)

Calculate the volume of DNAPL product in the well using the following equation:

DNAPL for a 2" diameter well
[4] (e) x 0.1632 = Volume (gallons) of product in well
(e) x 0.6178 = Volume (liters) of product in well

DNAPL for a 4" diameter well
[4] (e) x 0.6528 = Volume (gallons) of product in well
(e) x 2.4711 = Volume (liters) of product in well

DNAPL for a 6" diameter well
[4] (e) x 1.469 = Volume (gallons) of product in well
(e) x 5.561 = Volume (liters) of product in well

Once measurements have been taken and calculations have been made, collection of dense non-aqueous phase liquid (DNAPL) may commence.

2.3 DNAPL Collection Procedures

Collection of DNAPL shall be accomplished using common recovery techniques or technologies as follows:

- Peristaltic pumps
- Bailers
- Positive displacement down hole pumps (e.g. Hammerhead, Blackhawk pumps, etc)

Special care shall be taken to prevent any purged DNAPL causing a spill and coming into contact with the ground and sampling personnel. This includes the use of proper personal protective equipment (PPE), including gloves and protective eyewear (Tyvek® if necessary), along with plastic sheeting set beneath the pump, tubing, and collection container (sealed top 55-gallon drum or 5-gallon bucket with lid), and the surrounding work area. A site-specific work plan, HASP and job specific job safety analysis need to be developed prior to the start of work. Examples of DNAPL specific management equipment and tools are included as Attachment A. The specific operating procedures for common recovery methods are discussed in the following sections.

2.3.1 Sampling and recovery via peristaltic pump with dedicated tubing:

- Take and record the required measurements prior to commencing pumping.
- Connect the dedicated tubing to the peristaltic pump with the long end of the silicon tubing set to discharge water and product directly into either a 5-gallon bucket or a 55-gallon closed-top drum, ensuring that the entire set-up is underlain by plastic sheeting.
- Begin purging the well, occasionally checking the depth to water and depth to product.
- Once the DNAPL has been purged from the well, a sample will be collected and preserved if required, in accordance with laboratory standards.

- Following completion of NAPL recovery, disconnect the tubing from the pump, secure the well and road box, and clean/decontaminate the pump and oil/water interface probe, prior to moving to the next location.
- Impacted tubing will either be containerized for proper disposal or left in well for reuse.

2.3.2 Sampling and recovery via double check valve bailer:

- Take and record the required measurements prior to commencing bailing.
- Ensure the entire work area is covered in plastic sheeting to avoid potential spills of water and/or product.
- Tie the bailer to a piece of string that will allow the bailer to reach the bottom of the well.
- Using slow and controlled motions while lowering (and raising) the bailer to the bottom of the well, commence bailing product out of the well and draining the bailer directly into either a 5-gallon bucket or a 55-gallon closed-top drum.
- Once the NAPL has been purged from the well, collect and preserve the analytical sample, if required, in accordance with laboratory standards.

2.3.3 Sampling via piston-style pumps (HammerHead, Blackhawk etc)

For significant accumulations of DNAPL a variety of dedicated pumping technologies exist. Refer to manufacturer-specific operating procedures and site specific means and methods.

2.4 Waste Management and Disposal

Investigation derived waste should be managed in accordance with GEI SOP SC-003. Additional care should be taken with DNAPL while infrequent the potential for hazardous waste characteristics does exist. DNAPL waste management and disposal should be evaluated on a site by site basis as discussed in Section 3.

2.5 Troubleshooting Information

If there are any performance problems with the oil/water interface probe which result in inability to achieve the proper measurements presented in Section 5.1, or if there are any problems with the peristaltic pump, consult the appropriate section of the probe instruction manual for the checkout and self-test procedures. If the problem persists, consult the manufacturer's customer service department immediately for further instructions.

Lower temperatures can affect the ability to pump and/or bail NAPL. Weather should be taken into consideration when scheduling gauging and recovery sampling events.

2.6 Data and records management

All information pertaining to maintenance of the oil/water interface probe and the peristaltic pump shall be maintained in the project file. Field measurements (depth to

water, product, *etc.*) and all calculations (product column length, volume of product, *etc.*) shall be recorded on the appropriate field data sheets or in the logbook consistent with GEI SOP Section 5.

2.7 Health and safety considerations

The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the site specific Health and Safety Plan (HASP). The collection and accumulation of NAPL presents the potential for significant hazards that need to be managed. A detailed job safety analysis (JSA) should be completed prior to the start of work.

3. Limitations

- DNAPL gauging and recovery can be problematic and requires adaptive thinking. A variety of measurement and collection techniques may be necessary to properly execute the work.
- Exposure to DNAPL can accelerate the required maintenance/replacement intervals for tools and equipment.
- A site specific work plan, HASP and JSA needs to be developed prior to commencing work. The documents should address: safety, recovery technologies, waste containment and waste management.

4. References

U.S. EPA. Ground Water Issue: Dense Non-aqueous Phase Liquids, EPA/540/4-91-002, March 1991.

5. Attachments

Attachment A – Example specifications of DNAPL recovery and management tools and equipment.

6. Contact

Kathleen Slimon
Mike Quinlan

Section 8

Air Sampling and Monitoring (AR)

STANDARD OPERATING PROCEDURES

AR-001 General Guidance on Work Zone Monitoring Methods

1. Objective

Protect human health by measuring air quality at the perimeter of a work area.

2. Execution

Walk-around perimeter and work zone monitoring for Total Volatile Organic Compounds (TVOC), Respirable Particulate matter less than 10 microns (RPM_{10}), and odor will occur along the perimeter of the project site on a regular and as-needed basis. Specific site conditions that will trigger walk-around perimeter or work zone monitoring include:

- visible dust
- odor complaints
- detection of TVOCs and/or RPM_{10} at levels approaching or exceeding action levels
- direction by the site oversight consultant or client

Perimeter air monitoring and work zone monitoring, in the absence of any specific triggering criteria, will be conducted on a regular basis during the normal work day. Particular attention will be given to the direction of any residences or other sensitive receptors.

At the time when a triggering condition is observed, the walk-around perimeter and work zone monitoring will occur continuously until the conditions that triggered the monitoring have subsided. Additional temporary monitoring points may be established due to changing site or meteorological conditions.

TVOC concentrations will be monitored and recorded using a Rae Systems MiniRAE 2000 Portable Ionization Detector (PID) or equivalent. RPM_{10} will be measured and recorded using a MIE personal DataRAM 1200 (PDR-1200) portable real-time aerosol monitor equipped with a PM-10 monitor and Gilian personal air sampling pump. AR-002 Suspended Particulate Matter in Ambient Air using the MIE DataRAM Real-time Aerosol Monitor (Portable) provides guidance on the use of this meter. Odors will be noted based on the n-butanol scale, as adapted from ASTM E544-99.

At each monitoring point, the 15-minute average value of TVOC and RPM_{10}, sample time, and sample location will be collected and recorded. The odor intensity based on the n-butanol scale will be monitored over a 15-minute period and recorded. At each location, air temperature, wind direction, and wind speed may be monitored and recorded using a hand-held wind meter.

Odors as a function of naphthalene concentration will be monitored over a 15-minute period and recorded. To measure naphthalene concentrations, the zNose™ Model 4200 system will be used. The zNose™ is an ultra-fast gas chromatograph (GC) that is capable of analyzing airborne concentrations of VOCs and SVOCs in less than one minute. The zNose™ uses a surface acoustic wave (SAW) detector that changes in vibration frequency as compounds elute from the column and condense onto the surface of the detector.

The zNose™ is a portable instrument and will be positioned downwind of the remedial activities. Up to five samples will be analyzed for naphthalene concentrations over a 15-minute period. The concentrations will be averaged to produce a 15-minute result. The calibration will be checked at the start of the day, at mid-day, and at the end of the day. An air blank will be run every two hours. A blank will also be run if a reading exceeds the calibration range of the instrument.

The zNose™ also has the capability of generating fingerprint images of the chemical constituents in the vapor called VaporPrints™. A VaporPrint™ of an air sample can be collected through a headspace analysis. This VaporPrint™ can be compared to others generated at the perimeter and off-site to see if remedial operations are the source of the odors. VaporPrints™ can allow for identification of odors that may not be affiliated with remedial operations.

To monitor cyanide (as hydrogen cyanide gas), a real-time hand-held meter in conjunction with the Dräger Chip Measuring System (CMS) will be used. Types of continuously monitoring equipment include the V-RAE by Rae Systems and the Mini-Warn by Dräger Safety Systems and are available from rental equipment suppliers. Due to potential interference from sulfur compounds, hydrogen sulfide gas (H_2S) will also be monitored for comparison to the hydrogen cyanide gas levels detected. Hydrogen cyanide gas detections will also be confirmed with CMS Dräger tubes due to this interference. The Dräger CMS can quantify other gases that could potentially provide false positives for hydrogen cyanide gas (including sulfur dioxide, hydrogen sulfide, phosphine gas, chlorine, and nitrogen dioxide) detected by the real-time meter.

At each location, air temperature, wind direction, and wind speed will be monitored and recorded using a hand-held wind meter.

3. References

New York State Department of Environmental Conservation. 2010. DER-10 / Technical Guidance for Site Investigation and Remediation. Division of Environmental Remediation. May 3, 2010. Appendix 1A. pp. 204-206

ASTM E544 - 99(2004) Standard Practices for Referencing Suprathreshold Odor Intensity

4. Attachments

None

5. Contact

Chris Gordon/Mike Quinlan

STANDARD OPERATING PROCEDURE

AR-002 Air Sampling for Dust (Particulate Matter) using the MIE DataRAM™ Real-Time Aerosol Monitor

1. Objective

Describe standard procedures for the real-time monitoring of airborne particulate matter using a MIE DataRAM™ model DR-2000 real-time aerosol monitor.

The MIE DataRAM™ is a real-time, portable monitor that measures airborne particulate matter. It is capable of monitoring total suspended particulate matter, particulate matter less than 10 microns (PM_{10}), and particulate matter less than 2.5 microns ($PM_{2.5}$) by using an appropriate orifice to control the size of the particles being measured. The DataRAM can be programmed to collect continuous real-time data, or to record time averaged data.

2. Materials

- MIE DataRAM™ model DR-2000
- Shelter/Enclosure - a pre-constructed enclosure capable of protecting the instrumentation from severe weather conditions during sample collection
- Omnidirectional inlet
- Inlet heater
- $PM_{2.5}/PM_{10}$ impactor
- IBM compatible computer loaded with MIE DataRAM™ software
- Field notebook

3. Meter Calibration

- Assemble all necessary DataRAM™ attachments.
- Make sure the power selector switch on the rear panel is in the "on" position. Turn on the power by pressing the "on" button on the front display panel of the DataRAM™. "Main Menu I" will appear on the screen.
- Activate the zero mode by pressing the button indicating zero.
- When the screen indicates the zero mode is complete, activate the span check mode by pressing the button indicated, and follow the prompts that appear on the screen.
- Record the time of the zeroing and the calibration difference percent in the field notebook. If the zeroing procedure takes longer than 5 minutes press "exit" and then "off," and then put the power switch on the rear panel of the instrument in the "off" position. Wait several minutes, turn on the power and zero the instrument again. If the calibration difference percent is more than ±5% then follow the "Calibr Diff" Resetting Procedure in the DataRAM™ Instruction Manual.
- Set the DataRAM™ to automatically log data. Refer to the Instruction Manual for details on how to set the data logging function.

- Record the instrument flow rate from the parameters menu in the field notebook.

4. Sample Collection

- Set the DataRAM™ at the predetermined sampling location in a rain or weatherproof containment, with only the inlet tubing exposed to ambient air.
- Start the run.
- When sampling is completed, terminate run and download data using the RS-232 cable connector and the MIE DR-COM software.
- Once the data file has been successfully downloaded and saved in an appropriate location, clear the data from the instrument memory.

5. Limitations

Each instrument must be calibrated using the internal reference standard and zeroed at the start of each sampling event and at a frequency of once per day throughout the duration of the sampling event.

The DataRAM™ can be programmed to collect continuous real-time data, or can collect "averaged" real-time data. These various options should be addressed prior to field operations and must be referenced in an approved work plan. This work plan must be available to all field personnel.

Project objectives will usually dictate the sampling location. In general, for air monitoring, meters are usually placed near breathing height and away from objects that can interfere with air motions. Since the DataRAM™ is measuring particulate matter, placement of the instrument directly on the ground should be avoided to prevent the sampling of dust concentrations that may not be representative of the air that is intended to be sampled (e.g. air at breathing height).

6. References

Code of Federal Regulations, 40 CFR 50, Appendix J, Reference Method for the Determination of Particulate Matter as PM_{10} in the Atmosphere.

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Quality Monitoring Program, US Environmental Protection Agency, Office of Air Quality Planning and Standards, Washington, D.C. EPA-454/B-08-003 December, 2008.

7. Contacts

Chris Gordon
Mike Quinlan

STANDARD OPERATING PROCEDURE

AR-003 Air Sampling for PM_{10} Particulate Matter using the High-Volume Sampler Method

1. Objective

Describe standard procedures for the collection of air samples for laboratory analysis of PM_{10} particulate matter using the high volume sampler method.

2. Materials

- General Metal Works (GMW) Model IP 10-8000 or equivalent. The GMW sampler can be rented.
- Calibration kit, as specified for the selected sampler.
- PM_{10} sampling filters, to be supplied by the contract laboratory. A Whatman QM-A quartz filter is currently the only commercially available PM_{10} filter that satisfies all criteria specified in 40 CFR 50, Appendix J. .
- Ice chest for sample storage or shipping.

3. Sampling

This method measures the mass concentration of particulate matter with an aerodynamic diameter equal to or less than 10 micrometers (µm). A high volume (HV) sampler draws a known volume of ambient air at a constant flow rate through a size selective inlet and through one or more filters. Particulates of 10 µm or smaller are collected on the filter(s) during the prescribed time period. Each sample filter is weighed before and after sampling to determine the net weight gain of the collected PM_{10} sample.

A HV sampler consists of two basic components: a specially designed inlet that transmits only particles equal to or less than 10 µm in diameter and a flow control system capable of maintaining a constant flow rate within the design specifications of the inlet.

3.1. Sampler Installation

- On receipt of the sampler, inspect all shipping cartons to ensure that all components have been received and verify that the unit is operational.
- On site, assemble the unit according to the manufacturer's instructions. Check all power cords and tubing for crimps, cracks, and breaks. The HV sampler should be placed on a sturdy platform or table, with the air inlet 4 to 6 feet above ground level.
- The sampler should be strategically placed according to the work plan or objectives of the study and located free of any obstructions to ambient air flow.
- The HV sampler requires 110 V AC power. The electrical outlet should be protected by a ground fault interrupter and water proof electrical connectors should be used.

- Operate the sampler for 30 minutes to ensure that the motor is operating at full performance.
- Calibrate the sampler in accordance with the instructions provided with the appropriate calibration kit. Proper calibration of the sampler is critical.
- Field personnel should be familiar with both the sampling unit and the calibration procedure before attempting to record data.

3.2. Sampling Procedure

- Operate sampler as per manufacturer's instructions.
- Filters are received from the laboratory numbered and pre-weighed in their individual envelope or folder within an envelope. Powder free latex gloves, or equivalent, should be worn during the handling of filters. Only touch the edges of the filter.
- Examine the filter support screen to confirm that it is clean. If it appears to be dirty, wipe it clean using lint free wipes such as laboratory wipes or equivalent. Check the gasket to be sure that it is in good condition. The filter is placed on the support screen with the numbered side facing down. Tighten thumb nuts on alternate corners to properly align and seat the gasket. The nuts should be only hand tightened to avoid damaging the gasket.
- Record the sampler serial number, filter ID number, sampler location, sampling date, and the operator's initials in the field notebook, any field data sheets being used, and on the back of a clean chart and install the chart in the flow recorder.
- Turn the sampler on and allow it to equilibrate to operating temperature, about 3 to 5 minutes. Verify that the recorder is operating and that the pen is inking. Allow the sampler to run for the required sampling interval.
- When sampling interval is completed, turn off the sampler and carefully remove the filter as soon as possible. Sample degredation can occur if the filter is left in the sampler for an extended period of time. The filter should be folded in half with the exposed side inward and the folded filter carefully placed in its respective folder and/or envelope. When removing and folding the filter touch only the outer edges. Powder free latex gloves, or equivalent, should be worn when handling filters.
- Record the following parameters in the field notebook and in any field data sheet being used:
    1. Elapsed time of sampling interval in minutes
    2. Average recorder response in arbitrary units
    3. Starting flow rate and ending flow rate
- The average flow rate for GMW Model IP 10-8000 sampler should be close to 1.13 m^3/min.
- Calculate the total flow rate for the sampling interval by time weighted averaging the flow rate readings. Air monitoring results where the flow rates

varied more than +/- 10%, from beginning to end, should be qualified accordingly and discussed with the project manager.

- The exposed filters, folded in half, are placed back into their shipping envelope and forwarded with completed chain of custody forms to the contracted laboratory for analyses. Follow the contracted laboratory's instructions for handling and returning the exposed filters.

4. General Guidance

The total volume of air sampled is determined from the measured volumetric flow rate and the sampling time. The mass concentration of PM_{10} in the ambient air is calculated as the total mass of collected PM_{10} particles divided by the total volume of air sampled. The PM_{10} measurement is expressed as micrograms (µg) per standard cubic meter (µg/std M^3). The sampled volume must be corrected to EPA standard conditions, 25° C, 760 mm Hg or 101 kPa.

A field blank may be collected, which consists of an unexposed filter removed from its envelope, put in place in the HV sampler, immediately removed, folded, replaced in its envelope and sent to the laboratory. Field blanks, if collected, should be taken at a frequency of one per twenty samples. If fewer than twenty samples will be collected during one week, collect one field blank weekly during sampling.

5. References

Code of Federal Regulations, 40 CFR 50, Appendix J, Reference Method for the Determination of Particulate Matter as PM_{10} in the Atmosphere.

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Specific Methods (Interim Edition), Addendum to Section 2.11 Reference Method for the Determination of Particulate Matter as PM10 in the Atmosphere (High-Volume Sampler Method), US Environmental Protection Agency, Office of Research and Development, Washington, D.C. EPA/600/R-94/038b April 1994.

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Quality Monitoring Program, US Environmental Protection Agency, Office of Air Quality Planning and Standards, Washington, D.C. EPA-454/B-08-003 December, 2008.

6. Contacts

Chris Gordon
Melissa Felter

STANDARD OPERATING PROCEDURE

AR-004 Air Sampling for Polycyclic Aromatic Hydrocarbons (PAHs) using EPA Method TO-13A

1. Objective

Describe standard procedures for the collection of ambient air samples to be analyzed for polycyclic aromatic hydrocarbons (PAHs) using U.S. EPA Method TO-13A.

2. Materials

- Modified High Volume Sampler
- General Metal Works (GMW) Model PS-1 sampler, or equivalent, sample cartridges and filters
- GMW Model GMW-40 calibrator and associated equipment, or equivalent, for calibration of the GMW PS-1 sampler
- Cooler with ice
- Stopwatch
- Data sheets for recording the sampling location, date, duration, starting and stopping times, and calculated sample volume
- Airtight, labeled, screw-capped container (wide mouth, glass with Teflon seal) to hold filter and adsorbent cartridge during transport to analytical laboratory
- Raised platform for the GMW PS-1 sampler

3. Sampling

This section details the sampling methodology and the media preparation by the analytical laboratory.

3.1. Sampling Equipment Overview

- Filters and adsorbent cartridges (containing XAD-2, Polyurethane Foam (PUF), or combination XAD-2 and PUF) are stored in screw-capped containers wrapped in aluminum foil (for protection from light) prior to installation in a modified high volume sampler. The filters and cartridges are supplied by the laboratory ready for use.
- A GMW Model PS-1 or equivalent sampler must be calibrated to draw approximately 325 cubic meters (m^3) of air through the filter and adsorbent sample cartridge.
- The filter and sample cartridge are placed in an appropriately labeled container and shipped to the analytical laboratory for analysis. Since heat, ozone, nitrogen dioxide (NO_2), and ultra violet (UV) light can cause sample degradation, the exposed sampling media must be immediately removed from the sampler using polyester gloves, wrapped in clean aluminum foil, tightly sealed, and packed in ice or refrigerated.

3.2. Sample Collection

- Calibrate each unit weekly and check the calibration daily, before use and at the end of the run, using the calibration kit and calibration curves supplied by the manufacturer.
- The samplers should be located in an unobstructed area, at least six feet from any obstacle to air flow. The exhaust hose should be stretched out in the downwind direction to prevent recycling of air into the sample head. The sampler should be placed off the ground on a sturdy stand, with the air inlet 4 to 6 feet off the ground.
- Remove the empty sample module from the sampler, rinse all sample contact areas using reagent grade hexane from a Teflon bottle. Allow the hexane to evaporate from the module in a well ventilated area before loading the sample cartridge.
- Detach the lower chamber of the rinsed sampling module. While wearing disposable, clean, lint-free nylon or powder-free latex or nitrile gloves, remove a clean glass sample cartridge from its container (wide-mouthed glass jar) and unwrap its aluminum foil covering. Place the foil back into the jar for rewrapping the sample cartridge after use.
- Insert the sample cartridge into the lower chamber and tightly reattach it to the module.
- Using clean Teflon tipped forceps, carefully place a clean fiber filter atop the filter holder and secure in place by clamping the filter holder ring over the filter using the three screw clamps. Ensure that all module connections are tightly assembled. Failure to do so may cause leaks which could affect sample representativeness. Ideally, sample module loading and unloading should be conducted in a controlled environment within a centralized sample processing area so that the sample handling variables can be minimized.
- With the module removed from the sampler and the flow control valve fully open, turn the pump on and allow it to warm up for approximately five minutes.
- Record the required information for the sampling run on the test data sheet. Record location, sampling date, starting and stopping times. Calculate the volume of air sampled.
- Attach the loaded sample module to the sampler.
- Connect the sampler to a 110 volt AC power source. Turn the power switch on. Activate the lapsed time meter and record the start time.
- Record the Magnehelic reading every six hours during the sampling period. Use the calibration curve to calculate the flow rate. Record the temperature, barometric pressure, and the Magnehelic reading at the beginning and end of the sampling period.
- At the end of the sampling period, turn the power off. Carefully remove the sampling head containing the filter and adsorbent cartridge in a clean area. While wearing lint-free nylon or powder-free latex or nitrile gloves, remove the sorbent cartridge from the lower module chamber and lay it on the

retained aluminum foil in which the sample was originally wrapped. Carefully remove the glass fiber filter from the upper chamber using clean Teflon tipped forceps.

- Fold the filter paper in half twice (sample side inward) and place it in the glass cartridge above the sorbent.
- Wrap the combined samples in aluminum foil and place them in their original glass sample container. Complete and fix a sample label to the sample container. Maintain chain-of-custody records for all samples.
- Store the glass container in a cooler with ice and protect the samples from light to prevent photodecomposition of collected analytes. If the time span between sample collection and lab analysis will exceed 24 hours, samples must be kept refrigerated. The sample holding time is less than 20 days.
- Perform a final calculated sample flow check. If flow rate calibration deviated by more than 10 percent from the initial reading, the flow data for that sample must be marked as estimated.
- Store all samples in the field on ice at approximately 0°C until delivered to the laboratory.

4. General Guidance

- This method may be modified for indoor air sampling.
- Field Blank: If necessary, collect a field blank, which consists of an unexposed filter that is removed from its envelope, put into the sampler, immediately removed, folded, replaced in its envelope and sent to the laboratory for analysis. Collect field blanks at a frequency of one per twenty samples. If fewer than twenty samples will be collected during one week, collect one field blank weekly during the sampling.

5. References

Code of Federal Regulations, 40 CFR 50, Appendix J, Reference Method for the Determination of Particulate Matter as PM_{10} in the Atmosphere.

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Quality Monitoring Program, US Environmental Protection Agency, Office of Air Quality Planning and Standards, Washington, D.C. EPA-454/B-08-003 December, 2008.

Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, Compendium Method TO-13A, Determination of PAHs in Ambient Air Using GC/MS, US Environmental Protection Agency, Office of Research and Development, Center for Environmental Research Information, Cincinnati, OH, EPA/625/R-96/010b, January 1999.

6. Contacts

Chris Gordon
Melissa Felter

STANDARD OPERATING PROCEDURE

AR-005 Hydrogen Cyanide Work Zone Air Monitoring Procedures

1. Objective

Describe real-time monitoring of hydrogen cyanide gas during field activities.

2. Equipment

To monitor cyanide (as hydrogen cyanide gas), the GEI field representative should utilize a real time handheld meter in conjunction with the Dräger Chip Measuring System (CMS) during subsurface activities including subsurface excavations, borings and monitoring well installation, materials handling, and groundwater sampling in areas with confirmed or suspected cyanide impacts.

Continuous monitoring equipment includes the V-RAE by Rae Systems and the Mini-Warn by Dräger Safety Systems, and are available from rental equipment suppliers. Due to potential interference from sulfurs, hydrogen sulfide gas (H_2S) should also be monitored for comparison to the hydrogen cyanide gas levels detected. Hydrogen cyanide gas detections will also be confirmed with CMS Dräger tubes due to this interference. The Dräger CMS can quantify other gases that could potentially provide false positives for hydrogen cyanide gas (including sulfur dioxide, hydrogen sulfide, phosphine gas, chlorine, and nitrogen dioxide) detected by the real time meter.

3. Calibration

Prior to commencing work on-site, the real-time cyanide meter should be calibrated in accordance with the equipment manufacturer's specifications. If the meter is calibrated in the field, the daily calibration results should be recorded in the field notebook.

4. Execution

Cyanide will be monitored around the perimeter of the work zone on a regular basis. Continuous monitoring should be completed every fifteen minutes if sulfur odor or suspected purifier waste material (former MGP sites only) is encountered. Measurements should be monitored in the breathing zone and should be recorded into the field notebook or on an applicable form. In the event that hydrogen cyanide is detected, the GEI field representative should proceed as follows:

4.1. Action Level: HCN ≤1 ppm for 15-minute average using real time meter

- Run CMS Dräger tube.
- Continue monitoring with real time meter.
- Continue work if CMS Dräger tube for hydrogen cyanide reads <2 ppm.

4.2. Action Level: 1 ppm < HCN < 2ppm for 15-minute average using real time meter.

- Run CMS Dräger using hydrogen cyanide gas chip and confirm <2 ppm concentration.
- Continue monitoring with real time meter.
- Run CMS Dräger tube using sulfur dioxide, hydrogen sulfide phosphine chip to evaluate potential interference.
- Recalibrate the real time meter and continue to monitor the work zone.

4.3. Action Level: HCN 2 ppm on CMS Dräger tube

- Stop work and move (with continuous monitoring meter) at least 25 feet upwind from excavation or until continuous monitoring meter registers <1 ppm.
- Run CMS Dräger hydrogen cyanide chip and re-evaluate activities
- Continue monitoring with real time meter.
- Allow area to ventilate and continue to monitor while returning to the work zone.
- Do not move into an area when readings are >1 ppm without confirming with additional CMS Dräger measurement.
- May resume work if Dräger tube for cyanide reads <2 ppm.

5. Limitations

No air purifying respiratory protection is available for hydrogen cyanide gas.

The American Conference of Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) for Hydrogen Cyanide is 4.7 ppm.

6. References

Code of Federal Regulations, 40 CFR 50, Appendix J, Reference Method for the Determination of Particulate Matter as PM_{10} in the Atmosphere.

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Specific Methods (Interim Edition), Addendum to Section 2.11 Reference Method for the Determination of Particulate Matter as PM10 in the Atmosphere (High-Volume Sampler Method), US Environmental Protection Agency, Office of Research and Development, Washington, D.C. EPA/600/R-94/038b April 1994.

7. Contacts

Ryan Hoffman

STANDARD OPERATING PROCEDURE

AR-006 Air Sampling for Volatile Organic Compounds (VOCs) using Summa Canisters

1. Objective

Describe standard procedures for the collection of ambient air samples to be analyzed for volatile organic compounds (VOCs) using Summa canisters. Typically, U.S. EPA Method TO-15 is used for laboratory analysis. The site-specific Work Plan should be consulted for proposed sample locations and sampling duration.

2. Materials

- Sampling canister
- Flow controller
- Vacuum gauge
- Wrench for removing fittings and assembling the sample train
- Data sheets for recording the sampling location, date, duration, starting and stopping times, and calculated sample volume
- Camera and measuring tape
- Weather station data
- PID

3. Sampling

This section details the sampling methodology and the media preparation by the analytical laboratory.

3.1. Sampling Equipment Overview

- The laboratory prepares the canister for sampling by cleaning and then evacuating the contents to a vacuum of approximately 29.9 inches of Mercury (in. Hg). Opening the stainless steel bellows valve allows the air sample to enter the canister. When the target volume of sample is collected, close the valve and return the canister to the laboratory.
- A flow controller is used as part of the sample train to control the amount of air allowed to flow into the container over time. Flow controllers are typically set to a flow rate that collects a sample continuously over a 1-hour (hr), 8-hr, or 24-hr interval. The sampling duration needs to be communicated to the laboratory prior to sampling, so that the laboratory can provide the appropriate flow controller.
- Summa canisters are typically used and named after the “Summa” process which describes the electro polishing of the interior surface of the canister to prepare it for sampling.
- The holding time for a standard VOCs list of EPA Method TO-15 is 30 days after sample collection, although some projects may require a shorter hold time.

3.2. Document Field Conditions

Document pertinent field conditions prior to sample collection:

- Record weather information, if available (such as precipitation, temperature, barometric pressure, relative humidity, wind speed, and wind direction) at the beginning of the sampling event. Record substantial changes to these conditions that may occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport). Data should be obtained for at least the past 12 hours.
- Sketch the site, area streets, neighboring commercial or industrial facilities (with estimated distance to the site), outdoor air sampling locations (if applicable), and compass orientation (North).
- Record pertinent observations, such as odors and readings from field instrumentation.

3.3. Sample Collection

- Collect samples in a clean Summa canister (or equivalent) using a flow controller calibrated for the anticipated sample duration (e.g. 8-hour, 24-hour, etc.). The flow controller flow rate should not exceed 0.2 liters per minute.
- Verify the initial vacuum of the canister using the vacuum gauge. If the canister vacuum is less than 25 in. Hg, do not use it. The procedure to verify the initial pressure is simple, and a missed step can compromise the validity of the sample media.
    i. Confirm the canister's bellows valve is closed by turning the knob clockwise to tighten.
    ii. Remove the brass cap from the canister inlet.
    iii. Attach the vacuum gauge.
    iv. Open and close the bellows valve quickly (a few seconds).
    v. Read and record the vacuum on the gauge as 'Initial vacuum' on the chain-of-custody (COC).
    vi. Confirm the bellows valve is closed by turning the knob clockwise to tighten.
    vii. Remove the vacuum gauge and replace the brass cap.
- <u>Begin Sampling</u>
    i. Confirm the bellows valve is open by turning the knob counter-clockwise to loosen.
    ii. Remove the brass cap.
    iii. Attach the flow controller.
    iv. Attach a "J"-shaped sampling cane to prevent precipitation from entering the canister.
    v. Place the canister at the sampling location open the bellows valve. If the sample is collected from breathing height (e.g., 3 to 5 feet above ground), then mount the canister on a stable platform such that the sample inlet should be at the proper height.

vi. Record the start date and time on the COC.
vii. Record the identification numbers for the canister and flow controller and the vacuum gage.

- Begin Sampling (with a field duplicate)
  i. Confirm the bellows valve is closed by turning the knob clockwise to loosen on both canisters.
  ii. Remove the brass cap from both canisters.
  iii. Attach a flow controller on both canisters.
  iv. Attached a "T"-shaped sample train designed for field duplicates to both canisters.
  v. Attach a "J"-shaped sampling cane to the common end of the sampling "T" to limit precipitation entering the canisters.
  vi. Place the attached primary and duplicate canisters at the sampling location open the bellows valve. If the sample is collected from breathing height (e.g., 3 to 5 feet above ground), then mount the canister on a stable platform such that the sample inlet should be at the proper height.
  vii. Record the start date and time on the COC.
- Monitoring Sample progress
  i. At regular intervals, record the vacuum on the flow controller to confirm that the vacuum is decreasing in the canister. If the vacuum reads 5 in. Hg or less the bellows valve should be closed and the sample interval ended.
  ii. Some residual vacuum is important to maintaining sample integrity. If there is no vacuum remaining, call the laboratory and discuss the sample viability with them. Evaluate whether another sample will be taken after sharing the laboratory's opinion with your project manager.
- End Sampling
  i. Sampling will end when the time interval (e.g., 8-hr period) is completed, or when the canister vacuum reads 5 in. Hg or less.
  ii. Close the bellow valve by turning the knob clockwise to tighten.
  iii. Remove the "J"-shaped sampling cane.
  iv. Remove the flow controller.
  v. Attach the vacuum gauge.
  vi. Open and close the bellows valve quickly (a few seconds).
  vii. Read and record the vacuum on the gauge as 'Final vacuum' on the chain-of-custody (COC).
  viii. Confirm the bellows valve is closed by turning the knob clockwise to tighten.
  ix. Remove the vacuum gauge and replace the brass cap.
- Sample Transport
  i. Return the canister, flow controller, and sampling cane to the laboratory in the boxes provided.
  ii. Fill out the COC and relinquish samples properly with flow controller and canister numbers on the COC.

iii. Place the COC in the box and retain a copy of the COC for your records.
iv. Tape the box shut.
v. Deliver or ship the samples to the laboratory as soon as practical to adequately meet the holding time of the sample.

4. General Guidance

- This method may be modified for indoor air sampling.
- Field Blank: Do not collect a field blank.
- Trip Blank: Do not collect a trip blank. The canister is prepared for sampling by evacuating the contents to a vacuum of, so no air exists for a trip blank to provide meaningful information.

5. References

Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, Compendium Method TO-15, Determination of Volatile Organic Compounds (VOCs) in Air Collected In Specially-Prepared Canisters And Analyzed By Gas Chromatography/ Mass Spectrometry (GC/MS), US Environmental Protection Agency, Office of Research and Development, Center for Environmental Research Information, Cincinnati, OH, EPA/625/R-96/010b, January 1999.

Guide To Air Sampling & Analysis, Air Toxics, Ltd., Folsom, CA.

6. Contacts

Chris Gordon
Mike Quinlan

Section 9

Soil Gas Sampling (SG)

STANDARD OPERATING PROCEDURE

SG-001 General Guidance on Soil Vapor Intrusion Evaluations

1. Objective

The goal of a soil vapor intrusion evaluation is to assess whether complete exposure pathways of soil vapor to indoor air exist. A complete exposure pathway exists if vapors from constituents are migrating through various pathways into residential or commercial buildings at concentrations that may result in an unacceptable human health risk. If a complete exposure pathway does not exist, then further assessment of soil vapor intrusion is not required.

Depending on the status of investigation performed at the site it may be appropriate to approach an evaluation of soil vapor intrusion at different tiers. If little work has been performed relative to the potential for contaminants to affect soil vapor near a structure, then a screening level assessment is an appropriate first step. However, if a plume is well delineated and the potential for groundwater impacts, or nearby source material, to affect soil vapor near a potential receptor structure is well understood, then it may be more appropriate to directly develop and implement a soil vapor and/or indoor air sampling plan. To accommodate the potential varied states of knowledge when a vapor intrusion evaluation is required, a flexible approach is needed that incorporates the following elements.

- SOP SG-002 Soil Vapor Sample Collection
- SOP SG-003 Sub-Slab Soil Vapor Collection
- Indoor Air Sampling
- SOP SG-004 Ambient Air Sample Collection

Soil vapor intrusion evaluations should be approached on a site-specific basis and depending on the site-specific setting and proximity to impacted groundwater or source material, it may be appropriate to proceed in a hierarchical fashion through each tier of evaluation or a variety of tiers may be combined and implemented simultaneously. The SOPs presented in this SOP address each of these sampling procedures.

2. Execution

2.1. Implementation Triggers

Soil vapor intrusion evaluations may be implemented at various times based on event triggers throughout the Site Characterization (SC), Remedial Investigation (RI), and site remedial action plan. The following event triggers would require the implementation of this soil vapor intrusion investigation.

- Identification of a potential complete exposure pathway
- Private property owner request for sampling

- State or Federal administrative order

2.2. Factors Affecting Soil Vapor Intrusion

Prior to conducting a soil vapor intrusion assessment at a private property, an analysis of the factors contributing to the migration of soil vapor to indoor air should be conducted. The completion of this analysis should take into account the two types of factors: environmental and building factors.

2.2.1. Environmental Factors

Environmental factors include site specific conditions in the subsurface and above the ground surface that may affect the rate and direction at which soil vapor may migrate.

The soil and groundwater conditions between the contamination and the residential/commercial building should be evaluated and recorded in any soil vapor intrusion investigation. If the SC/RI has been completed, then the data are available for this review. If the SC/RI has not been completed, then at a minimum the nature and extent of impacted soil and/or groundwater between the site and the residential/commercial building should be defined.

After compiling the necessary site-specific data, that information should be reviewed to determine groundwater conditions at the site. The potential for man-made or natural preferential pathways for vapor migration in the vadose zone and/or for groundwater migration in the saturated zone should also be determined at this time.

- The depth to groundwater below the residential or commercial building will be determined. For example, in cases where groundwater intersects the foundation there is no vadose zone to collect a sub-slab sample. In cases where the groundwater is close to the foundation, there is a risk of causing/exacerbating groundwater intrusion through the foundation during periods of high groundwater.

Additional Site Observations

- Direction of groundwater flow from the contaminant source to the residential or commercial building;
- The location, depth, extent, and concentration of potential constituents in unsaturated soil and groundwater on the property; and,
- Presence of an overlying water bearing zone that does not have impacts beneath the residential or commercial building. An un-impacted shallow water zone will significantly retard or completely prohibit the potential for deeper impacted groundwater to affect soil vapor.
- Potential "smear zones" (residual non-aqueous phase liquid (NAPL) present at depths over which the water table fluctuates) should also be identified as they may also affect the rate of soil vapor migration.
- Location, depth, extent of NAPL, if present.

Soils which are highly organic, wet, and/or of low permeability should be identified. If these soils are present beneath a structure and above impacted groundwater or soil, they may effectively shield the building from potential vapor intrusion. Conversely, dry and porous soils underlying a building may provide a less inhibited soil vapor intrusion pathway. The limits of backfill surrounding residential or commercial building should be also noted.

2.2.2. Building Factors

Building Factors include the physical characteristics, such as structure, floor layout, air flow, and physical conditions. These conditions will be documented during the evaluation. The New York State Department of Health (NYSDOH) Center for Environmental Health's Indoor Air Quality Questionnaire and Building Inventory form is presented in Attachment A. At a minimum, the following information should be recorded.

- Building foundation construction characteristics (basement, footers, crawl spaces, etc), including potential preferential vapor intrusion pathways such as foundations cracks and utility penetrations.
- Basement wall materials (hollow block, stone, or poured concrete, etc.)
- Presence of an attached garage.
- Recent renovations to the building such as new paint or new carpet.
- Mechanical heating/cooling equipment that may affect air flow.
- Use and storage of petroleum products such as home heating oil storage tanks, underground storage tanks (USTs), or kerosene heaters.
- Recent use of petroleum-based finish or other products containing volatile organic compounds (VOCs).
- Areas of pavement on the property should also be identified in the event sub slab vapor sampling is not feasible or appropriate due to a high groundwater table. Paved areas could serve as surrogate locations in lieu of sub slab soil vapor sampling if high water table conditions exist.

The construction materials and integrity of the floor of the structure closest to the potential point of entry for soil vapor (basement level or first floor for slab-on-grade constructions) should be identified. In addition to the foundation type and integrity, this survey should note any preferential pathways (utility lines/pipes, sumps, etc.) that may exist within the bottom-most level of the structure.

The operation and presence of heating systems, including fireplaces and clothes dryers, may create a pressure differential between the structure and the outside environment, causing an increase of migration of soil vapor into the building. The NYSDOH guidance document suggests limiting indoor air sampling to the heating season (with the exception of immediate inhalation hazard situations), which is roughly defined as November 15th to March 31st. However, sampling may be completed at any time during the year for any sampling completed in response to a request by a community member. In situations where non-heating season sampling

has taken place, consideration should be given to re-sampling the property within the heating season. The operation of HVAC systems should be noted on the building inventory form (Attachment A).

During the initial building assessment and visit, and again when sub-slab soil vapor and/or indoor air sampling are performed, differential pressure measurements between indoor air, ambient air, and soil vapor should be collected and recorded to document the potential effect building conditions have on soil vapor migration.

2.2.3. Property Visit

A property visit will be conducted prior to sampling. During the site visit, technical representatives will complete site visit observations, inventories and occupant questionnaire forms (Appendix A). During the course of the interview, observations will be made to identify any potential areas or issues of concern or the presence of any odors, and if sampling appears necessary, identify potential sampling points and general building characteristics. The questionnaire is also used to identify potential sources and activities that may interfere with sampling results. The questionnaire will specifically address the activities of the occupant's (e.g., smoking, work place activities) that may contribute to indoor air concentrations of volatile chemicals.

The responses to the questionnaire will be evaluated and a determination will be made as to whether additional investigation is required.

2.2.4. Chemical Inventory

The chemical inventory complements the identification of the building factors affecting soil vapor intrusion. The chemical inventory will identify the occurrence and use of chemicals and products throughout the building. These products can be used to develop an indoor environmental profile. A separate inventory should be prepared for each room on the floor being tested as well as any other indoor areas physically connected to the areas being tested. Inventories will include product names, chemical ingredients, or both. If possible, photographs of the products should be taken of the location and condition of the inventoried products and the photographic records should be indexed with the inventory records. The products inventory can also be used to document odors and if possible portable vapor monitoring equipment measurements should be taken and recorded. A product inventory will be repeated prior to each round of testing at the building. If available, the volatile ingredients should be recorded for each product. If the ingredients are not listed on the label, record the manufacturer's name and address or phone number if available. The product inventory form is presented in Attachment A.

2.2.5. Water Table Conditions and Vapor Intrusion Assessment Approach

Sub-slab soil vapor sampling is intended to evaluate the potential for vapor intrusion. However, there are circumstances where collection of sub-slab soil vapor samples may not be feasible if the water table is near, at, or above the elevation of a buildings foundation slab. An evaluation of the water table elevation relative to the

building slab should be made before attempting to install a sub-slab vapor sampling point.

If the water table is found to be sufficiently below the building slab and sub-slab vapor sampling can be performed, then the following Low Water Table Scenario should be followed.

2.2.5.1. Low Water Table Scenario

If the water table elevation is lower than the basement slab, then the following samples should be collected.

- Sub-slab soil vapor samples
- Indoor air samples from basement level
- Indoor air samples from main living space (First floor)
- Outdoor ambient air sample

If the water table is deemed to be at too high of an elevation to allow sub-slab vapor sampling, then alternate means of evaluating the potential for vapor intrusion must be employed. If a building has a groundwater sump, the sump should be evaluated to determine if there is water present in the sump and if that water is representative of groundwater or if the water is stagnant. If water in the sump represents groundwater, then a sample from the sump should be collected. The High Water Scenario below summarizes the methods to evaluate potential vapor intrusion if sub-slab vapor sampling cannot be conducted due to high groundwater conditions.

2.2.5.2. High Water Table Scenario

If the water table elevation is higher than the basement slab, then the following tasks should be performed.

- Determine if a sump pump is present and actively pumping water.
- If sump is actively pumping, collect a sample of groundwater from the sump.
- Collect an indoor air sample from basement level.
- Collect an indoor air sample from main living space (first floor).
- Identify exterior soil vapor sample location near foundation (outside of foundation backfill) and preferably beneath a surrogate vapor cap (e.g. paved driveway, patio).
- Collect soil vapor samples from exterior soil vapor location
- Collect an outdoor ambient air sample.

3. References

USEPA modified Method TO-15 and helium via ASTM D-1945.

Section 2.7.1 of the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York, *dated October 2006.*

4. Attachments

Attachment A - NYSDOH Center for Environmental Health's Indoor Air Quality Questionnaire and Building Inventory Form

5. Contact

Mike Quinlan

Melissa Felter

ATTACHMENT A

Off-Site Property Sampling Documentation Form

Property Location/Address: _____

Property: _____

Sampling Date: _____

Property Location/Address: _____
Property: _____
Sampling Date: _____

Preparer's Name: _____ Date/Time Prepared: _____

Preparer's Affiliation: _____ Phone No.: _____

Purpose of Investigation:_____

1. OCCUPANT Interviewed: Yes ☐ No ☐

Last Name: _____ First Name: _____

Address: _____

County: _____

Home Phone: _____ Office Phone: _____

Number of Occupants/persons at this location _____ Age of Occupants_____

2. OWNER OR LANDLORD (Check if same as occupant __) Interviewed: Yes ☐ No ☐

Last Name: _____ First Name: _____

Address: _____

County: _____

Home Phone: _____ Office Phone: _____

3. CONTACT NAME (Check if same as Occupant ____, Owner ____)

Last Name: _____ First Name: _____

Address: _____

County: _____

Home Phone: _____ Office Phone: _____

4. PROPERTY LOCATION: _____

Relative to Site:

Direction _____ Direction to Nearest Cross Street: _____

Distance _____ Distance to Nearest Cross Street: _____

Surrounding Land Use:

North: _____ East: _____

South: _____ West: _____

Property Location/Address: _____
Property: _____
Sampling Date: _____

5. PROPERTY BOUNDARIES

Delineate the boundaries of the property (on a separate project map, outline property location, private well location, septic/leachfield location, groundwater flow, compass direction, windrose.)

6. BUILDING CONSTRUCTION

Type of Building (Circle appropriate response)

Residential	School	Commercial/Multi-use
Industrial	Church	Other: _____

If the property is residential, type? (Circle appropriate response)

Ranch	2-Family	3-Family
Raised Ranch	Split Level	Colonial
Cape Cod	Contemporary	Mobile Home
Duplex	Apartment House	Townhouses/Condos
Modular	Log Home	Other:_____

If multiple units, how many? _____

If the property is commercial, type?

Business Type(s) _____

Does it include residences (i.e., multi-use)? Yes □ No □

If yes, how many? _____

Other characteristics:

Number of floors_____ Building age_____

Is the building insulated? Yes □ No □ How air tight? Tight / Average / Not Tight

Construction Material _____

7. BASEMENT AND CONSTRUCTION CHARACTERISTICS

Does the building have a basement and/or crawl space, or is it slab-on-grade construction?

_____

Describe the construction of the basement/crawl space (Circle all that apply)

a. Above grade construction:	wood frame	concrete	stone	brick
b. Basement type:	full	crawlspace	slab	other _____

Property Location/Address: _____
Property: _____
Sampling Date: _____

c. Basement floor:	concrete	dirt	stone	other _____
d. Basement floor surface:	uncovered	covered	covered with _____	
e. Concrete floor:	unsealed	sealed	sealed with _____	
	unpainted	painted	painted with _____	
f. Foundation walls:	poured	block	stone	other _____
g. Foundation walls:	unsealed	sealed	sealed with _____	
h. The basement is:	wet	damp	dry	moldy
i. The basement is:	finished	unfinished	partially finished	

Does your basement have a sump? Yes ☐ No ☐

Is, is there water in the sump? Yes ☐ No ☐

Describe sump conditions:_____

_____

Have you observed standing water in your basement? Yes ☐ No ☐

If so, what is the frequency of this observation? _____During rain events? ☐

Have you observed sheen atop the standing water? Yes ☐ No ☐

Basement/Lowest level depth below grade: _____(feet)

Are there any cracks in the floor of your basement? Yes ☐ No ☐

Description: _____

_____

Identify potential soil vapor entry points and approximate size (e.g., cracks, utility ports, drains)

Description: _____

_____

What activities occur in the finished basement?

Description: _____

_____

Approximately how many hours per day (or week) do you spend in your basement? _____

8. HEATING, VENTING AND AIR CONDITIONING

Type of heating system(s) used in building: (Circle all that apply – note primary)

Property Location/Address: _____
Property: _____
Sampling Date: _____

Hot Air Circulation	Hot Water Baseboard	Steam Radiation
Electric Baseboard	Heat Pump	Wood Stove
Space Heaters	Radiant Floor	Outdoor wood boiler
Unvented Kerosene Heater	Other _____	

The primary type of fuel used is:

Fuel Oil	Natural Gas	Electric
Kerosene	Propane	Solar
Wood	Coal	Other? _____

Time of use of each type of heating? _____

Domestic hot water tank fueled by: _____

Boiler/furnace located in: Basement Outdoors Main Floor Other_____

Air conditioning: Central Air Window units Open Windows None

Are there air distribution ducts present? Yes □ No □

Describe the supply and cold air return ductwork, and its condition where visible, including whether there is a cold air return and the tightness of duct joints. Indicate the locations on the floor plan diagram.

_____

_____

_____

_____

Type of insulation (e.g. blown, fiber, etc.)? _____

Does building have energy efficient windows (e.g. double paned) Yes □ No □

Was weather-stripping recently added/upgraded? Yes □ No □

Particleboard used in construction? Yes □ No □

9. OCCUPANCY

Property Location/Address: _____
Property: _____
Sampling Date: _____

Level	General Use of Each Floor (e.g., family room, bedroom, laundry, workshop, storage)
Basement	_____
1st Floor	_____
2nd Floor	_____
3rd Floor	_____
4th Floor	_____

10. BULK PETROLEUM STORAGE

Aboveground storage tank on the property Yes ☐ No ☐

If yes, how old is tank? _____ Condition? _____

Last inspected? _____ Location: _____

Describe conduits to building (type, location, and entry portal condition): _____

_____

Underground storage tank on the property. Yes ☐ No ☐

If yes, how old is tank? _____ Condition? _____

Last inspected? _____ Location: _____

Describe conduits to building (type, location, and entry portal condition): _____

_____

11. WATER AND SEWAGE

Water Supply:

Public Water Drilled Well Driven Well Dug Well Other _____

Is there use of groundwater water for irrigation purposes? Yes ☐ No ☐

Sewage Disposal:

Public Sewer Septic Tank Leach Field Dry Well Other _____

12. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY

a. Is there an attached garage? Yes ☐ No ☐

If not, is there a separate garage or carport? Yes ☐ No ☐

b. Does the garage have a separate heating unit? Yes ☐ No ☐ NA ☐

Property Location/Address: _____
Property: _____
Sampling Date: _____

c. Are petroleum-powered machines or vehicles stored in the garage (e.g., lawnmower, ATV, car)
Yes ☐ No ☐ NA ☐ Please specify_____

Is gasoline stored in the garage? Yes ☐ No ☐

Quantity? _____

d. Has the building ever had a fire? Yes ☐ No ☐

When?_____

e. Is a kerosene or unvented gas space heater present? Yes ☐ No ☐

Where? _____

f. Is there a workshop or hobby/craft area? Yes ☐ No ☐

Where & Type? _____

g. Is there smoking in the building? Yes ☐ No ☐

How frequently? _____

h. Have cleaning products been used recently? Yes ☐ No ☐

When & Type? _____

i. Have cosmetic products been used recently? Yes ☐ No ☐

When & Type? _____

j. Has painting/staining been done in the last 6 months? Yes ☐ No ☐

Where & When? _____

Is house paint stored inside? Yes ☐ No ☐

Where? _____

k. Is there new carpet, drapes or other textiles? Yes ☐ No ☐

Where & When? _____

l. Have air fresheners been used recently? Yes ☐ No ☐

When & Type? _____

m. Is there a kitchen exhaust fan? Yes ☐ No ☐

If yes, where vented?_____

n. Is there a bathroom exhaust fan? Yes ☐ No ☐

If yes, where vented?_____

o. Is there a clothes dryer? Yes ☐ No ☐

If yes, is it vented outside? Yes ☐ No ☐

p. Has there been a pesticide/chemical fertilizer application? Yes ☐ No ☐

Property Location/Address: _____
Property: _____
Sampling Date: _____

When & Type?_____

Conducted by Owner or Private Yard Service _____

Is yard waste/trash burned on-site? Yes ☐ No ☐

Do any of the building occupants use solvents at work? Yes ☐ No ☐

(e.g., chemical manufacturing or laboratory, auto mechanic or auto body shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetologist

If yes, what types of solvents are used? _____

If yes, are their clothes washed at work? Yes ☐ No ☐

Do any of the building occupants regularly use or work at a dry-cleaning service? (Circle appropriate response)

Yes, Use dry-cleaning regularly (weekly) No

Use dry-cleaning infrequently (monthly or less) Unknown

Yes, work at a dry-cleaning service

Is there a radon mitigation system for the building/structure? Yes ☐ No ☐

Date of Installation: _____

Is the system active or passive? Active ☐ Passive ☐

Are there any recent/past improvements to building? Yes ☐ No ☐

Interior painting? _____

Any landscaping improvements that involved bringing fill on site? Yes ☐ No ☐

Other _____

Approximately when (how long ago) did these improvements occur? _____

Does anyone living here engage in any of the following activities or hobbies?

a. Art projects (e.g. oil painting, ceramics, pottery, stained glass, metal sculpture)

Yes ☐ No ☐

Name: _____ Age: _____ Sex: _____

Name: _____ Age: _____ Sex: _____

Property Location/Address: _____
Property: _____
Sampling Date: _____

b. Furniture refinishing Yes ☐ No ☐

Name: _____ Age: _____ Sex: _____

Name: _____ Age: _____ Sex: _____

c. Model building(e.g. planes,boats,cars) Yes ☐ No ☐

Name: _____ Age: _____ Sex: _____

Name: _____ Age: _____ Sex: _____

d. Gardening Yes ☐ No ☐

Name: _____ Age: _____ Sex: _____

Name: _____ Age: _____ Sex: _____

e. Automotive work Yes ☐ No ☐

Name: _____ Age: _____ Sex: _____

Name: _____ Age: _____ Sex: _____

f. Ammunition reloading Yes ☐ No ☐

Name: _____ Age: _____ Sex: _____

Name: _____ Age: _____ Sex: _____

Is there a wood burning stove? Yes ☐ No ☐

If so, how frequently is it used?

_____

_____

Is there a barbeque grill? Yes ☐ No ☐

If so, how frequently is it used? What is the type of fuel?

_____

_____

Has the building ever had fumigation? Yes ☐ No ☐

Property Location/Address: _____
Property: _____
Sampling Date: _____

If so, when and how frequently? Type?

_____

_____

13. ODOR SUMMARY

Have the occupants observed any unusual odors? _____

_____

_____

_____

_____

History of odor observation – date of onset, duration, severity, etc.

_____

_____

_____

_____

_____

_____

_____

14. PRODUCT INVENTORY

Record the specific products found in building that have the potential to affect indoor air quality on the attached product inventory form.

15. INDOOR SKETCH

Draw a plan view sketch (on grid paper) of the basement, first floor, and any other floor where sampling was conducted in the building as well as any outdoor sample locations. Indicate air sampling locations, possible indoor air pollution sources and PID meter readings. If the building does not have a basement, please note.

Property Location/Address: _____
Property: _____
Sampling Date: _____

Product Inventory
Off-Site Property Sampling Documentation
Soil Vapor Intrusion Investigation

Property Address:	**Performed by:**
Date of Inventory:	**Field Instrument Make & Model:**

Location	**Product Description**	**Size (units)**	**Condition ***	**Chemical Ingredients**	**Field Instrument Reading (units)**	**Photo ** Y/N**

Notes

* Describe the condition of the product containers as Unopened (UO), Used (U), or Deteriorated (D)

** Photographs of the front and back of product containers can replace the handwritten list of chemical ingredients. However, the photographs must be of good quality and ingredient labels must be legible.

STANDARD OPERATING PROCEDURE

SG-002 Soil Vapor Sample Collection

1. Objective

This procedure outlines the general steps to collect soil vapor samples. The site-specific Sampling and Analysis Work Plan should be consulted for proposed sample locations, sample depths, and sampling duration.

2. Execution

Permanent and temporary soil vapor probes should be installed using the procedures outlined below. All soil vapor probes should be installed using a direct-push drill rig (e.g., Geoprobe® or similar), hand auger, or manually using a slide hammer.

2.1. Document Field Conditions

Document pertinent field conditions prior to installation of any probe points.

- Record weather information (precipitation, temperature, barometric pressure, relative humidity, wind speed, and wind direction) at the beginning of the sampling event. Record substantial changes to these conditions that may occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport). Data should be obtained for the past 24 to 48 hours.
- If sampling near a commercial or industrial building, uses of volatile chemicals during normal operations of the facility should be identified.
- Outdoor plot sketches should be drawn that include the site, area streets, neighboring commercial or industrial facilities (with estimated distance to the site), outdoor air sampling locations (if applicable), and compass orientation (North);
- Any pertinent observations should be recorded, such as odors and readings from field instrumentation.

2.2. Soil Vapor Point Installation Specifications

Each soil vapor point should be constructed as follows:

- Six-inch stainless steel Geoprobe® AT86 series Permanent Implants (soil vapor screens) or equivalent and threaded to an (expendable) stainless steel anchor point.
- The implants should be fitted with inert Teflon or stainless steel tubing of laboratory or food grade quality.
- The annular space surrounding the vapor screen interval and a minimum of 6-inches above the top of the screen should be filled with a porous backfill

material (e.g., glass beads or coarse silica sand) to create a sampling zone 1 foot in length.

For temporary points, a hydrated bentonite surface seal should be created at the surface to minimize infiltration. For permanent points, the additional measures described below should be included.

- The soil vapor points should be sealed above the sampling zone with a bentonite slurry for a minimum distance of 3 feet (or to grade, whichever is smaller) to prevent ambient air infiltration.
- If needed, the remainder of the borehole should be backfilled with clean material.
- A protective casing should be set around the top of the point tubing and grouted in place to the top of the bentonite to minimize infiltration of water or ambient air, as well as to prevent accidental damage to the soil vapor point.
- The tubing top should be fitted with a Swagelok® and cap to prevent moisture and foreign material from infiltrating the tubing.

2.3. Soil Vapor Sample Collection

Soil vapor samples should be collected as indicated in the work plan and in accordance with applicable state or federal guidance documents. Specifically, samples from the points should be collected as follows:

- Permanent soil vapor points should not be sampled or purged for a minimum of 24 hours after installation. Temporary points may be purged and sampled immediately following installation.
- Document pertinent field conditions prior to sampling as described above.
- A suction pump should be used to remove a minimum of three implant volumes from the soil vapor points prior to sampling. Include the volume of any additional tubing added to affix sampling equipment and the annular space between the probe and the native material if sand or glass beads were used.
- The purge rate shall not exceed 0.2 liters per minute.
- Samples should be collected for volatile organic compounds (VOCs) in an individually laboratory certified clean 1-liter SUMMA® canister (or equivalent) using a certified flow controller calibrated for the anticipated sample duration (4 minutes). The regulator flow rate should not exceed 0.2 liters per minute.
- A helium tracer gas should be used to identify any potential migration or short circuiting of ambient air during sampling as described below.
- Remove the protective brass plug from the canister. Connect the pre-calibrated flow controller to the canister.
- Record the identification numbers for the canister and flow controller.
- Record the initial canister pressure on the vacuum gauge (check equipment-specific instructions for taking this measurement). A canister with a significantly different pressure than originally recorded by the testing

laboratory should not be used for sampling. Record these numbers and values on the chain-of-custody form for each sample.

- Connect the tubing from the soil vapor probe to the flow controller.
- Open the valve on the canister. Record the time that the valve was opened (beginning of sampling) and the canister pressure on the vacuum gauge.
- Photograph the canister and the area surrounding the canister.
- Monitor the vacuum pressure in the canister routinely during sampling.
- Stop sample collection when the canister still has a minimum amount of vacuum remaining. Check with the laboratory supplying the canister and flow controller for the ideal final vacuum pressure. Typically, the minimum vacuum is between 2 and 5 inches of mercury, but not zero. If there is no vacuum remaining, the sample should be rejected and collected again in a new canister.
- Record the final vacuum pressure and close the canister valve. Record the date and time that sample collection was stopped.
- Remove the flow controller from the canister and replace the protective brass plug.
- Attach labels/tags (sample name, time/date of sampling, etc.) to the canister as directed by the laboratory.
- Place the canister and other laboratory-supplied equipment in the packaging provided by the laboratory.
- Enter the information required for each sample on the chain-of-custody form, making sure to include the identification numbers for the canister and flow controller, and the initial and final canister pressures on the vacuum gauge.
- Samples should be analyzed for VOCs and naphthalene via modified USEPA modified Method TO-15 and helium via ASTM D-1945.
- Include the required copies of the chain-of-custody form in the shipping packaging, as directed by the laboratory. Maintain a copy of the chain-of-custody for the project file.
- Deliver or ship the samples to the laboratory as soon as practical.
- All laboratory analytical data should be validated by a data validation professional in accordance with the USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, January 2005 and the USEPA Region II Standard Operating Procedure (SOP) for the Validation of Organic Data modified to accommodate the USEPA Method TO-15 and natural gas analysis by ASTM D-1945.

2.4. Tracer Gas Evaluation

The tracer gas evaluation provides a means to evaluate the integrity of the soil vapor probe seal and assess the potential for introduction of ambient air into the soil vapor sample.

A tracer gas evaluation should be conducted on the each temporary soil vapor probe to be sampled in a sampling event. A tracer gas evaluation should be conducted on

the each permanent soil vapor probe during the initial sampling event and a minimum of 10% of the soil vapor probes during subsequent sampling events.

The following tracer gas evaluation procedure uses helium as a tracer gases which can be measured through laboratory analysis or by a portable detector.

Retain the tracer gas around the sample probe by filling an air-tight chamber (such as a plastic bucket) positioned over the sample location.

- Make sure the chamber is suitably sealed to the ground surface.
- Introduce the tracer gas into the chamber. The chamber should have tubing at the top of the chamber to introduce the tracer gas into the chamber and a valved fitting at the bottom to let the ambient air out while introducing tracer gas. Close the valve after the chamber has been enriched with tracer gas at concentrations >10%.
- The chamber should have a gas-tight fitting or sealable penetration to allow the soil vapor sample probe tubing to pass through and exit the chamber.
- After the chamber has been filled with tracer gas, attach the sample probe tubing to a pump that should be pre-calibrated to extract soil vapor at a rate of no more than 0.2 liters per minute. Purge the tubing using the pump. Calculate the volume of air in the tubing and probe and purge one to three tubing/probe volumes prior collecting an analytical sample or using a portable device to measuring the tracer gas concentration.
- Samples collected from vapor points during a tracer gas evaluation should be analyzed for VOCs and naphthalene via modified USEPA modified Method TO-15 and helium via ASTM D-1945.
- Alternately, a tracer gas detector may be used to verify the presence of the tracer gas in the chamber by affixing it to the valve fitting at the bottom of the chamber. The tracer gas detector may also be used to measure the tracer gas concentration in the pump exhaust during purging. If used, then record the tracer gas concentrations in the chamber and in the soil vapor sample.
- Based on the concentrations of the tracer gas detected during analysis or direct measurement, determine whether additional gas tracer evaluations are necessary.

If the evaluation on a probe indicates a high concentration of tracer gas in the sample (>10% of the concentration of the tracer gas in the chamber), then the surface seal is not sufficient and requires improvement via repair or replacement prior to commencement subsequent sample collection.

A non-detectable level of tracer gas is preferred, however, if the evaluation on a probe indicates a low potential for introduction of ambient air into the sample (<10% of the concentration of the tracer gas in the chamber), then proceed with the soil

vapor sampling. While lower concentrations of tracer gas are acceptable, the impact of the detectable leak on sample results should be evaluated in the sampling report.

3. References

USEPA modified Method TO-15 and helium via ASTM D-1945

Section 2.7.1 of the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York*, dated October 2006.*

4. Contact

Mike Quinlan

Melissa Felter

STANDARD OPERATING PROCEDURE

SG-003 Sub-slab Soil Vapor Collection

1. Objective

This procedure outlines the general steps to collect sub-slab soil vapor samples. The site-specific Sampling and Analysis Work Plan should be consulted for proposed sample locations, sample depths, and sampling duration.

2. Execution

Permanent and temporary sub-slab soil vapor probes will be installed using the procedures outlined below. All sub-slab soil vapor probes will be installed using a direct-push drill rig (e.g., Geoprobe® or similar), hand auger, or manually using a slide hammer.

2.1. Document Field Conditions

Document pertinent field conditions prior to installation of any probe locations.

- Record weather information (precipitation, temperature, barometric pressure, relative humidity, wind speed, and wind direction) at the beginning of the sampling event. Record substantial changes to these conditions that may occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport). Data should be obtained for the past 24 to 48 hours. Record the indoor conditions (temperature, heating/cooling system active, windows open/closed, etc.).
- Measure the differential pressure at the building. Measure the indoor and outdoor barometric pressure using a high resolution device. Where possible, measure the sub-slab barometric pressure at the sampling point.
- If sampling near a commercial or industrial building, uses of volatile chemicals during normal operations of the facility should be identified.
- Indoor floor plan sketches should be drawn that include the floor layout with sampling locations, chemical storage areas, garages, doorways, stairways, location of basement sumps or subsurface drains and utility perforations through building foundations, heating, ventilating and air conditioning (HVAC) system air supply and return registers, compass orientation (North), footings that create separate foundation sections, and any other pertinent information should be completed;
- Outdoor plot sketches should be drawn that include the building site, area streets, outdoor air sampling locations (if applicable), compass orientation (north), and paved areas.
- Any pertinent observations should be recorded, such as odors and readings from field instrumentation.

2.2. Sub-Slab Soil Vapor Point Installation Specifications

Each sub-slab soil vapor point will be constructed as follows:

- Drill an approximately 3/8-inch hole through the slab. If necessary, advance the drill bit 2-3 inches into the sub-slab material to create an open cavity.
- Using dedicated inert Teflon or stainless steel tubing of laboratory or food grade quality, insert the inlet of the tubing to the specified depth below the slab. For permanent installation, only stainless steel tubing and fittings will be used.
- For permanent point installations, the annular space surrounding the vapor probe tip will be filled with a porous backfill material (e.g., glass beads or coarse silica sand) to cover 1-inch of the above the tip of the probe.
- Seal the annular space between the hole and the tubing using an inert non-shrinking sealant such as melted 100% beeswax, permagum grout, putty, etc. For permanent installations, cement may be used.
- For permanent points, a protective casing will be set around the top of the point tubing and grouted in place minimize infiltration of water or ambient air, as well as to prevent accidental damage to he permanent point.
- The tubing top will be fitted with a Swagelok® and cap to prevent moisture and foreign material from infiltrating the tubing.

In cases where sub-slab sampling is impractical or infeasible, a surrogate location (attached garage, concrete patio, asphalt driveway, etc.) may be used if it is representative of sub-slab conditions. In surrogate locations, the vapor sampling point may be installed in accordance with SOP SG-002 Soil Vapor Collection.

2.3. Sub-Slab Soil Vapor Sample Collection

Sub-slab soil vapor samples will be collected as indicated in the site-specific Sampling and Analysis Work Plan and in accordance with state or Federal guidance documents. Specifically, sub-slab samples from the points will be collected as follows:

- Document pertinent field conditions prior to sampling as described above.
- A suction pump will be used to remove one to three implant volumes from the sub-slab soil vapor points prior to sampling. Include the volume of any additional tubing added to affix sampling equipment and the annular space between the probe and the native material if sand or glass beads were used.
- The purge rate shall not exceed 0.2 liters per minute.
- Samples will be collected in an individually laboratory certified clean 1-liter SUMMA® canister (or equivalent) using a certified flow controller calibrated for the anticipated sample duration (4 minutes). The regulator flow rate will not exceed 0.2 liters per minute.
- A helium tracer gas will be used to identify any potential migration or short circuiting of ambient air during sampling as described below.

- Remove the protective brass plug from the canister. Connect the pre-calibrated flow controller to the canister.
- Record the identification numbers for the canister and flow controller.
- Record the initial canister pressure on the vacuum gauge (check equipment-specific instructions for taking this measurement). A canister with a significantly different pressure than originally recorded by the testing laboratory should not be used for sampling. Record these numbers and values on the chain-of-custody form for each sample.
- Connect the tubing from the sub-slab soil vapor probe to the flow controller.
- Open the valve on the canister. Record the time that the valve was opened (beginning of sampling) and the canister pressure on the vacuum gauge.
- Photograph the canister and the area surrounding the canister.
- Monitor the vacuum pressure in the canister routinely during sampling.
- Stop sample collection when the canister still has a minimum amount of vacuum remaining. Check with the laboratory supplying the canister and flow controller for the ideal final vacuum pressure. Typically, the minimum vacuum is between 2 and 5 inches of mercury, but not zero. If there is no vacuum remaining, the sample will be rejected and collected again in a new canister.
- Record the final vacuum pressure and close the canister valve. Record the date and time that sample collection was stopped.
- Remove the flow controller from the canister and replace the protective brass plug.
- Attach labels/tags (sample name, time/date of sampling, etc.) to the canister as directed by the laboratory.
- Place the canister and other laboratory-supplied equipment in the packaging provided by the laboratory.
- Enter the information required for each sample on the chain-of-custody form, making sure to include the identification numbers for the canister and flow controller, and the initial and final canister pressures on the vacuum gauge.
- Samples will be analyzed for volatile organic compounds (VOCs) and naphthalene via modified USEPA modified Method TO-15 and helium via ASTM D-1945
- Include the required copies of the chain-of-custody form in the shipping packaging, as directed by the laboratory. Maintain a copy of the chain-of-custody for the project file.
- Deliver or ship the samples to the laboratory as soon as practical.
- All laboratory analytical data will be validated by a data validation professional in accordance with the USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, January 2005 and the USEPA Region II Standard Operating Procedure (SOP) for the Validation of Organic Data modified to accommodate the USEPA Method TO-15 and natural gas analysis by ASTM D-1945.

2.4. Tracer Gas Evaluation

The tracer gas evaluation provides a means to evaluate the integrity of the sub-slab soil vapor probe seal and assess the potential for introduction of indoor air into the sub-slab soil vapor sample. A tracer gas evaluation should be conducted on the each temporary sub-slab soil vapor probe to be sampled in a sampling event. A tracer gas evaluation should be conducted on the each permanent sub-slab soil vapor probe during the initial sampling event and a minimum of 10% of the sub-slab soil vapor probes during subsequent sampling events.

The following tracer gas evaluation procedure uses helium as a tracer gases which can be measured through laboratory analysis or by a portable detector.

- Retain the tracer gas around the sub-slab sample probe by filling an air-tight chamber (such as a plastic bucket) positioned over the sample location.
- Make sure the chamber is suitably sealed to the ground surface.
- Introduce the tracer gas into the chamber. The chamber will have tubing at the top of the chamber to introduce the tracer gas into the chamber and a valved fitting at the bottom to let the ambient air out while introducing tracer gas. Close the valve after the chamber has been enriched with tracer gas at concentrations >10%.
- The chamber will have a gas-tight fitting or sealable penetration to allow the sub-slab soil vapor sample probe tubing to pass through and exit the chamber.
- After the chamber has been filled with tracer gas, attach the sample probe tubing to a pump that will be pre-calibrated to extract sub-slab soil vapor at a rate of no more than 0.2 lpm. Purge the tubing using the pump. Calculate the volume of air in the tubing and purge one to three tubing volumes prior collecting an analytical sample or using a portable device to measuring the tracer gas concentration.
- Samples collected from vapor points during a tracer gas evaluation will be analyzed for VOCs and naphthalene via modified USEPA modified Method TO-15 and helium via ASTM D-1945.
- Alternately, a tracer gas detector may be used to verify the presence of the tracer gas in the chamber by affixing it to the valve fitting at the bottom of the chamber. The tracer gas detector may also be used to measure the tracer gas concentration in the pump exhaust during purging. If used, then record the tracer gas concentrations in the chamber and in the soil vapor sample.
- Based on the concentrations of the tracer gas detected during analysis or direct measurement, determine whether additional gas tracer evaluations are necessary:

If the evaluation on a probe indicates a high concentration of tracer gas in the sample (>10% of the concentration of the tracer gas in the chamber), then the

surface seal is not sufficient and requires improvement via repair or replacement prior to commencement subsequent sample collection.

A non-detectable level of tracer gas is preferred; however, if the evaluation on a probe indicates a low potential for introduction of ambient air into the sample (<10% of the concentration of the tracer gas in the chamber), then proceed with the soil vapor sampling. While lower concentrations of tracer gas are acceptable, the impact of the detectable leak on sample results should be evaluated in the sampling report.

3. References

USEPA modified Method TO-15 and helium via ASTM D-1945.

Section 2.7.1 of the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York, dated October 2006.

4. Contact

Mike Quinlan
Melissa Felter

STANDARD OPERATING PROCEDURE

SG-004 Ambient Air Sample Collection

1. Objective

Describe procedures to collect ambient air samples. The site-specific Work Plan should be consulted for proposed sample locations and sampling duration.

2. Execution

2.1. Document Field Conditions

Document pertinent field conditions prior to sample collection:

- Record weather information, if available (such as precipitation, temperature, barometric pressure, relative humidity, wind speed, and wind direction) at the beginning of the sampling event. Record substantial changes to these conditions that may occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport). Data should be obtained for at least the past 12 hours.
- If sampling near a commercial or industrial building, uses of volatile chemicals during normal operations of the facility should be identified.
- Outdoor plot sketches should be drawn that include the site, area streets, neighboring commercial or industrial facilities (with estimated distance to the site), outdoor air sampling locations (if applicable), and compass orientation (North).
- Any pertinent observations should be recorded, such as odors and readings from field instrumentation.

2.2. Sample Collection

- Samples should be collected in laboratory-certified clean SUMMA® canister (or equivalent) using a flow controller calibrated for the anticipated sample duration (1-hour, 8-hour, etc.). The regulator flow rate should not exceed 0.2 liters per minute.
- Place the canister at the sampling location. If the sample is collected from breathing height (e.g., 3 to 5 feet above ground), then mount the canister on a stable platform such that the sample inlet should be at the proper height.
- Remove the protective brass plug from canister. Connect the pre-calibrated flow controller to the canister.
- Record the identification numbers for the canister and flow controller.
- Record the initial canister pressure on the vacuum gauge (check equipment-specific instructions for taking this measurement). A canister with a significantly different pressure than originally recorded by the testing laboratory should not be used for sampling. Record these numbers and values on the chain-of custody form for each sample.

- Connect the tubing to the flow controller.
- Open the valve on the canister. Record the time that the valve was opened (beginning of sampling) and the canister pressure on the vacuum gauge.
- Photograph the canister and the area surrounding the canister.
- If possible, monitor the vacuum pressure in the canister routinely during sampling. During monitoring, note the vacuum pressure on the gauge.
- Stop sample collection after the scheduled duration of sample collection but make sure that the canister still has a minimum amount of vacuum remaining. Check with the laboratory supplying the canister and flow controller for the ideal final vacuum pressure. Typically, the minimum vacuum is between 2 and 5 inches of mercury, but not zero. If there is no vacuum remaining, call the laboratory and discuss the sample viability with them. Determine whether another sample will be taken after sharing the laboratory's opinion with your project manager.
- Record the final vacuum pressure and close the canister valves. Record the date and time that sample collection was stopped.
- Remove the flow controller from the canister and replace the protective brass plug.
- Attach labels/tags (sample name, time/date of sampling, etc.) to the canister as directed by the laboratory.
- Place the canister and other laboratory-supplied equipment in the packaging provided by the laboratory.
- Enter the information required for each sample on the chain-of-custody form, making sure to include the identification numbers for the canister and flow controller, and the initial and final canister pressures on the vacuum gauge.
- Include the required copies of the chain-of-custody form in the shipping packaging, as directed by the laboratory. Maintain a copy of the chain-of-custody for the project file.
- Deliver or ship the samples to the laboratory as soon as practical.

3. References

USEPA modified Method TO-15 and helium via ASTM D-1945

Section 2.7.1 of the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York*, dated October 2006.*

4. Contacts

Mike Quinlan
Melissa Felter

Section 10

Quality Control – Quality Assurance (QA)

STANDARD OPERATING PROCEDURE

QA-001 Equipment Decontamination

1. Objective

This SOP describes methods used to decontaminate reusable sampling equipment for projects that require collection of organic and inorganic analytical samples. The goal is to minimize cross-contamination between samples. This maximizes confidence that field samples will be representative of specific locations and conditions.

Refer to the work plan or project manager to determine if different decontamination methods are acceptable.

2. Execution

- All contractor-provided equipment (augers, rods, spoons, backhoe buckets) should be decontaminated by steam cleaning or pressure washing prior to coming on site. If there is doubt about cleanliness of drilling tools, they should be decontaminated before use at the site.
- Sampling equipment decontamination is a sequential procedure consisting of the following steps:

    - Alconox-solution wash (or equivalent non-phosphate detergent)
    - Potable water rinse
    - A ten percent reagent grade nitric acid wash should be used to strip potential inorganic contaminants from sampling devices.
    - Laboratory grade 100 percent methanol, should be used to strip potential organic contaminants from sampling devices.
    - Three distilled/deionized water rinses.

- Alconox solution is a mixture of approximately 1 cup of Alconox per 1 gallon of potable water. Alconox solution wash requires scrubbing the equipment with a brush soaked in Alconox solution to remove visible contamination or dirt from sampling devices.
- Split-spoon samplers must be decontaminated prior to collecting each sample. The procedure follows:

    - Overall wash and scrub in a bucket of Alconox solution
    - Potable water rinse.
    - 10% nitric rinse
    - 100% laboratory grade methanol rinse
    - Three distilled-water rinses.

The same procedure is applied to all devices that may contact soil or groundwater slated for analytical samples - spoons and knifes used to inspect or sample soils; water level indicators; oil/water interface probes.

Equipment used for well development of multiple wells must be decontaminated between wells.

Pumps and tubing should be flushed using a minimum of one gallon of Alconox-solution followed by a gallon of potable water. Some projects may require methanol (in much lower quantities) and distilled water instead of or in addition to the Alconox-solution and potable water.

For pumps and tubing, a final rinse of the sampling equipment may be performed with the water being sampled.

Equipment blanks measure the effectiveness of the decontamination procedures. Blanks should be collected per guidance provided in QA-002, Field Quality Control Samples.

3. Limitations

- Do not store the deionized/distilled water in polyethylene bottles, use Nalgene, glass, or Teflon. Polyethylene may leach phthalates.
- Do not attempt to decontaminate string or rope - replace it.
- Due to eye and skin absorption hazards, safety glasses and gloves must be worn when handling decontamination solvents.
- Decontamination procedures may also require modification based on state or federal requirements.
- Steam cleaning or pressure washing with potable water is generally an acceptable decontamination method for drilling equipment (i.e., augers). Check with the work plan.
- Dedicated equipment need not be decontaminated beyond initial decontamination prior to field use.

4. References

Environmental Response Team (ERT), US EPA. Sampling Equipment Decontamination, SOP No. 2006, Revision 0.0. August 11, 1994.

US EPA Region 9. Sampling Equipment Decontamination, SOP No. 1230, Revision 1.September 1999.

5. Contacts

Mackenzie Fannon
Pat King

STANDARD OPERATING PROCEDURE

QA-002 Field Quality Control Samples

1. Objective

Field Quality Control (QC) samples are used to monitor the reproducibility and representativeness of field sampling. The QC samples are handled, transported, and analyzed in the same manner as the associated field samples. QC samples may include trip blanks, equipment blanks, and field duplicates.

2. Execution

2.1. Trip blanks

- Used to monitor possible sources of contamination from transport, storage, inadequate bottle cleaning, or laboratory methodologies.
- Sample containers filled at the laboratory with analyte-free water are transported to and from the site, and are not opened until time of analysis.
- Trip blanks are stored with the sample containers prior to and after field activities and remain with the collected samples until analyzed.
- Generally, one trip blank per volatiles analysis (e.g. volatile organic compounds) shipment.
- Consider submitting a trip blank when sample shipment is by Fed Ex or other large carrier, or laboratory courier.
- Trip blanks should be recorded in the field notebook and on the chain-of-custody that same as all other samples.

2.2. Equipment blanks

- Equipment blanks (also known as equipment rinsate blanks) are used to monitor possible sources of contamination associated with sample collection. Monitors on-site sampling environment, sampling equipment decontamination, sample container cleaning, the suitability of sample preservatives and analyte-free water, and sample transport and storage conditions
- Equipment blanks are collected by pouring laboratory supplied or distilled or deionized water over sampling tools that have been decontaminated per the work plan, into sample containers.
- Equipment blanks are stored with the associated field samples until submitted for analysis.
- Generally collected when site conditions indicate site related contamination is a concern. Check project-specific work plan and/or quality assurance project plan for required frequency.
- Prepare equipment blanks immediately after the equipment is cleaned in the field and before leaving the sampling site.
- Prepare equipment blanks by rinsing the decontaminated sampling equipment set with the appropriate type of analyte-free water and collecting the rinse water in appropriate sample containers.

- If a potable water rinse is the typical final step, collect the equipment blank with analyte-free water after the potable water rinse.
- Equipment blanks should be recorded in the field notebook and on the chain-of-custody that same as all other samples.

2.3. Field Duplicates

- Used to evaluate the precision and representativeness of the sampling procedures.
- Field duplicates are two samples collected from the same location using the same procedures. Both samples are submitted to the laboratory as individual samples with different sample identification.
- Field duplicates from groundwater sampling for all analyses except volatiles analysis are collected by alternating filling sample containers from the same sampling device. Field duplicates for volatiles analysis are filled sequentially.
- Soil or sediment field duplicates are collected by homogenizing the sample for all analyses except volatiles. The homogenized sample is then divided into two equal portions and placed in separate sample containers. Field duplicates for volatile analysis are collected at two adjacent sampling locations.
- Each sample is assigned different sample identifications.
- Field duplicates are generally collected at frequency of 1/20 samples. Check project-specific work plan and/or quality assurance project plan for required frequency.
- All field QC samples should be labeled in the field and submitted “blind” to the laboratory – as if they are separate, primary samples.
- Field duplicates should be recorded in the field notebook and on the chain-of-custody that same as all other samples.
-

2.4. Matrix-Spike samples (MS/MSD)

- Matrix spike and matrix spike duplicate samples (MS/MSDs) are environmental samples that are spiked in the laboratory or in the field with a known concentration of a target analyte(s) to verify percent recoveries.
- Matrix spike and matrix spike duplicate samples are primarily used to check sample matrix interferences. They can also be used to monitor error due to laboratory bias and poor precision. However, a data set of at least three or more results is necessary to statistically distinguish between laboratory performance and matrix interference.
- Generally, the laboratory is required to extract and analyze MS or MS / MSDs at a minimum frequency of 5% of samples being analyzed for the target analyte(s). If the project or client criteria require an MS or MS/MSD, collect sufficient volume in the appropriate containers, and designate the sample to be used as the MS or MS/MSD on the chain of custody.
- Calculate the percent recovery for all spiked analytes for both the MS and MSD. For MS/MSDs also calculate the relative percent difference (RPD). The

RPD for each spiked analyte is calculated using the amount detected not percent recovery. If your data will be subjected to validation, the % recovery and the RPD will generally be determined by the validator.

2.5. Typical QA/QC Frequency

- QA/QC frequency is determined by project, client or regulatory criteria and should be verified prior to sample collection. Generally, QA/QC samples are collected according to the frequency described below:

Duplicate Samples	One per sampling event, one per 10 samples collected, or one every two weeks, whichever comes first.
Equipment Blanks	For each equipment type that is not dedicated or disposable - one per sampling event, one per 20 samples collected, or one every two weeks, whichever comes first.
Trip Blanks	One per sample delivery group, or in each cooler containing VOC soil or aqueous samples, depending on project.
MS or MS / MSDs	One MS or MS/MSD per sampling event, one per 20 samples collected, or one every two weeks, whichever comes first.

3. Limitations

- Trip blanks must never be opened in the field.
- Trip blanks are usually for VOCs only because less volatile compounds are not likely to cross-contaminate other samples by simply being in close proximity.
- Laboratory-grade water must be used during the collection of equipment blanks.
- Field duplicates must have different sample identifications.

4. References

Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (November 1986), U.S. Environmental Protection Agency Department of Solid Waste, Washington, D.C.

U.S. Environmental Protection Agency Office of Emergency and Remedial Response, 1990, Quality assurance/quality control guidance for removal activities: EPA/540/G-90/004, Sampling QA/QC Plan and Data Validation Procedures Interim Final, April, 1990.

5. Contact

Pat King

APPENDIX J - SITE MANAGEMENT FORMS

SITE INSPECTION FORM
Williamsburg Works Site

SITE INSPECTION DATE: _____ **TIME OF ARRIVAL:** _____

DEPARTURE: _____

National Grid SIR Representative(s): _____

INSPECTION TYPE: **Annual Inspection or Emergency Inspection**

(if emergency, indicate event that required an inspection): _____

Are the Institutional Controls in place, performing properly, and remain effective?

Site Signage in Place? Yes / No

Hazard Communication Documents Present? Yes / No

Has ownership of the property changed since the last inspection? Yes / No

SITE INSPECTION FORM
Williamsburg Works Site

Are the Engineering Controls in place, performing properly, and remaining effective?

Surface Cover Intact (ie no evidence of erosion, excavations)? Yes / No

GENERAL SITE OBSERVATIONS:

Have there been any changes to the property since the last inspection? Yes / No

(i.e. new equipment or facilities, changes in site topography, erosion, etc.)

COMPLETED BY:	**REVIEWED BY:**
SIGNATURE:	**SIGNATURE:**

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Request to Import/Reuse Fill or Soil

This form is based on the information required by DER-10, Section 5.4(e). Use of this form is not a substitute for reading the applicable Technical Guidance document.

SECTION 1 – SITE BACKGROUND

The allowable site use is: Choose an item

Have Ecological Resources been identified? Choose an item

Is this soil originating from the site? Choose an item

How many cubic yards of soil will be imported/reused? Choose an item

If greater than 1000 cubic yards will be imported, enter volume to be imported:

SECTION 2 – MATERIAL OTHER THAN SOIL

Is the material to be imported gravel, rock or stone? Choose an item

Does it contain less than 10%, by weight, material that would pass a size 80 sieve? Choose an item

Is this virgin material from a permitted mine or quarry? Choose an item

Is this material recycled concrete or brick from a DEC registered processing facility? Choose an item

SECTION 3 - SAMPLING

Provide a brief description of the number and type of samples collected in the space below:

Example Text: 5 discrete samples were collected and analyzed for VOCs. 2 composite samples were collected and analyzed for SVOCs, Inorganics & PCBs/Pesticides.

If the material meets requirements of DER-10 section 5.5 (other material), no chemical testing needed.

SECTION 3 CONT'D - SAMPLING

Provide a brief written summary of the sampling results or attach evaluation tables (compare to DER-10, Appendix 5):

Example Text: Arsenic was detected up to 17 ppm in 1 (of 5) samples; the allowable level is 16 ppm.

If Ecological Resources have been identified use the "If Ecological Resources are Present" column in Appendix 5.

SECTION 4 – SOURCE OF FILL

Name of person providing fill and relationship to the source:

Location where fill was obtained:

Identification of any state or local approvals as a fill source:

If no approvals are available, provide a brief history of the use of the property that is the fill source:

Provide a list of supporting documentation included with this request:

The information provided on this form is accurate and complete.

_____ _____

Signature Date

_____

Print Name

_____

Firm

Revised August 2014

APPENDIX K – NAPL RECOVERY PLAN

AECOM Imagine it. Delivered.

NAPL MONITORING AND RECOVERY PLAN

50 Kent Avenue Property Holder Area, Brooklyn, Kings County, New York

October 2 , 2020

Quality information

Prepared by	Checked by	Verified by	Approved by
Melissa Saunders Project Manager/Environmental Scientist	Shail Pandya Associate Vice President		

Revision History

Revision	Revision date	Details	Authorized	Name	Position
DRAFT	October 2, 2020	Draft for Review		Melissa Saunders	Project Manager

Distribution List

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Appendix

Appendix A – Well Construction Logs

Appendix B – NAPL Recovery Checklist

Appendix C – Recovery Well Field Form

Appendix D – Health & Safety Plan

Appendix E – Standard Operating Procedures for NAPL Recovery

Acronym List

bgs	below ground surface
CCR	Construction Completion Report
CFR	Code of Federal Regulations
DSNY	New York City Department of Sanitation
EPA	Environmental Protection Agency
ft	feet
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
IRM	Interim Remedial Measure
MGP	Manufactured Gas Plant
NAPL	Non-Aqueous Phase Liquid
OSHA	Occupational Safety and Health Administration
NYC Parks	New York City Department of Parks & Recreation
NYSDEC	New York State Department of Environmental Conservation
PCB	Polychlorinated Biphenyl
PID	Photoionization Detector
PPE	Personal Protection Equipment
PVC	Polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
VOC	Volatile Organic Compound

1. Introduction

On behalf of National Grid, AECOM USA, Inc. (AECOM) has prepared this Non-Aqueous Phase Liquid (NAPL) Monitoring and Recovery Plan to describe NAPL monitoring and recovery activities implemented as part of the NAPL Recovery Well Interim Remedial Measure (IRM) for the 50 Kent Avenue Property Holder Area located in Brooklyn, New York as shown in **Figure 1-1**.

Routine NAPL monitoring and recovery is completed at the Site to assess NAPL levels and to ensure those levels are maintained below the top of sump of recovery wells. This NAPL Monitoring and Recovery Plan presents the following information:

- Overview of the NAPL recovery well network
- Field activities associated with monitoring of NAPL and the collection and disposal of recovered NAPL
- Data review and reporting requirements
- Periodic well maintenance considerations.

This plan shall be updated annually to address changes associated with the NAPL monitoring and recovery program (i.e. project contacts, recovery frequency, monitoring requirements).

1.1 Background

As per the approved IRM Design and Implementation Plan, 13 NAPL recovery wells were installed for the NAPL Recovery IRM in 2014 and an IRM NAPL Recovery Wells Construction Completion Report (CCR) was submitted to New York State Department of Environmental Conservation (NYSDEC) in 2015. NAPL collection began at these wells in September 2014. A soil excavation/solidification IRM was conducted from November 2015 through June 2017 and a CCR for that work was prepared and submitted to NYSDEC in 2018.

1.2 Well Maintenance, Monitoring, and Collection Completed to Date

In 2016, with NYSDEC's permission, three recovery wells (NRW-01, NRW-02, and NRW-03) located within the Site boundary along with two recovery wells (NRW-09 and NRW-11) damaged during the soil excavation/solidification IRM implementation were abandoned. The latter two wells were replaced with recovery wells NRW-09R and NRW-11R at locations selected in consultation with the NYSDEC in 2017.

Throughout and upon completion of the soil excavation/solidification IRM, NAPL collection continued from existing recovery wells at the Site. NAPL was removed by pump from the recovery wells two to three times a week to maintain the level of cumulated NAPL below the top of the well sumps. During the soil excavation/solidification IRM, sump depths were reduced at some of the recovery wells due to sedimentation and gravel falling into the well or due to damage to well casings. Based on the depth to bottom measurements collected prior to and after completion

of the soil excavation/solidification IRM, it was clear that sump capacities in recovery wells NRW-01, NRW-02, NRW-07, NRW-08, NRW-09R, NRW-11R and NRW-13 were compromised.

In 2019, sump capacities of five of the seven compromised wells were successfully restored using air lift and surge and purge methods. Attempts of obstruction removal was not successful at two NAPL recovery wells (NRW-01 and NRW-08), which resulted in decommissioning of these wells and replacing them with NRW-01R and NRW-08R, as approved by NYSDEC. For further detail regarding the 2019 recovery well rehabilitation and reinstallation effort, refer to the AECOM document titled *2019 NAPL Recovery Well Rehabilitation and Reinstallation Report,* dated September 2019 (AECOM, 2019).

1.3 Recovery Well Network and Recovery Program

Currently, a total of 10 NAPL recovery wells comprise the Site well network, namely: NRW-01R, NRW-02, NRW-06, NRW-07, NRW-08R, NRW-09R, NRW-10, NRW-11R, NRW-12 and NRW-13. Eight NAPL recovery wells are located along North 12th Street, and two NAPL recovery wells are located along North 11th St (North 11th Street and North 12th Street are hereinafter referred to as “the Site”) as shown in **Figure 1-2** attached. NAPL monitoring and recovery events are currently undertaken once a week at the Site and include the following activities:

- Measurement of depth of recovery wells
- Measurement of NAPL thickness in each recovery well
- Recovery of NAPL from wells as required
- Evaluation of NAPL collected in each well sump
- Containerization and off-Site disposal of recovered NAPL.

Whilst it is noted that NAPL recovery events are currently undertaken once a week, NAPL recovery data may indicate that the frequency of NAPL recovery events may be reduced. This will be assessed through ongoing data review as discussed in **Section 3.1**.

Further detail regarding field activities associated with NAPL recovery is provided in the following sections.

1.4 Recovery Well Construction

Each well is six inches in diameter and screen intervals were generally determined based on depths where NAPL contamination was observed during the well drilling process. The bottom of the screen was located at the top of a clay layer at approximately 50 to 60 feet below grade surface (ft bgs). A five-foot long sump was installed into the clay layer, beneath the lowest screened zone, for collection of NAPL. The well construction logs are included in **Appendix A**.

Table 1-1 presents a summary of the depths of each well and the screen intervals.

Table 1-1

NAPL Recovery Well Summary

Recovery Well	Well Depth (ft)	Stainless Steel Screen Intervals bgs (ft)	PVC Screen Intervals bgs (ft)	Stainless Steel Sump Depth bgs (ft)
NRW-01R	58.5	8.5-28.5, 38.5-53.5	---	53.5-58.5
NRW-02	65	20-30, 35-60	---	60-65
NRW-06	67	12-27, 52-62	---	62-67
NRW-07	63	13-18, 38-58	---	58-63
NRW-08R	60.5	10.5-25.5, 35.5-55.5	---	55.5-60.5
NRW-09R	58	10-20, 30-55	---	55-60
NRW-10	55	15-50	---	50-55
NRW-11R	57	---	28-58	58-63
NRW-12	60	20-55	---	55-60
NRW-13	60	---	20-55	55-60

Each well is constructed with a 6-inch diameter by 5-foot long stainless-steel sump; 6-inch diameter, schedule 40 PVC, 0.020-slot continuous wire-wrap screen and/or a 6-inch diameter, stainless-steel, 0.020-slot continuous wire-wrap screen or combination thereof; and a 6-inch diameter, schedule 40 PVC solid riser to grade. Well sumps and screens have been constructed using stainless steel to improve durability and mitigate well degradation caused by NAPL.

2. Field Activities

This section describes the activities that shall be performed during each NAPL monitoring and recovery event. To assist in compliance with health and safety requirements as well as the performance of the tasks below, a checklist is provided in **Appendix B**. The Recovery Well Field Form provided in **Appendix C** is to be completed for each event.

2.1 Health and Safety

The work to be performed under this plan will occur in an area of soil and groundwater contamination as well as the area impacted with NAPL. All work shall be performed in accordance with the latest revision of the Health and Safety Plan (HASP). The current HASP is provided in **Appendix D**.

2.2 Site Access

North 12th Street is secured by locking entrance gate with chains and padlocks. If the gate is not secured with an AECOM- or National Grid-supplied lock, field personnel will coordinate with the New York City Department of Parks and Recreations (NYC Parks) to obtain the keys necessary to gain access to North 12th Street. Keys shall be returned to the person and place where the keys were obtained. Copies of the keys will be requested and made by the field personnel.

NYC Parks contact for the Site and keys:

Mary Salig
North Brooklyn Park Director NYC Parks
Bushwick Inlet Park
86 Kent Avenue
Brooklyn, NY 11211
Office (718) 218-6130
Cell (646) 739-3181

2.3 Site Mobilization

Currently, there is no storage allowed at the Site after field work. Therefore, an off-Site storage facility has been rented for storage of equipment. Prior to work, drums shall be purchased from a local dealer and the equipment shall be retrieved from the storage unit and transported to the Site. Gasoline may not be stored in the storage space, so gasoline for the generator, if the Waterra Hydrolift collection technique is used, must be purchased locally prior to commencement of field work. Purchase only enough gasoline to perform one day's worth of work (approximately 0.5 gallons).

2.4 Well Gauging

The recovery wells are currently gauged for NAPL during scheduled recovery events once a week. For each well, the presence of NAPL is measured using NAPL detection equipment or weighted string. Depth to bottom measurements are also collected for all recovery wells to assess well depth and sump capacity.

The frequency of gauging will be determined based on the accumulation rate of NAPL. **Section 3.1** describes the ongoing data review process that is implemented to inform decision making regarding the frequency of NAPL gauging.

2.5 NAPL Recovery

NAPL recovery events are currently undertaken once a week in conjunction with well gauging. This frequency is designed to prevent overflow of sumps, using accumulation rates based on data collected during recent gauging events.

NAPL collection is performed immediately following gauging activities, unless 1) no NAPL is observed during gauging or 2) the measured NAPL level in the well plus the anticipated accumulation, based on recently collected data, will be less than the height of the sump by the next recovery event.

Approximate volume of NAPL expected is calculated based on the gauging data prior to NAPL removal. NAPL is recovered via pumping using a peristaltic pump or an inertial hydrolift pump (i.e., a Waterra Pump), with the extracted NAPL directed into a drum. Extraction continues until relatively NAPL-free liquid is recovered.

2.6 Storage and Disposal

NAPL shall be collected directly into drums or consolidated into drums that shall be disposed of off-Site daily, unless permission is obtained for on-Site storage. National Grid's current contractor for disposal arrangements is as follows:

George Paolillo
Veolia North America
3001 Burns Avenue, Wantagh NY 11793
1 Eden Lane, Flanders NJ 07836
Office 516-221-8300
Cell 201-874-5390

Schedule for daily pick-up must be made four (4) days or more in advance. Pick-up shall also be confirmed by field personnel the day before the NAPL collection event. Drums with NAPL are not be left unattended at the Site prior to pick-up unless the field personnel have to use the restrooms located in the Parks Building, two blocks south of the Site. The drums shall be properly labeled and secured and the Site gates locked prior to taking the restroom break.

2.7 Standard Operating Procedures for NAPL Recovery

Standard Operating Procedures for NAPL recovery are provided in **Appendix E**.

2.8 Waste Characterization

An initial gauging event took place prior to NAPL recovery activities as well as the collection of an initial sample for disposal characterization on September 12, 2014.

AECOM gauged the amount of NAPL present in each well, and collected a composite sample from two wells that had the greatest amounts of NAPL present, and submitted this for analysis for the following parameters:

- Flash Point
- pH
- Resource Conservation and Recovery act (RCRA) (8 metals)
- Volatiles and semi-volatiles
- Polychlorinated biphenyls (PCBs)

The results of this analysis determined that the NAPL is characterized as hazardous waste based on its ignitability (Flash Point) and toxicity. Unless future analyses change this designation, the NAPL drums shall be labeled as hazardous. PPE and other plastic waste derived from the gauging and recovery activities are not hazardous and shall be clearly labeled as non-hazardous waste.

3. Data Review and Reporting

3.1 Data Review

NAPL monitoring and recovery data is uploaded weekly and maintained in a dedicated project file. Once a month, a data review will be undertaken to assess:

- NAPL thickness in each recovery well and trends (i.e. stable, increasing or decreasing thickness)
- Sump capacity (i.e. stable or decreasing length)
- Well depth (i.e. stable or decreasing depth)
- Well condition (i.e. potential casing damage or blockage)

In addition to the above, NAPL collection rates are to be reviewed to determine if the well screen is damaged or clogged which may prevent the inflow of NAPL.

The outcomes of the monthly data review will be used to inform decision making regarding:

- The frequency of gauging and recovery events (based on the accumulation rate of NAPL)
- The requirements for well maintenance (if any).

A reduction in recovery frequency may be recommended for select recovery wells on a case by case basis should it be demonstrated that NAPL levels:

- Are stable or decreasing; and
- Can be maintained below the top of sump for the designated timeframe.

Section 4.0 provides detail with regard to actions to be taken should the data review identify the need for well maintenance.

3.2 Quarterly NAPL Monitoring and Recovery Report

AECOM will prepare quarterly NAPL Monitoring and Recovery reports that will include the following:

- Presented in cumulative table format:
  - NAPL gauging data
  - Recovered volumes
  - Total well depths.
- Graphs showing:
  - NAPL thickness in each well from commencement of monitoring through to the end of the subject monitoring quarter.
  - Volume of liquid recovered during each event from commencement of monitoring through to the end of the subject monitoring quarter
  - Cumulative volume of liquid recovered since commencement of monitoring.

NAPL Monitoring and Recovery reports will be delivered to NYSDEC in January (for the quarter ending December), April (for the quarter ending March), July (for the quarter ending June) and October (for the quarter ending September).

It is noted that the activities and outcomes of periodic well maintenance (refer **Section 4.0**) will be reported in a comprehensive standalone report which will be submitted to NYSDEC for review.

4. Periodic Recovery Well Maintenance

Periodic recovery well maintenance is required to maintain sufficient well yield to promote NAPL recovery and mitigate NAPL migration. Of note is that well screens can become clogged by NAPL over time which may prevent the inflow of NAPL.

Based on the outcomes of the data review described in **Section 3.1**, it may be considered necessary to undertake well rehabilitation to restore screen functionality and sump capacity. In addition, should it be determined or suspected that recovery wells are compromised and no longer functioning as intended, it may be necessary to undertake well decommissioning and reinstallation activities in order to maintain an adequate well network for NAPL recovery.

Prior to the commencement of well maintenance activities, a Work Plan will be submitted to NYSDEC for review and approval. An overview of well maintenance activities that may be required is provided in the following sections.

4.1 Recovery Well Rehabilitation

Based on well rehabilitation works completed at the Site in 2019 (AECOM, 2019), it is likely that rehabilitation will be accomplished by re-development to remove sediment from the well sumps. However, well rehabilitation may also be required to remove NAPL blockages and restore screen functionality.

Recovery well rehabilitation methods will be assessed on a case by case basis. As discussed in AECOM, 2019, well redevelopment has previously been achieved using a combination of two methods, namely; surge and pump and/or air lifting.

Following well development, wells are to be gauged to provide confirmation that the well has been successfully rehabilitated. It is noted that should redevelopment using surge and pump and/or air lifting not be successful, consideration should be given to the implementation of additional rehabilitation measures or well decommissioning (refer **Section 4.2**).

4.2 Recovery Well Decommissioning

In the event that wells are damaged and need to be decommissioned, wells will be decommissioned in accordance with NYSDEC's CP-43, Groundwater Monitoring Well Decommissioning Policy.

4.3 Recovery Well Installation

In summary, the sequence of work for installation of the NAPL recovery wells will be as follows:

- Removal of hardstand surface at the designated location
- Hand-clearing of well locations to 5ft bgs
- Advancement of soil borings and well installation
- Installation of flush-mount well boxes at each well location
- Development of wells
- Surface restoration.

Recovery wells are to be constructed with:

- 6-inch diameter by 5-foot long stainless-steel sumps;
- 6-inch diameter, 0.020 slot continuous wire-wrap screen (62 square inches open area per foot of screen); and
- 6-inch diameter Schedule 40 PVC solid riser to grade.

After a minimum period of 24-hours post-installation, each well will be developed using a combination of surge and pump and air lift procedures to remove drilling fluids and fine-grained material from the sump, well screen, and filter pack to enhance connectivity with the surrounding aquifer.

5. References

AECOM.2019. NAPL Recovery Well Rehabilitation and Reinstallation Report, dated September 2019.

NYSDEC.2009.CP-43: Groundwater Monitoring Well Decommissioning Policy, dated November 3, 2009.

Figures



Source: Google Earth Pro - © 2012 Google

APPROXIMATE SCALE IN FEET

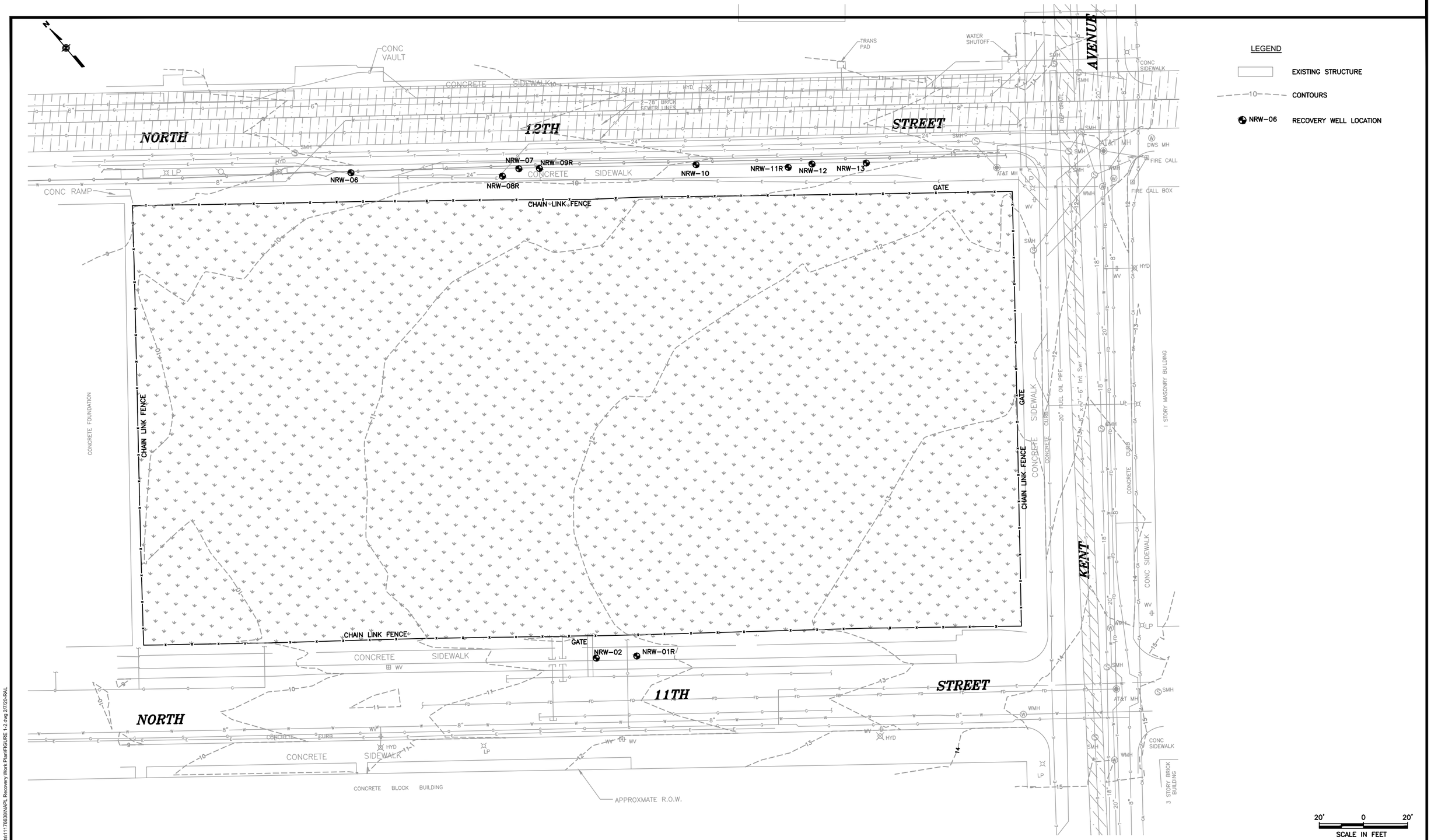
2000 0 2000

AG20745-111176638-071812-GCM

AECOM

50 KENT AVENUE PARCEL OF THE
WILLIAMSBURG WORKS FORMER MGP SITE
BOROUGH OF BROOKLYN, NEW YORK
SITE LOCATION MAP

FIGURE 1-1



LEGEND

- EXISTING STRUCTURE
- 10 CONTOURS
- NRW-06 RECOVERY WELL LOCATION

20' 0 20'
SCALE IN FEET

AECOM

NATIONAL GRID
FORMER WILLIAMSBURG MGP SITE
BROOKLYN, KINGS COUNTY, NEW YORK

NAPL MONITORING AND
RECOVERY PLAN

NAPL RECOVERY WELL LOCATIONS

DATE: FEBRUARY 2020

FIGURE 1-2

\\URSBuffalo.us.ie.urs\Buffalo\Projects\41177683\NAPL Recovery Work Plan\FIGURE 1-2.dwg 2/7/20-RAL

Appendices

Appendix A – Well Construction Logs

AECOM

Boring Log

BORING NO. : NRW-01R

PROJECT:	National Grid Williamsburg	**SHEET:** 1 OF 3	
PROJECT LOCATION:	Midpoint of N 11th St, w of Kent Ave/~20' from NRW-02	**JOB NO. :**	
CLIENT:	National Grid	**TOTAL DEPTH OF BOREHOLE:**	60 ft. bgs
DRILLING CONTRACTOR:	ADT	**GROUND ELEVATION:**	
DRILLING METHOD:	Sonic	**DATE STARTED:**	5/14/2019
DRILL RIG TYPE:	Fraste XL Max	**DATE FINISHED:**	5/21/2019
DRILL BIT SIZE/TYPE:	5" Sonic Core	**DRILLER:**	Tony Palomeque
SAMPLING METHOD(S):	5' Sonic Cores	**GEOLOGIST:**	M Dascoli & R Doshi
		REVIEWED BY:	

DEPTH FEET	STRATA	VISUAL IMPACT	SAMPLE	PID (ppm)	RECOVERY (inches)	USCS	MATERIAL DESCRIPTION	REMARKS	WELL CONSTRUCTION
0					60"	FILL	Sidewalk/ concrete 0'-5' Handcleared 0'-5' FILL - dk brown coarse, angular gravel with fine- coarse sand, few silt at 2' moderate mothball-like odor, dark gray color at 3' water seeping in from the sides. Boulder		FLUSH MOUNT PROTECTIVE CASING AND LOCKABLE CAP
-5				391	32"	MH	5'-7' Dk gray SILT, few fine-med sand & some gravel & brick pieces @ 6.5'- light brown NAPL stringer, 35% saturation	Wet	20 ft of 6" STAINLESS STEEL SCREEN SLOT SIZE: 0.020"
			1	780		SP	7'-10' med brown fine SAND, few silt & gravel @ 9'- med brown NAPL stringer, 40% saturation	Dry	SCH.40 PVC Casing, Stainless Steel Screens, statinless steel sump 6" Inch Diameter
				1123					
-10				284	32"	CL	10'-12' dense, med brown silty CLAY, few gravel 12'-12.5' med dense, med brown fine-med SAND, few silt		BENTONITE (BENSEAL) INSTALLED
			2	485					
				1445		SP	12.5'-14.5' loose, dk brown- black fine SAND with dk brown NAPL of 75-100% saturation, strong mothball-like odors	Wet	
				>15000					
				>15000			14.5'-15' med brown very fine SAND w/ black staining, burnt odor	Dry	
-15				676	36"	GP	15'-20' no odor in soil, drilling water has mothball-like odor 15'-16' dk brown very fine-fine SAND with mica & silt	Wet	
			3	1582		ML	16'-17' loose, dk gray, fine-coarse angular GRAVEL, with some cobbles and some silt 17'-20' very dense, medium brown, SILT with few clay and few fine to medium sand		SAND PACK #0
-20				141	51"	CL	20'-25' no odors in soil, drilling water has mothball-like odor 20'-22.5' medium dense, medium red-brown CLAY	Dry	20 ft of 6" STAINLESS STEEL SCREEN SLOT SIZE: 0.020"
			4	77					
				359			22.5'-23.5' dense, medium brown silty CLAY with few fine-med sand and few fine gravel, trace coarse gravel		
				288					
-25				1406			23.5'-25' dense, same as above with red-brown		

COMMENTS:

BORING NO. : NRW-01R

Boring Log

AECOM

PROJECT:	National Grid Williamsburg
PROJECT LOCATION:	Midpoint of N 11th St, w of Kent Ave/~20' from NRW-02
CLIENT:	National Grid
DRILLING CONTRACTOR:	ADT
DRILLING METHOD:	Sonic
DRILL RIG TYPE:	Fraste XL Max
DRILL BIT SIZE/TYPE:	5" Sonic Core
SAMPLING METHOD(S):	5' Sonic Cores

BORING NO. :	NRW-01R
SHEET:	2 OF 3
JOB NO. :	
TOTAL DEPTH OF BOREHOLE:	60 ft. bgs
GROUND ELEVATION:	
DATE STARTED:	5/14/2019
DATE FINISHED:	5/21/2019
DRILLER:	Tony Palomeque
GEOLOGIST:	M Dascoli & R Doshi
REVIEWED BY:	

DEPTH FEET	STRATA	VISUAL IMPACT	SAMPLE	PID (ppm)	RECOVERY (inches)	USCS	MATERIAL DESCRIPTION	REMARKS	WELL CONSTRUCTION
-25			5	767 1382 >15000 >15000 >15000	60"		and med brown banding at 25'- boulder 25'-26' same as 23.5-25' 26'- 30' very dense, medium gray CLAY with some silt at 27-27.5' lense of dk gray fine SAND with 100% NAPL saturation at 27.5' - 27.75' Iron colored staining, with some fine sand, 50% saturation at 28'-30' with few fine-coarse angular gravel		
-30			6	52.6 680 134 142 177	48"		30'-35' very dense, med gray CLAY with some silt, few fine to medium angular gravel throughout at 31' - cobble at 35' - boulder	Wet	TIME RELEASE BENTONITE PELLETS 10 ft of 6" STAINLESS STEEL SCREEN SLOT SIZE: 0.020"
-35			7		25"	ML	35'-40'- Mothball-like odors throughout interval. No free product. 35'-36.5' CLAY with some silt and little sand 36.5'-40' very dense, gray SILT with few sand, few gravel/ cement-like pieces.	Saturation Level Not Recorded	
-40			8	870 2300 1325 1600	36"	SP ML	40'-41.5' fine SAND with few silt, few gravel and mica, mothball- like odors 41.5'-43.5' brown fine SAND with some silt, mothball-like odors 43.5'-44.5' gray fine SAND with some silt and mica. Trace blebs of brown NAPL visible, strong mothball-like odor. 44.5'-45' light gray SILT with some sand, strong mothball-like odor		
-45			9	>1000 715 695	32"	SP	45'-46' very fine SAND with mica. 90% NAPL saturation, strong mothball-like odor. 46'-48.5' brown very fine SAND with some silt and mica. 35% NAPL saturation. Mothball-like odor. 48.5'-50' fine SAND with mica and trace silt. 20% NAPL saturation.		SAND PACK #0 15 ft of 6" STAINLESS STEEL SCREEN SLOT SIZE: 0.020"
-50									

COMMENTS:

BORING NO. : NRW-01R

Boring Log

AECOM

PROJECT:	**National Grid Williamsburg**	**BORING NO. :**	**NRW-01R**
PROJECT LOCATION:	**Midpoint of N 11th St, w of Kent Ave/~20' from NRW-02**	**SHEET:**	**3 OF 3**
CLIENT:	**National Grid**	**JOB NO. :**	
DRILLING CONTRACTOR:	**ADT**	**TOTAL DEPTH OF BOREHOLE:**	60 ft. bgs
DRILLING METHOD:	**Sonic**	**GROUND ELEVATION:**	
DRILL RIG TYPE:	**Fraste XL Max**	**DATE STARTED:**	5/14/2019
DRILL BIT SIZE/TYPE:	**5" Sonic Core**	**DATE FINISHED:**	5/21/2019
SAMPLING METHOD(S):	**5' Sonic Cores**	**DRILLER:**	Tony Palomeque
		GEOLOGIST:	M Dascoli & R Doshi
		REVIEWED BY:	

DEPTH FEET	STRATA	VISUAL IMPACT	SAMPLE	PID (ppm)	RECOVERY (inches)	USCS	MATERIAL DESCRIPTION	REMARKS	WELL CONSTRUCTION
-50			10	15000 640 690 129 30	40"	ML CL	50'-51' find SAND. 100% black NAPL saturation. 51'-52.5' SAND with few silt. 35% black NAPL saturation. 52.5'-53.5' brown SILT with some clay. Faint petroleum-like and mothball-like odors. 53.5'-55' grayish brown CLAY with some silt. No odors noted.		
-55			11	3.0 2.0	60"	SP	55'-57.5' hard, grayish brown CLAY. No odors noted. 57.5'-59' brown SAND with some silt and clay. No impacts. 59'-60' hard, dark gray CLAY. No impacts.		5 ft of 6" STAINLESS STEEL SOLID PIPE SUMP*Centrali Installed at 56' bgs TIME RELEASE BENTONITE PELLETS
-60				5.0		CL			

COMMENTS:

BORING NO. : NRW-01R

URS Corporation

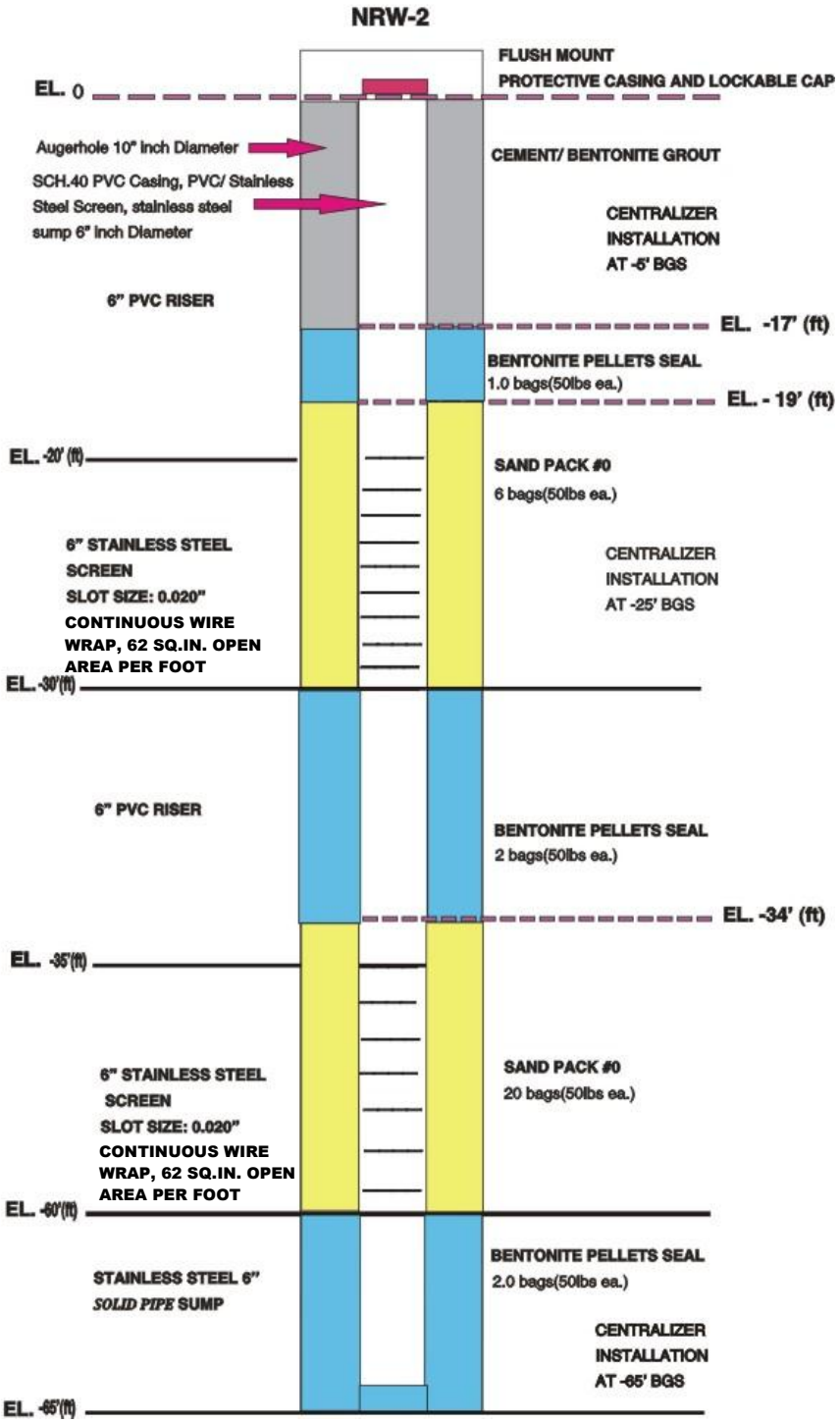
Client: National Grid

Location: 50 Kent Ave.,
Williamsburg, Brooklyn, New York
Project No.11176638.00019

DRILLING SUMMARY

GEOLOGIST: ANDREAS PAPANEOCLEOUS
DRILLING COMPANY: CASCADE
DRILLER: JOHN GRAGLIA
DRILLING RIG TYPE: SONIC
DATE: 03-17-2014

Recovery Well Construction Details



URS

50 KENT AVENUE PROPERTY, BROOKLYN KINGS COUNTY, NEW YORK

URS Corporation

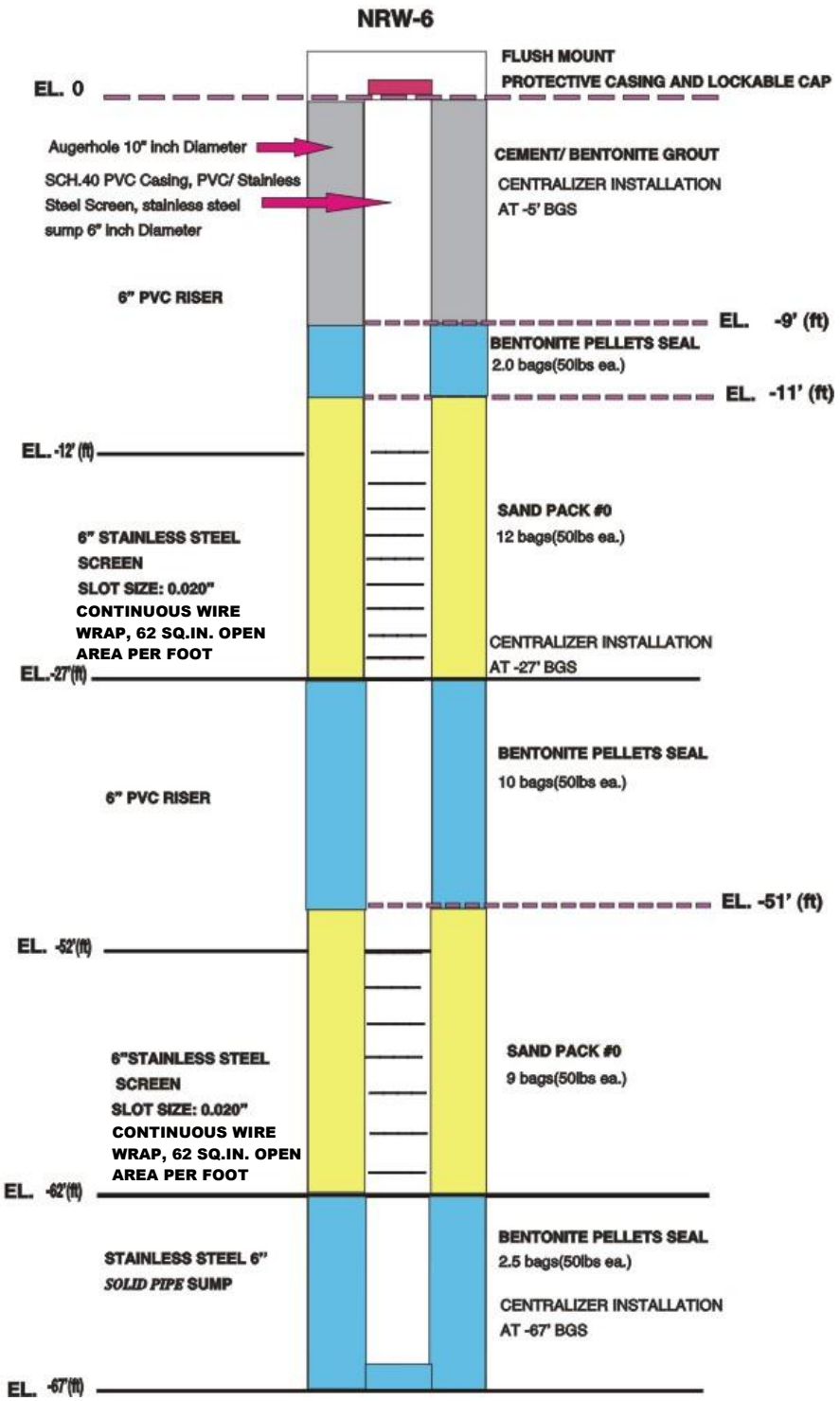
Client: National Grid

Location: 50 Kent Ave.,
Williamsburg, Brooklyn, New York
Project No.11176638.00019

DRILLING SUMMARY

GEOLOGIST: ANDREAS PAPANEOCLEOUS
DRILLING COMPANY: CASCADE
DRILLER: JOHN GRAGLIA
DRILLING RIG TYPE: SONIC
DATE: 04-02-2014

Recovery Well Construction Details



URS Corporation

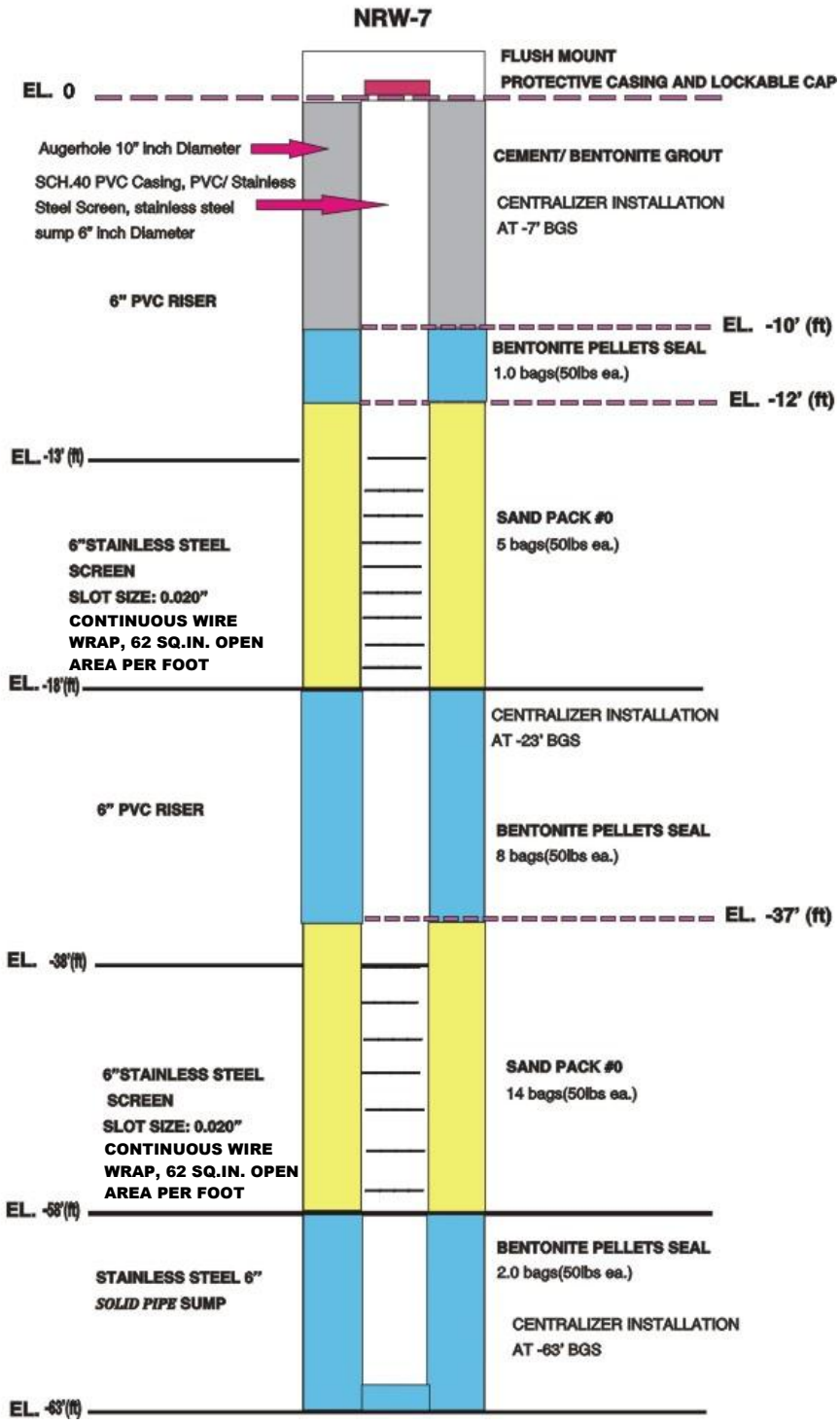
Client: National Grid

Location: 50 Kent Ave.,
Williamsburg, Brooklyn, New York
Project No.11176638.00019

DRILLING SUMMARY

GEOLOGIST: ANDREAS PAPANEOCLEOUS
DRILLING COMPANY: CASCADE
DRILLER: JOHN GRAGLIA
DRILLING RIG TYPE: SONIC
DATE: 04-03-2014

Recovery Well Construction Details



AECOM

Boring Log

BORING NO. : NRW-08R

PROJECT:	National Grid Williamsburg
PROJECT LOCATION:	Mid-way down N 12th St, west of Kent Ave.
CLIENT:	National Grid
DRILLING CONTRACTOR:	ADT
DRILLING METHOD:	Sonic
DRILL RIG TYPE:	Fraste XL Max
DRILL BIT SIZE/TYPE:	5" Sonic Core
SAMPLING METHOD(S):	5' Sonic Cores

SHEET: 1 OF 3	
JOB NO. :	
TOTAL DEPTH OF BOREHOLE:	60 ft. bgs
GROUND ELEVATION:	
DATE STARTED:	5/142019
DATE FINISHED:	5/24/2019
DRILLER:	Tony Palomeque
GEOLOGIST:	M Dascoli & R Doshi
REVIEWED BY:	

DEPTH FEET	STRATA	VISUAL IMPACT	SAMPLE	PID (ppm)	RECOVERY (inches)	USCS	MATERIAL DESCRIPTION	REMARKS	WELL CONSTRUCTION
0					60"	FILL	4" Sidewalk/ concrete 0'-5' Handcleared 0'-5' FILL - medium brown sand and silt, trace brick with some gravel and few cobbles, no odor or staining noted at 4' with medium gray color		FLUSH MOUNT PROTECTIVE CASING AND LOCKABLE CAP
-5			1	0.2 0.2 0.3 11.5 25.6	55"	ML	5'-10' medium gray, soft 5'-9' SILT with few sand and clay, trace gravel 9'-10' same as above with some clay, with black silt, possible staining 10'-12' same as above	Wet Dry	15 ft of 6" STAINLESS STEEL SCREEN SLOT SIZE: 0.020" BENTONITE (BENSEAL) INSTALLED
-10			2	44.3 29.0 50.0 109 131	45"	SP ML	12'-12.4' 4" layer of fine SAND with 100% NAPL saturation, dark brown NAPL, burnt, acrid odor 12.4'- 15' alternating layers of brown and black, very soft, SILT, some clay, trace sand and gravel	Wet Dry	SCH.40 PVC Casing, Stainless Steel Screens, statinless steel sump 6" Inch Diameter
-15			3	15.0 49.5 217 196 925	31"		15'-17' dark gray SILT 17'-18' possible weathered rock with mica and silt, mothball-like odor 18'-19.5' crushed boulder, dry 19.5'-20' medium brown, very fine SAND & SILT, strong mothball-like odor, about 15% NAPL	Wet	SAND PACK #0 15 ft of 6" STAINLESS STEEL SCREEN SLOT SIZE: 0.020"
-20			4	290 151 307 234 75.1	48"	SP/ML CL	20'-21' Hard, medium brown CLAY, trace gravel, dry 21'-22.5' dark brown, stained, very fine SAND, trace medium sand, 20% NAPL saturation, strong mothball-like odor 22.5'-25' same as 20'-21' (Hard, medium brown CLAY, trace gravel, dry) at 23.5'-25' with some coarse gravel and trace cobble	Dry	
-25									

COMMENTS:

BORING NO. : NRW-08R

AECOM

Boring Log

BORING NO. : NRW-08R

PROJECT:	National Grid Williamsburg
PROJECT LOCATION:	Mid-way down N 12th St, west of Kent Ave.
CLIENT:	National Grid
DRILLING CONTRACTOR:	ADT
DRILLING METHOD:	Sonic
DRILL RIG TYPE:	Fraste XL Max
DRILL BIT SIZE/TYPE:	5" Sonic Core
SAMPLING METHOD(S):	5' Sonic Cores

SHEET:	2 OF 3
JOB NO. :	
TOTAL DEPTH OF BOREHOLE:	60 ft. bgs
GROUND ELEVATION:	
DATE STARTED:	5/142019
DATE FINISHED:	5/24/2019
DRILLER:	Tony Palomeque
GEOLOGIST:	M Dascoli & R Doshi
REVIEWED BY:	

DEPTH FEET	STRATA	VISUAL IMPACT	SAMPLE	PID (ppm)	RECOVERY (inches)	USCS	MATERIAL DESCRIPTION	REMARKS	WELL CONSTRUCTION
-25			5	27.8 21.6 167.1 6.3 24.8	60"		25'-28' dark gray, CLAY, few gravel, stiff, dry, no odor at 27'-30' chemical-like odor noted 28'- 29' very stiff, brick red CLAY, dry 29'-30' hard, dark gray CLAY, few coarse gravel		
-30			6	2.5 2.6 2.8 3.0 3.1	40"		30' - 35' hard, dark gray CLAY, few gravel		
-35			7	28 7.2 77.9 11.3 36.3	48"	SP CL	35'-35.5' Boulder 35.5'-38' dark brown very fine SAND and few silt, few mica, faint chemical-like odor 38'-40' hard, dark gray CLAY, some fine to coarse gravel	Wet Saturation Level Not Recorded	
-40			8	538 366 988 736 658	38"	SP	40'-45' medium brown very fine SAND with few silt, very strong mothball-like odor throughout @ 43.5'-43.75' dark brown NAPL, ~20% saturation @ 44.5'-45' medium brown NAPL, ~20%, with layer of black staining		SAND PACK #0
-45			9	1270 618 1154 2065 1726	41"	ML SP	45'-50' very loose, medium brown, very strong mothball-like odor 45'-47' SILT with mica, 5% NAPL saturation 47'-47.25' sub-rounded coarse SAND, 50% lt brown NAPL sat. 47.25'-49' very fine SAND with few medium-coarse sand, 50% light brown NAPL saturation 49'-50' find SAND, with some silt, staining, 100% dark brown NAPL saturation		TIME RELEASE BENTONITE PELLETS 20 ft of 6" STAINLESS STEEL SCREEN SLOT SIZE: 0.020" 20 ft of 6" STAINLESS STEEL SCREEN SLOT SIZE: 0.020"
-50									

COMMENTS:

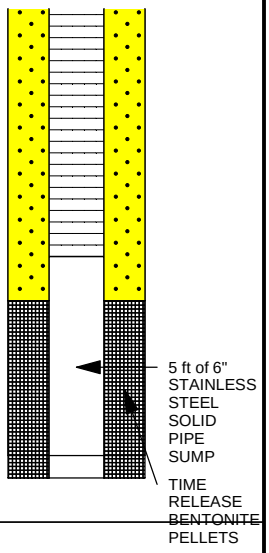
BORING NO. : NRW-08R

Boring Log

AECOM

		BORING NO. :	NRW-08R
PROJECT:	National Grid Williamsburg	SHEET: 3 OF 3	
PROJECT LOCATION:	Mid-way down N 12th St, west of Kent Ave.	JOB NO. :	
CLIENT:	National Grid	TOTAL DEPTH OF BOREHOLE:	60 ft. bgs
DRILLING CONTRACTOR:	ADT	GROUND ELEVATION:	
DRILLING METHOD:	Sonic	DATE STARTED:	5/142019
DRILL RIG TYPE:	Fraste XL Max	DATE FINISHED:	5/24/2019
DRILL BIT SIZE/TYPE:	5" Sonic Core	DRILLER:	Tony Palomeque
SAMPLING METHOD(S):	5' Sonic Cores	GEOLOGIST:	M Dascoli & R Doshi
		REVIEWED BY:	

DEPTH FEET	STRATA	VISUAL IMPACT	SAMPLE	PID (ppm)	RECOVERY (inches)	USCS	MATERIAL DESCRIPTION	REMARKS	WELL CONSTRUCTION
-50			10	340.8 391 386.6 99.9 51.6	55"	ML	50'-55' strong mothball-like odor 50'-52' medium gray very fine SAND with 15% light brown NAPL saturation @51'-51.5' with 50% NAPL saturation 52'-54' dark gray SILT @52.5'- 1/2" of very fine SAND with 100% dk brown NAPL sat. 54'-55' medium brown very find SAND with some silt		
-55			11	470 62.3 30.5 12.5 12.0	50"	SP CL	55'-56.5' loose, medium brown, very find SAND, trace silt 56.5'- 61.5' hard CLAY of various colors- medium brown with red and white streaking throughout		
-60									



COMMENTS:

BORING NO. : NRW-08R

DRILLING SUMMARY

Geologist:
J. Christopher

Drilling Company:
ADT

Driller:
G. Rivera

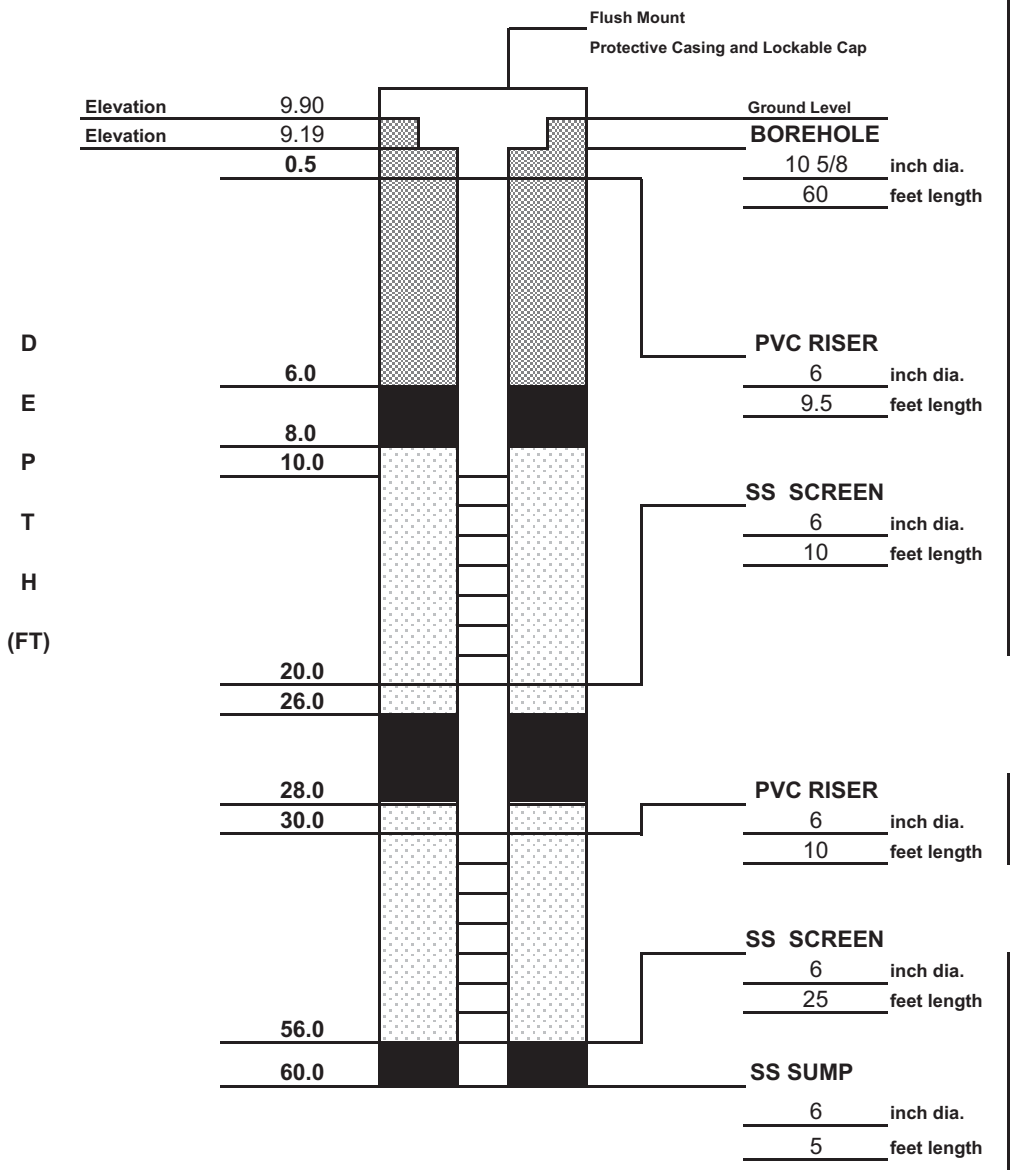
Rig Make/Model:
Fraste Sonic XL Max 250 MS

Date:
3/28/17

GEOLOGIC LOG

Depth(ft.)	Description
	See Boring Log for Lithologic Description.

WELL DESIGN



CASING MATERIAL		*SCREEN MATERIAL*		*FILTER MATERIAL*		
Surface:	12" Flush mount steel grade box	**Type:**	6" Continuous Wrap Stainless Steel	**Type:** #0 Sand	**Setting:**	8.0-26.0 ft 28.0-56.0 ft
Riser:	6" Schedule 40 PVC	**Slot Size:**	0.020"			

SEAL MATERIAL		
Type: Bentonite Chips	**Setting:**	6.0-8.0 ft 26.0-28.0 ft 56.0-60.0 ft

COMMENTS:
Seal Material

Bentonite Chips: 6'-8'/26'-28'/56'-60'

LEGEND

- Concrete
- Bentonite
- Silica Sandpack

Client: **National Grid**	**Williamsburg Works** **Former MGP Site**	**Project No.:** **J1144**
Sevenson	**MONITORING WELL CONSTRUCTION DETAILS**	**Well Number:** **NRW-09R**

URS Corporation

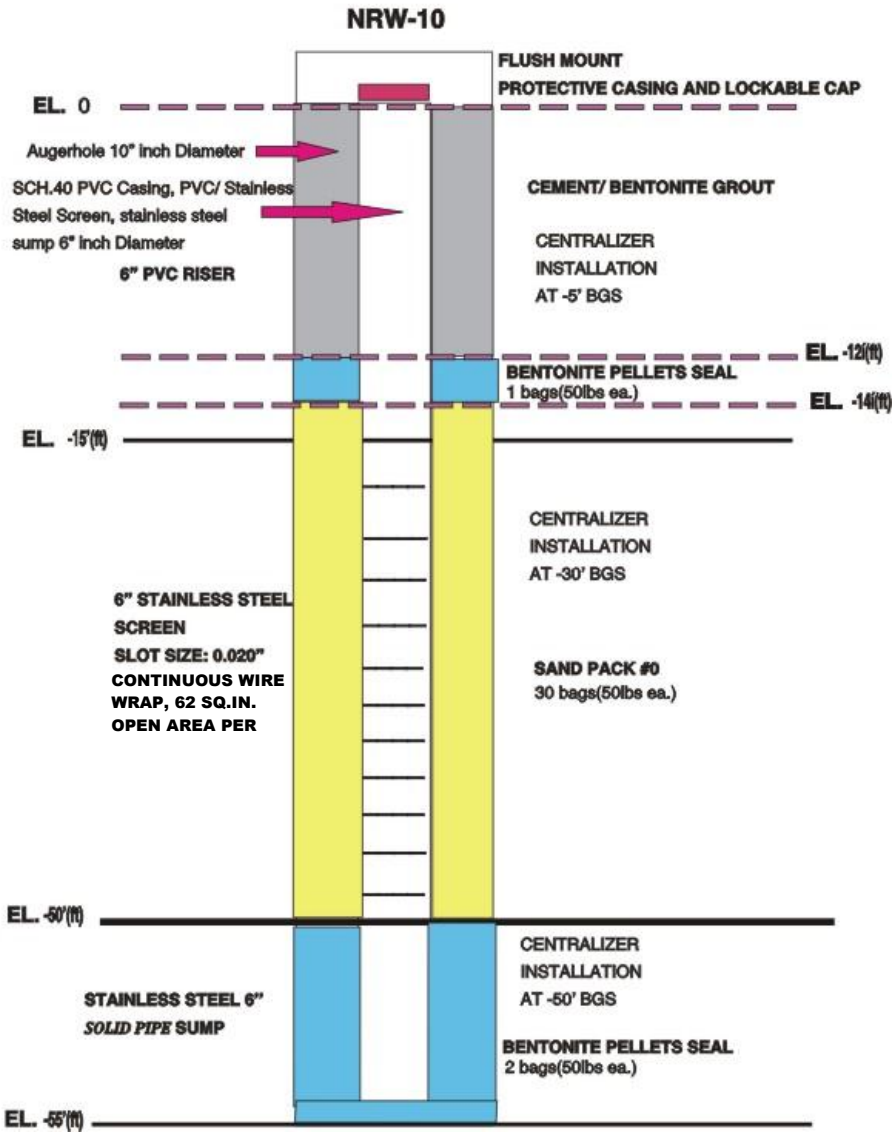
Client: National Grid

Location: 50 Kent Ave.,
Williamsburg, Brooklyn, New York
Project No.11176638.00019

DRILLING SUMMARY

GEOLOGIST: ANDREAS PAPANEOCLEOUS
DRILLING COMPANY: CASCADE
DRILLER: JOHN GRAGLIA
DRILLING RIG TYPE: SONIC
DATE: 03-20-2014

Recovery Well Construction Details



DRILLING SUMMARY

Geologist:
M. Dascoli

Drilling Company:
ADT

Driller:
G. Rivera

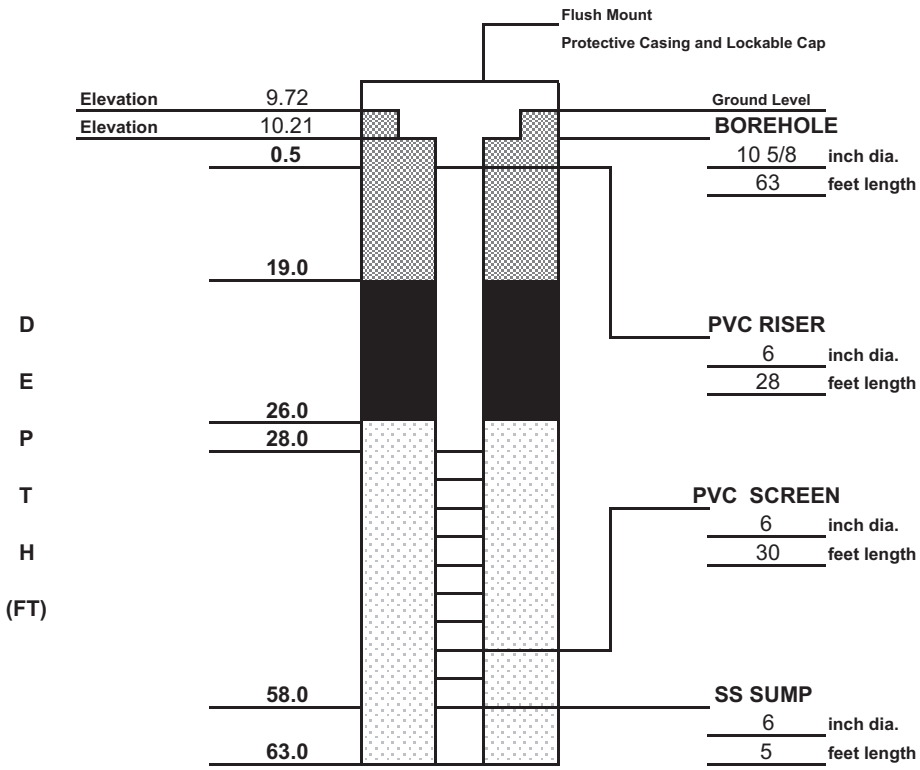
Rig Make/Model:
Fraste Sonic XL Max 250 MS

Date:
3/24/17

GEOLOGIC LOG

Depth(ft.)	Description
	See Boring Log for Lithologic Description.

WELL DESIGN



CASING MATERIAL

Surface: 12" Flush mount

Riser: 6" Schedule 40 PVC

SCREEN MATERIAL

Type: 6" Continuous Wrap Stainless Steel

Slot Size: 0.020"

FILTER MATERIAL

Type: #0 Sand **Setting:** 26.0-63.0 ft

SEAL MATERIAL

Type: Bentonite Chips **Setting:** 19.0-26.0 ft

COMMENTS:

LEGEND

Concrete

Bentonite

Silica Sandpack

Client: National Grid	**Williamsburg Works** **Former MGP Site**	**Project No.:** J1144
Sevenson	**MONITORING WELL CONSTRUCTION DETAILS**	**Well Number:** NRW-11R

URS

50 KENT AVENUE PROPERTY, BROOKLYN KINGS COUNTY, NEW YORK

URS Corporation

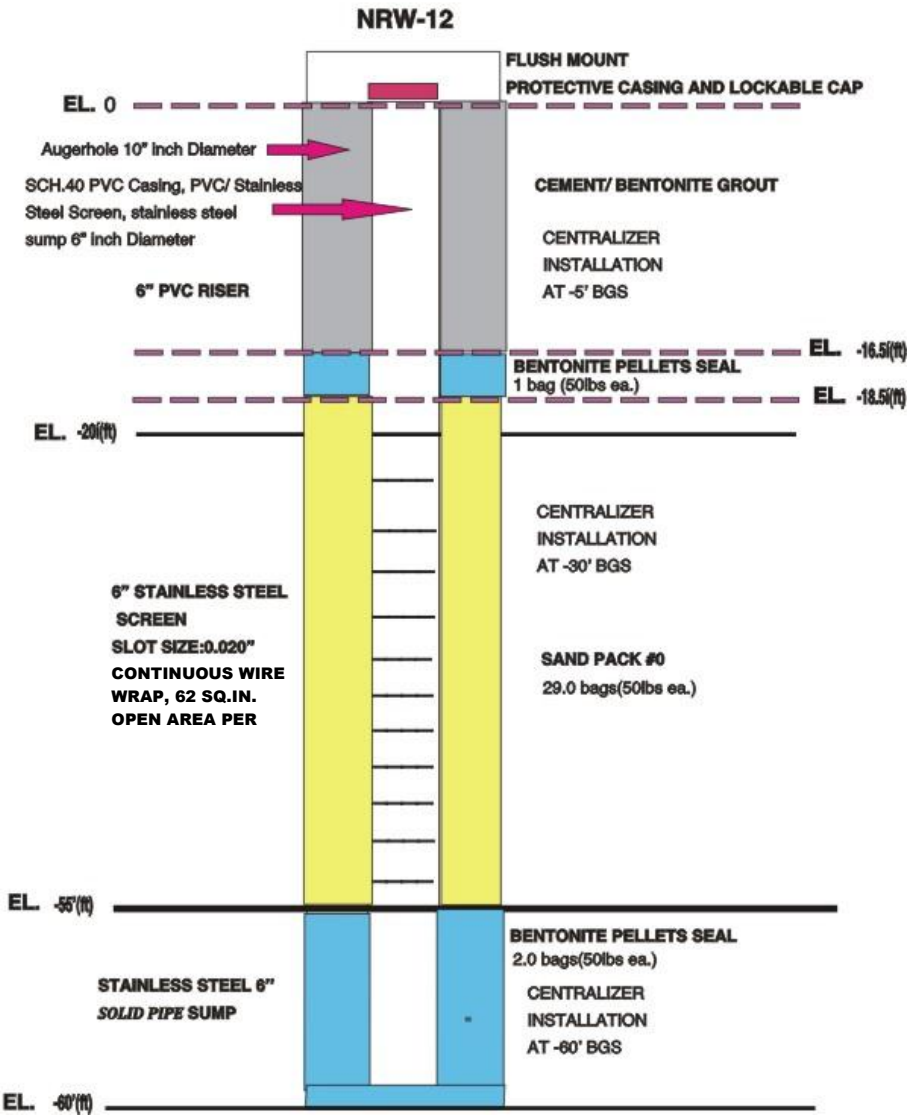
Client: National Grid

Location: 50 Kent Ave.,
Williamsburg, Brooklyn, New York
Project No.11176638.00019

DRILLING SUMMARY

GEOLOGIST: ANDREAS PAPANEOCLEOUS
DRILLING COMPANY: CASCADE
DRILLER: JOHN GRAGLIA
DRILLING RIG TYPE: SONIC
DATE: 03-27-2014

Recovery Well Construction Details



URS Corporation

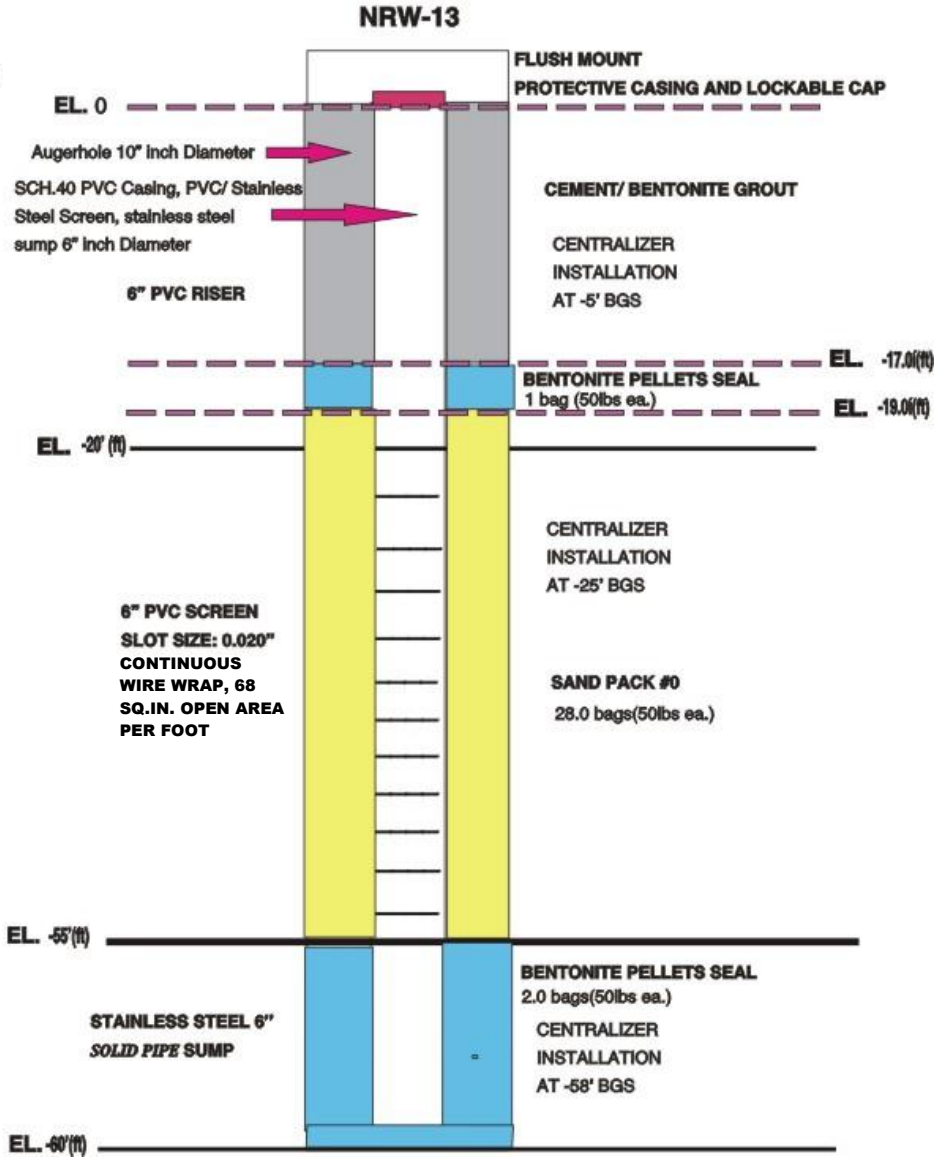
Client: National Grid

Location: 50 Kent Ave.,
Williamsburg, Brooklyn, New York
Project No.11176638.00019

Recovery Well Construction Details

DRILLING SUMMARY

GEOLOGIST: ANDREAS PAPANEOCLEOUS
DRILLING COMPANY: CASCADE
DRILLER: JOHN GRAGLIA
DRILLING RIG TYPE: SONIC
DATE: 03-28-2014



Appendix B – NAPL Recovery Checklist

AECOM Imagine it. Delivered.

NAPL Recovery Checklist

Date: _____ Day: _____ Prepared By: _____

Action Items	Yes	No	NA	Comment/Reason
Fuel generator				
Ensure field equipment is hired as required and is in good working order.				
Pick up drums.				
Check field consumables are in adequate supply and re-order as required.				
Inform your Site point of contact when you get to the Site and check in routinely during the day.				
Note down arrival time, date, weather, and objective in the field book.				
Review tasks for the day and associated hazards. Note down safety topic for the day in the field book. Complete Task Hazard Assessment.				
Calibrate PID and note down readings for 0 and 100 in the book.				
Put poly and absorbent pads around the well to be gauged and pumped.				

Action Items	Yes	No	NA	Comment/Reason
Wear all appropriate PPE, including Tyvek while working with NAPL.				
Gauge wells and note Well ID, NAPL thickness (measure coating on the string with a tape), and depth to bottom in the field book.				
Refer to available sump height for each well and remove NAPL from the wells that require pumping. Note which wells were pumped in the field book.				
Measure height of NAPL in the drum after removing NAPL from each sump (use either (1) a steel yard stick and decon following use, or (2) a weighted string and measure against a tape for accurate reading). Do this after each well to inform the calculation of volume recovered from each well. Note this in the field.				
Note down if there are any issues or observations at the Site, or with NAPL gauging or recovery and inform the Project Manager.				
Label drums appropriately.				
Note how many product and PPE drums were created.				
Note down time of drum pick up.				
Call your Site point of contact when you leave the Site.				

Action Items	Yes	No	NA	Comment/Reason
Scan or take pictures of field notes and forms and send to the Project Manager at the end of the day.				

Appendix C – Recovery Well Field Form

AECOM Imagine it. Delivered.

RECOVERY WELL FIELD FORM
50 KENT AVENUE PROPERTY

AECOM TECH: _____
AECOM TECH: _____
DATE: _____
WEATHER: _____

SAFETY MEETING
ATTENDEES: _____

TOPICS COVERED _____

	Gauging Details				Recovery Details				
Recovery Well	**Date of Gauging**	**Depth to Water (ft)**	**Product Thickness w/ String (ft)**	**Measured Well Depth (ft)**	**Total Liquid Removed (gal)**	**Volume of Water in Tube (gal)**	**Product Removed (gal)**	**DNAPL Thickness, After Recovery (ft)**	**Comments/Observations**
NRW-01R									
NRW-02									
NRW-06									
NRW-07									
NRW-08R									
NRW-09R									
NRW-10									
NRW-11R									
NRW-12									
NRW-13									
					TOTAL PRODUCT REMOVED		***0.0***		

Notes:
All depths are recorded as feet below Top of Riser, unless otherwise noted.
x - No Data
NM - Not Measured
NA - No Access
NP - No Product
ND - Not Detected

Appendix D – Health & Safety Plan

Appendix E – Standard Operating Procedures for NAPL Recovery

Standard Operating Procedures for NAPL Recovery

Waste Containers

- On the day before the NAPL recovery event, talk to waste hauler to confirm drum pick up. Do not recover NAPL if drum pickup cannot be scheduled.
- Empty drums shall be picked up from a local dealer on the morning of the NAPL gauging and recovery event.
- Two additional drums shall be maintained in the off-site rented storage area in case the local drum dealer does not have drums in stock for a day.
- Since there is no on-site storage, drum pick up shall be scheduled with advanced notice for the same day as the NAPL recovery event.

Well Gauging

Equipment needed

- Screwdriver and 15/16” ratchet to open wells (and drums)
- Interface Probe (IP), 100’
- Cotton string with a stainless-steel weight on bottom
- Environment-friendly cleaning products and supplies for cleaning NAPL off of equipment (e.g., Simple Green)
- Plastic sheeting and oil absorbent pads

Steps

- Set up PID (for worker protection)
- Don required PPE (nitrile gloves, safety glasses, etc.)
- Lay down spill pads around well
- Open well
- Using an IP or weighted string, measure NAPL thickness, if present
- Once per month, use IP or weighted steel tape to measure depth to bottom of well
- Record measurements
- Lower string down slowly until it hits the bottom, but don’t allow string to slacken as the measurement may be skewed
- Wind string back up and measure length of product staining on string
- Record measurement
- Decontaminate tape, weight and IP, as needed
- Cut off stained string and reattach weight
- Close and secure well

NAPL Recovery

Equipment Needed- General

- Rental truck or van to hold equipment
- Hand truck (for moving drums when stored on-site)
- At least two 5-gallon containers or 55-gallon drums with closable tops
- Appropriate tubing
- Screwdriver and ratchet to open wells
- Environment-friendly cleaning products (for cleaning NAPL from equipment)
- Plastic sheeting and oil absorbent spill pads
- Heavy duty garbage bags
- Weighted bailer and string
- Drum wrench with 15/16” bit
- Traffic safety barriers/cones and caution tape
- In winter: Snow shovels, salt, non-slip footwear

Needed for Peristaltic Purging

- Peristaltic pump with two external batteries (rental)
- Tubing for peristaltic pump
- Hose clamps for intake and discharge on pump

Needed for Waterra Purging

- Waterra pump (rental)
- Generator (rental)
- Tubing and check valves for Waterra pump
- Extension cord
- Spare check valves

Peristaltic Purge Steps

- Lay 6 mil plastic sheeting and place equipment on it
- Don PPE, including poly-coated Tyvek suit or Tyvek apron with sleeves if there are concerns for heat exhaustion
- Set up cones and lay out plastic and spill pads around well
- Open well
- Set up 55-gallon drum or 5-gallon buckets, with spill pad underneath bucket or edges of drum
- Set up peristaltic pump powered by external battery or car battery
- Connect hose to dedicated tubing and secure hose clamps
- Insert tubing into bucket or drum and secure with a clamp
- Turn on the pump and pump well until product is pumped out- until water being pumped out is relatively NAPL free (during pumping: reduce odors by covering well and bucket)
- Disconnect and pack up equipment, clean area if needed

- Record volume of liquid removed by using markings on side of container or measure with weighted string (1” in a 55-gallon drum = 1.6 gallons)
- Close up bucket or drum and well.

Waterra Purge Steps

- Lay 6 mil plastic sheeting and place equipment on it
- Don PPE, including poly-coated Tyvek suit or apron
- Set up cones and lay out plastic and spill pads around well
- Open well
- Set up 55-gallon drum or 5-gallon buckets with spill pad underneath
- Set up wooden stand and Waterra pump
- Start generator and connect extension cord to Waterra
- Insert tubing into bucket or drum and secure with a clamp
- Turn on pump and pump well until product is pumped out- until water being pumped out is relatively NAPL free
- Disconnect and pack up equipment, clean area if needed
- Record volume of liquid removed by using markings on side of container or measure with weighted string (1” in a 55-gallon drum = 1.6 gallons)
- Close up bucket or drum and well.

Containerization Steps

- All efforts shall be made to prevent spills, splashes, or drips of NAPL onto ground or personnel.
- Spill pads and plastic sheeting shall be laid on the ground around the NAPL recovery wells and pumping activities.
- Direct all extracted NAPL to a 55-gallom drum.
- Drums shall be moved from well location to well location using a hand truck.
- A 5-gallon bucket may be utilized in lieu of a drum for select wells:
    - The 5-gallon buckets shall be fully closed prior to transport to the drum.
    - The contents must be transferred to a 55-gallon drum using a peristaltic pump or siphon pump to reduce splashing.
    - The 5-gallon buckets shall be wiped with a spill pad at the end of each collection event to remove NAPL.

After NAPL Recovery

- Put impacted waste, i.e. used PPE and supplies, in a heavy duty trash bag. Impacted waste should be placed in dedicated 55-gallon drum for disposal at the end of each event. Transfer recovered liquid from buckets to 55-gallon drums by using a peristaltic pump or siphon pump working as cleanly as possible.
- If the drums are left at the Site unattended for some time (i.e. while taking a break to use the restrooms), attach an appropriate Hazardous Waste Label to each NAPL drum and secure them by closing the drum lid, moving them to the side of the road inside the fenced area, and locking the access gate.
- Generator’s address, and Generator’s EPA ID #:

The Brooklyn Union Gas Co. d/b/a National Grid NY One MetroTech Center

Brooklyn, NY 11201

EPA ID # NYD986872265

- Site name and address:

  Williamsburg Works Manufactured Gas Plant (MGP) Site

  50 Kent Avenue

  Brooklyn, NY 11249

- Since there is not an on-site storage area, drum pick-ups MUST occur on the same day as the NAPL recovery.
- Clean-off IP, equipment, and vehicle as needed with environment-friendly cleaning supplies.
- Call equipment rental company to end equipment rental.

End of Event

- Return cleaned vehicle and arrange for rental equipment pick-up.
- Assign one person to enter data electronically.

Universal
Health and Safety Plan

For use on all high-risk, industrial and HAZWOPER projects
Includes control measures for the Coronavirus Pandemic

National Grid Williamsburg

50 Kent Avenue
Brooklyn, New York

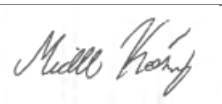
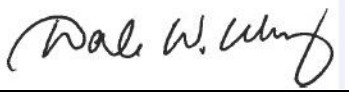
60601906
Williamsburg Works Former Manufactured Gas Plant

Prepared for

National Grid
One MetroTech Center
Brooklyn, New York 11201

Prepared by

AECOM
125 Broad Street
New York, NY 10004

Prepared By: Michal Kosciarz, PE Environmental Engineer	 Signature	7/2/2021 Date Prepared
Reviewed By: Dale "Pete" Wray, CSP, CHMM, STS Safety, Health and Environment Manager, Northeast EBL	 Signature	7/2/2021 Date Reviewed
Approved By: Melissa Saunders Project Manager	 Signature	7/2/2021 Date Approved

Expiration: 7/2/2022	Valid for one (1) year maximum or until the scope of work, subcontractor(s), methods and/or equipment change.

HASP SUMMARY

Note: This Summary is intended to provide key information only and cannot be substituted for reading, understanding, and complying with the full HASP, including the Emergency response section. This summary may be continually updated as tasks and personnel change. Use Continuation Sheets if necessary.

Project Name:	Williamsburg Works Former Manufactured Gas Plant	**Project Number:**	60601906
Client Name:	National Grid		

SH&E INCIDENT REPORTING

DCS Americas Incident Hotline 1-800-348-5046

TOLL-FREE | 24 HOURS PER DAY | 7 DAYS PER WEEK

Immediately report injuries, illnesses, property damage, security issues, regulatory inspections, environmental impacts/spills, and any potentially work-related injury, illness, discomfort/pain or damage.

MEDICAL TREATMENT RESOURCES

Identify the nearest Occupational Clinic and Hospital to the site that accepts AECOM Workers Compensation Insurance (see **Attachment A** for instructions). If the they are an unreasonable distance from the site, identify nearer hospitals or clinics. Attach maps and directions to the clinics and hospitals in **Attachment A**.

AECOM Occupational Nurse

1-512-419-5016 *24 HOURS PER DAY | 7 DAYS PER WEEK*

Nearest Occupational Clinic

Name:	**City MD**	**Phone Number:**	**718-414-2013**
Address:	154 North 7th St. Brooklyn, NY 11249		
Hours of Operation:	8AM-8PM		

Nearest Hospital

Name:	**Woodhull Medical Center**	**Phone Number:**	**718-963-8000**
Address:	760 Broadway, Brooklyn, NY 11206		

KEY PERSONNEL

Project Manager (PM):	Melissa Saunders	**Contact No.:**	206-502-7914
Site Supervisor (SS):	Sunil Samaroo, Megan Dascoli, Adib Rahman or other qualified on-Site personnel as directed by the Project Manager	**Contact No.:**	908-797-3796, 908-623-0145, 631-942-9700 respectively
Safety Officer (SSO):	Sunil Samaroo, Megan Dascoli, Adib Rahman or other qualified on-Site personnel as directed by the Project Manager	**Contact No.:**	908-797-3796, 908-623-0145, 631-942-9700 respectively
Regional SH&E Manager	Candice Johnson (Environment)	Contact No.: 416-407-9661	

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KEY PERSONNEL			
Area SH&E Manager:	Pete Wray (EBL EH&S East/REM-IAP NE)	Contact No.: 302-660-9178	
Account SH&E Manager Environment BL:	Not Applicable		
Client PM:	Donald Campbell	**Contact No.:**	M: 347-452-5973
NOTES: D – Direct Office Number O – General Office Number M – Mobile Device Number R – Radio Channel			

Short Service Employees (AECOM and Subcontractors)
< 6 months with Company in Current Job Description

☐ **Yes, see table below for details**
☒ **None, not applicable**

Name	Company	Mentor	Mentor's Phone Number

NOTES: D – Direct Office Number O – General Office Number M – Mobile Device Number R – Radio Channel

Subcontractors (List All)

☐ **Yes, see table below for details**
☒ **None, not applicable**

Company Name	Task(s)	Site Safety Officer	SSO's Phone Number

NOTES: D – Direct Office Number O – General Office Number M – Mobile Device Number R – Radio Channel

Note no AECOM subcontractors are currently engaged on the project. Veolia (516-221-8300) is currently engaged by National Grid to transport and dispose of hazardous wastes generated through project activities.

PM must positively verify subcontractors are approved in Subport (or by an equivalent evaluation process) for the work described. If there were any limitations/ conditions of approval, describe them below and how they are being met including the following (where applicable):

- ☐ Copy of their Corporate Safety Management Manual
- ☐ Copy of their Project/Site-specific health and safety plan
- ☐ Copy of task specific THAs/JHAs and daily inspection/tailgate forms
- ☐ Copy of their Pre-Qualification form
- ☐ Copy of their latest Workers Compensation Board (WCB) documents
- ☐ Copy of the signed contract
- ☐ Copy of their business license and training certificates (task specific)
- ☐ Other (Describe)

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Subcontractors (List All)			☐ Yes, see table below for details ☒ None, not applicable
Company Name	**Task(s)**	**Site Safety Officer**	**SSO's Phone Number**

☐ I have verified that all subcontractors are approved in Subport (or equivalent), and that all conditions of approval are met.

Project Manager Name	Project Manager Signature	Date

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Attachment B:	THA Forms, and Tailgate Safety Meeting Form
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Attachment D.	Stretch/Flex Poster
Attachment E:	Site Orientation
Attachment F.	Safety Data Sheets
Attachment G	Work Plan/Client SH&E Requirements

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REVISION LOG

Template Revisions			
Version	Revised By	Date	Details of Revision
1.0	Alberto Munuera, Patrick Walz, & Gregg Ferris	14 FEB 2020	Initial Version, merging and replacing previous template documents (HAZWOPER HASP and Industrial/Project HASP)
1.1	Patrick Walz & Alberto Munuera	26 MAR 2020	Modified to add Coronavirus prevention and response guidelines
1.2	Tim Gilles, Kelly Dwyer, Scott Dietz, Lisa Rygiel, & Maria Hunt	28 MAY 2020	Formatting and grammar correction. Customized for universal use on high risk, Industrial and HAZWOPER projects

Project-Specific Revisions			
Version	Revised By	Date	Details of Revision
0	Michal Kosciarz	2 JUL 2021	Annual HASP update to current template
1			
2			

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1. INTRODUCTION

This written Health and Safety Plan (HASP) is designed to identify, evaluate, and control safety and health hazards, and to outline emergency response actions for AECOM-managed activities. This HASP must be kept on site during work activities and made available to all workers including subcontractors and other site occupants for informational purposes. AECOM subcontractors are expected to independently characterize, assess, and control site hazards created by their specific scope of work.

This section of the HASP summarizes important AECOM SH&E Procedures that apply to all Design and Consulting Services (DCS) Americas jobs. See **Attachment B** for the Project Task Hazard Assessment (THA) forms and **Attachment C** for complete copies of applicable field SH&E Procedures.

1.1 Applicable References

This HASP conforms to the regulatory requirements and guidelines established in the following documents:

- Federal Occupational Safety and Health Administration (OSHA) Code of Federal Regulation Title 29, Part 1910 (29 CFR Part 1910), Safety and Health Regulations for General Industry and 29 CFR 1926, Safety and Health Regulations for Construction.
- Title 8 of the California Code of Regulations (8 CCR), with special attention to Section 5192 Hazardous Waste Operations and Emergency Response, and Section 3202, Injury Illness Prevention Program and to Sub Chapter 4, Sections 1500 - 1938 Construction Safety Orders.
- National Institute for Occupational Safety and Health/Occupational Safety and Hazards Administration/U.S. Coast Guard/U.S. Environmental Protection Agency, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, Publication No. 85-115, 1985.
- The requirements in this HASP also conform to AECOM's Safety for Life Program requirements as specified in the AECOM Safety, Health and Environment (SH&E) Manual.
- The work plan provided in the document titled *NAPL Recovery Plan for the 50 Kent Avenue Property, Brooklyn, Kings County, New York* and dated February 2020 (AECOM, 2020).
- National Grid Safety Procedure, N-1402 Contractor Safety Requirements, Rev. No. 16 dated 3/24/2021.
- National Grid Safety Procedure, A-116 COVID-19 Health & Safety Plan, Rev. No. Initial dated 4/28/2020.
- National Grid Pandemic Plan Protocol dated 3/18/2020.
- National Grid Incident Reporting Requirements.

1.2 Project Assumptions

- This is a NYC Parks-controlled site.
- No confined spaces will be entered on this project.
- No excavations will be entered.
- No work at heights (with fall protection) will be performed.
- Work will be performed during daylight hours.
- Work shifts will be no more than 12 hours/day on-Site.

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2. SITE DESCRIPTION

The Williamsburg Works Former Manufactured Gas Plant (MGP) site is located at 50 Kent Avenue in an industrial and commercial section of the Williamsburg neighborhood of Brooklyn, New York (the Site). The Site Location Map is provided as Figure 1-1 attached in the **Figures** section.

The Site is bordered by North 12th Street to the northeast, Kent Avenue to the southeast, North 11th Street to the southwest, and a vacant parcel owned by the New York City Parks to the northwest. Work covered by this HASP will be performed on the Site and on adjacent properties, such as the sidewalks next to the Site, which are currently owned by New York City Parks.

2.1 Site Background/History

The Williamsburg Works Former MGP operated from the 1860s to the 1930s, first by the Williamsburg Gas Light Company and later by The Brooklyn Union Gas Company (BUG), a predecessor to National Grid. The Williamsburg Works Former MGP was dismantled prior to 1941 and was subsequently divided into four parcels, sold to third parties, and redeveloped for commercial and industrial uses. During manufactured gas production, the 50 Kent Avenue parcel housed MGP production facilities, including three gas holders (Relief Holder, Holder No. 1, and Holder No. 2), purifying houses, saltwater condensers, and offices.

Following the closure of the MGP, the MGP structures were dismantled. However, the holder tanks and other underground structures remained. The 50 Kent Avenue parcel was temporarily leased by the United States Navy from July 1, 1945 and was sold by BUG on January 30, 1946. A warehouse/industrial building was constructed on the Interim Remedial Measure (IRM) Site prior to 1951 by the Site's then current owner and was occupied by the Ferro-Co. Corporation and used for sheet metal product manufacturing. By 1965, the building was occupied by Commercial Corrugated Container Corporation. By 1978, the property, and same building, was occupied by a New York City Department of Sanitation (NYCDOS) garage and gas station facility. This building was dismantled in 2009.

The 50 Kent Ave property was remediated through an IRM during the period of 2015 – 2017. The Site currently operates as a park under the management of the New York City Parks department.

2.2 Client and/or Third-Party Operations at Site

The New York City Parks department and their contractors occupy North 12th Street. The 50 Kent Avenue property is currently subject to construction works associated with park redevelopment and construction is scheduled for completion in April 2022.

The current use of the Site and adjacent streets could lead to traffic hazards. It is noted that a bike lane runs along Kent Avenue, and care must be taken to look both left and right when entering the roadway.

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2.3 Scope of Work

2.3.1 Project Scope and Objective(s)

The purpose of the Site activities is to recover Non-Aqueous Phase Liquid (NAPL) from wells that were installed as part of the Site remedial approach. Whilst NAPL monitoring and recovery is the primary Site activity, additional activities that may be completed on an 'as needed' basis include recovery well performance rehabilitation potentially involving drilling, soil sampling and re-installation of recovery wells.

Field activities covered by this HASP include the following:

- NAPL Monitoring and Recovery including:
  - NAPL gauging
  - NAPL recovery from all functioning NAPL recovery wells (refer Figure 1-2 in the Figures section)
  - Remediation-derived waste (RDW) characterization and disposal
  - Managing the National Grid waste transport and disposal contractor.
  - Recording activities.
- Drilling/Soil Sampling/Well Installation including:
  - Soil sampling during drilling
  - Remediation-derived waste characterization and disposal
  - Manage the rehabilitation work including AECOM subcontractors
  - Engineering for well construction
  - Recording activities.

2.3.2 Risk Register

The following tasks will be performed to achieve the project objective(s). A Task Hazard Assessment (THA) for each operation being performed by AECOM must be included in **Appendix B**, while those performed by the managed subcontractors must be prepared by the subcontractor. Oversight of managed subcontractor activities is considered a discrete AECOM task and shall also be listed below.

Task Name	Permit(s) Required		Task Performed By		
			AECOM	SUB	Third-Party
Coronavirus Precautions THA	☐ Yes	☒ No	☒	☐	☐
NAPL Recovery THA	☐ Yes	☒ No	☒	☐	☐
Driving to and from site THA	☐ Yes	☒ No	☒	☐	☐
	☐ Yes	☐ No	☐	☐	☐
	☐ Yes	☐ No	☐	☐	☐

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2.3.3 Scope of Work Risk Assessment

☐	**Low Risk**	Examples: Non-intrusive work, occasional exposure and/or low risk hazards
☐	**Medium Risk**	Examples: Intrusive work, heavy equipment use, frequent exposure and/or moderate hazards
☒	**High Risk**	Examples: Complicated scope, large/multiple work crews, and/or constant exposure to hazards

In general, the following tasks are considered High Potential (HiPo), as identified in S3AM-209-PR, Risk Assessment, based on the factors contributing to the severity and probability of credible outcomes resulting from ineffective mitigation of their hazards. Additional tasks or activities could be added to the list below based on a similar assessment their hazards and associate control measures. The following HiPo tasks will be required to complete the approved scope of work.

☐	Working at heights > 4 ft (including aerial lifts, snooper trucks, scaffolds)	☐	Working in a controlled area
☐	Working in a confined space	☐	Extreme heat or cold stress environments
☐	Working in a trench or excavation	☐	Working with power tools/equipment (drill, chain saw, grinder, etc.)
☐	Performing tasks requiring lock out/tag out	☒	Working with/operating heavy equipment or machinery, including drill rigs
☐	Work on energized equipment	☐	Working in isolation from first aid services or immediate/emergency assistance
☐	Working with electricity	☐	Working around mobile equipment
☒	Working with hazardous substances or materials (including all HAZWOPER projects)	☒	Exposure to vehicular traffic (highways, roads, parking lots)
☐	Working with material under pressure	☐	All-Terrain Vehicle Work
☐	Working where there is a possible threat of violence, including civil unrest	☐	Working on Railroads or within 25 Feet of Tracks
☐	Working in avalanche areas	☒	Any activity/task involving non-voluntary use of respiratory protection, including for site access
☐	Working on or over water or ice	☐	Working with people diagnosed with coronavirus or other pandemic diseases
☐	Working in remote or wilderness isolation	☐	Other HiPo Task(s) [specify]:

The following AECOM procedures provide task specific permit requirements and shall be consulted if applicable to the scope of work *(S3AM-218-PR)*:

☐	S3AM-120-PR, Radiation	☐	S3AM-304-PR, Fall Protection
☒	S3AM-209-PR, Risk Assessment & Management	☐	S3AM-310-PR, Cranes & Lifting Devices
☐	S3AM-301-PR, Confined Spaces	☐	S3AM-325-PR, Lockout Tagout
☐	S3AM-302-PR, Electrical Safety	☐	S3AM-330-PR, Underground Work
☐	S3AM-303-PR, Excavation	☐	S3AM-332-PR, Hot Work

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2.4 Cleaning/Disinfecting, Housekeeping and Personal Hygiene

During the Pandemic, AECOM has identified three basic levels of cleaning that are described in our AECOM Pandemic Procedure. AECOM also requires that each location develop a Touch Point Cleaning program. Each project site shall implement a touch point cleaning program to minimize the transmission of the virus through environmental sources, specifically hard surfaces or "touch points." It is recommended that each site develop a checklist to identify the touch points specific to the site. The checklist can be initialed, dated, and signed for each touch point item to document the cleaning process. This cleaning should be conducted daily or more often as needed/desired. Contract a service or designate a person(s) and/or develop a schedule for cleaning responsibilities. Common touch points are listed below:

- Light Switches
- Equipment controls
- Cabinet and file drawer knobs/handles.
- Vending machines
- Chair arms
- Copier/printer/fax control buttons
- Shared desks and keyboards
- Shared tools and equipment
- Garage access buttons
- Handrails
- Doorknobs/handles
- Elevator buttons
- Sinks and Faucets
- Counter tops
- Tabletops
- Coffee pots
- Refrigerator
- Microwave
- Water dispensers
- Windowsills
- Portable toilet commonly touched areas
- Personal protective equipment (PPE) items

Basic housekeeping requirements for offices and work sites, as well as personal hygiene and sanitation standards can be found in S3AM-013-PR Housekeeping. Inspections will be performed at the regular interval specified below. The housekeeping inspection form S3AM-013-FM1 is available for use. Complete the table below regarding site-specific Housekeeping and Personal Hygiene requirements:

Cleaning/ Disinfecting	***Frequency:***	Daily
	Responsible Party:	Site Employees
Housekeeping:	***Inspection Frequency:***	Daily (Inspection findings to be documented in field notes)
	Inspector:	Site Supervisor/Site Safety Officer or designee
Eating, Drinking, Smoking:	Permitted only in designated area(s).	
Handwashing:	Handwashing and toilets are located at the New York City Parks building at Kent Avenue and North 10th Street. Site personnel will wash hands and face after completing work activities and prior to breaks or meals. Due to COVID-19 wash hands more frequently: • Wash hands with soap and water for 20 seconds.	

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- Wash hands after sneezing, coughing, blowing your noise, or being in a public place.
- Use hand sanitizer that contains at least 60% or up to 95% of alcohol
- Avoid touching face, mouth, nose, and eyes



Toilets:	**Toilets** are located at the nearby public restrooms at the New York City Parks building at Kent Avenue and North 10th Street. Ensure hand sanitizer is carried when attending a public restroom and limit contact with frequently touched items (i.e. door pulls and toilet seats). If a task requires multiple people (i.e. greater than 10), then a portable toilet will be made available. Each contractor on-Site is to provide their own portable toilets, and portable toilets should be cleaned and disinfected regularly as per New York State guidance. *NOTE: A minimum of one toilet must be provided for every 20 personnel on site. For mobile crews where work activities and locations permit transportation to nearby toilet facilities, on-site facilities are **NOT** required.*

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Water:	**Water** is located at local hydrants. Field personnel are to bring potable water to Site for use. A water supply meeting the following requirements will be used: *Potable Water:* Field personnel will need to bring their own supply of potable water to the Site as it is not readily available at the Site. Potable water containers brought to the Site will be properly identified in order to distinguish them from non-potable water sources. Potable water is also available for field personnel consumption via a public fountain at the nearby New York City Parks building located at Kent Avenue and North 10th Street. However, use of this fountain should be avoided during the COVID-19 pandemic. *Non-Potable Water:* Outlets for non-potable water shall be posted or otherwise marked in a manner that will indicate clearly that the water is unsafe and is **NOT** to be used for drinking, washing of the person, cooking, washing of food, washing of cooking or eating utensils, washing of food preparation or processing premises, or personal service rooms, or for washing clothes. **Non-potable water is water that does not meet OSHA's Sanitation standard for potable water.** All containers of non-potable water will be marked with a label stating ***"Non-Potable Water, Not Intended for Drinking Water Consumption"***
Illumination:	**Artificial illumination** will be provided in the form of spotlight if natural light or installed lighting fixtures are not sufficient in the work area, toilet, and/or break area.

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3. AECOM SAFETY, HEALTH, AND ENVIRONMENT PROGRAM

3.1 AECOM Policy

AECOM's Safety, Health and Environment Policy, which establishes the framework to attain best-in-class Safety, Health and Environmental (SH&E) performance in the interest of benefitting AECOM's employees and stakeholder in the global marketplace, is available on AECOM's Ecosystem (intranet).

3.2 Safety for Life



"Safety for Life" is a comprehensive integrated AECOM Safety Management System that drives our nearly 100,000 employees toward AECOM's commitment to achieving zero work-related injuries and/or illnesses; preventing damage to property and the environment; and maintaining an environmentally friendly and sustainable workplace. Our Safety for Life program is supported by nine Life Preserving Principles that apply to all AECOM activities.

3.3 Life Preserving Principles

AECOM has adopted these "Life-Preserving Principles" to help demonstrate the commitment of our Safety for Life program. We firmly believe these "Life-Preserving Principles" will enable AECOM to achieve its goal of zero employee injuries, property damage and an environmentally friendly and sustainable workplace. The nine Life-Preserving Principles, along with their descriptions, can be found on AECOM's Ecosystem (intranet).

Commitment:
Managers will lead on safety, continuously demonstrating commitment to the highest standards.

Participation:
All employees are encouraged to engage in helping to control the risks we face.

Budgeting and Staffing for Safety:
The costs of managing SH&E are budgeted into every project. Our safety staff are fully trained to provide expert guidance.

Pre-planning:
We assess risks and produce detailed plans to control them during design, planning, and execution of work.

Contractor Management:
We carefully select and collaborate with all our partners to create a safe working environment.

Recognition and Rewards:
Employees are rewarded for safety excellence and we share best practices..

Orientation and Training:
Our employees will be provided with effective safety training in order to identify and mitigate hazards in the workplace to prevent injuries to themselves and others who may be affected by their actions.

Incident Investigation:
We investigate recordabe incidents and serious near misses to understand the causes and take action to prevent recurrence.

Fit for Duty:
All staff come to work each day fit and well, so they do not pose a hazard to themselves or others.

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3.4 Driving and Vehicle Safety

The proper operation of vehicles is critical to protecting the safety of AECOM employees and subcontractors. Drivers face numerous hazards while operating vehicles. Some of the hazards include collision with another vehicle, collision with a fixed object, vehicle break down or failure, or falling asleep or becoming otherwise incapacitated while driving. All employees will adhere to Driving procedure S3AM-005-PR, which includes the following key practices:

1. **Authorized Drivers**
   Managers must authorize drivers following evaluation of driver criteria to drive and maintain an AECOM-owned, leased or rented vehicle, a client or customer-owned vehicle, or a personal vehicle operated in the course of conducting AECOM business.

2. **Electronic Devices Prohibited**
   AECOM prohibits use of all portable electronic devices while operating a motor vehicle/ equipment, which includes being stopped at a traffic light or stop sign. Electronic devices include, but are not limited to, all mobile phones, two-way radios, pagers, iPods, MP3s, GPS, DVD players, tablets laptops, and other portable electronic devices that can cause driver distraction. Hands-free device use is **NOT** allowed.

   - GPS units and devices used for navigation may only be used if factory installed or secured to the vehicle with a bracket that allows the driver to view the image without having to take their eyes off the road. Electronic devices shall be setup for operation prior to commencing driving activities and shall **NOT** be changed by the driver while driving.

3. **Vehicle Inspections**
   The driver shall conduct pre-trip vehicle inspections prior to each trip. A vehicle inspection checklist, S3AM-005-FM2, can be used to guide and document the inspection process. Vehicle inspection is to include a 360-degree walk around and visual inspection under the vehicle for leaks and obstructions prior to moving the vehicle.

4. **Training**
   All drivers shall complete defensive driver training. Additional training (i.e., hands-on defensive driver training) may apply for medium and high-risk drivers; see Driving procedure S3AM-005-PR and SHE Training procedure S3AM-003-PR for more details.

5. **Journey Management Plan**
   Drivers who undertake trips in excess of 250 miles (400 kilometers) one way, drive in remote or hazardous areas, or when otherwise deemed necessary, shall develop and document a Journey Management Plan using S3AM-005-FM1 or equivalent.

6. **Secure Loads**
   Cargo is only to be carried within the passenger compartment of a vehicle when segregated and restrained to prevent objects from becoming distractions, obstructions, or projectiles to occupants should emergency vehicle maneuvers be required (e.g., harsh braking or crash). All

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goods transported on flatbed trucks or in pickup beds must be securely fastened to prevent them from becoming hazards. All applicable laws and regulations regarding securing of loads must be met. It is prudent to check the load after a few miles to ensure that load has not shifted or loosened prior to completing the remainder of the trip.

7. **Backing Up**
   Reversing the vehicle is to be avoided if at all possible. If backing up is necessary, use the following guidelines:

   - ✓ Pre-plan all vehicle movements.
   - ✓ If the pull-through method of parking is not possible, drivers will scan parking spot/area for hazards and back in; thereby, facilitating departure where the first move is forward.
   - ✓ A light tap of the horn should be used to alert others of your intention to back up.
   - ✓ Avoid tight spaces.

Vehicles rated over 10,001 pounds (4,536 kilograms) gross vehicular weight are required to have a competent spotter in place when backing. A competent spotter is one that has received spotter training. (For additional requirements pertaining to vehicles in this weight rating, see Commercial Motor Vehicles procedure S3AM-320-PR).

All vehicles shall have a competent spotter in place when backing in an active work zone. Parking and public access areas are recommended but not required to have a spotter.

3.5 Fitness for Duty

One of AECOM's nine Life-Preserving Principles is Fitness for Duty (see Fitness for Duty procedure S3AM-008-PR). Fitness for Duty means that individuals are in a state (physical, mental, and emotional) that enables them to perform assignments competently and in a manner that does not threaten the health and safety of themselves or others. On certain projects or for specific tasks, fit for duty certifications may be requested of medical providers by SH&E Managers or Human Resources (HR). Employees should ensure they are fit for duty prior to leaving home and unimpaired by substances or fatigue, and if necessary, contact your supervisor rather than attempting to report to work in unfit condition. Supervisors must observe their employees and work with the employee, SH&E staff, and HR to address deficiencies. AECOM will **NOT** tolerate retaliation against any employee for filing a complaint or concern regarding their fitness for duty or participating in any way in an investigation.

3.5.1 Medical Surveillance

AECOM's S3AM-128-PR Medical Screening and Surveillance details the requirements to participate in a medical monitoring program. Medical Surveillance provides a streamlined process to determine if employees meet the physical requirements to perform assigned duties as defined by applicable regulations. It is also designed to provide a means to collect data relevant to exposure to chemical and physical agents for the protection of the workers and to confirm the effectiveness of health and safety programs. The scope of work outlined in Section 2.3 involves the following types of medical surveillance:

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Task or Exposure	Type of Screening or Surveillance
Working in an exclusion zone and the regulatory required exposure limit is anticipated to be exceeded.	HAZWOPER Baseline (Initial), Annual, and Exit Physicals
Working in an exclusion zone more than 30 days a year and the regulatory required exposure limit is not exceeded.	HAZWOPER Baseline (Initial), Biennial and Exit Physicals

3.5.2 Proactive Health

AECOM is committed to promoting proactive health activities in addition to the planning for prevention of safety and environmental incidents. Proactive health activities will be completed on an on-going basis at AECOM on a corporate-wide basis (i.e., the wellness program associated with employee benefits), at offices, and at this project site. Management will be actively involved in providing and encouraging opportunities for health and wellness education and improvement. Health initiatives and education will be discussed periodically during office-based meetings as the safety moment or during the daily tailgate meeting as a toolbox talk. Topics may be related to, but are not limited to, the following:

- ✓ Heart health
- ✓ Stress management
- ✓ Smoking cessation
- ✓ Diabetes prevention
- ✓ Diet
- ✓ Exercise benefits

Topics and educational materials can be located on the AECOM Wellness page, National Institutes of Health website, Centers for Disease Control and Prevention website, and other reputable sources online.

In addition, the field team will be encouraged to participate in a daily stretch and flex routine (a standardized way to avoid soft tissue damage from work activities) to the best of their abilities, given their own personal limits. It is particularly beneficial to warm and loosen muscles before repetitive work, manual handling of loads, and when working in cold temperatures or with static postures. The Stretch and Flex manual and poster (**Attachment D**) serve as guidance for the leader to follow.

3.5.3 Fatigue

One aspect of fit for duty is fatigue management. AECOM has developed procedures that limit work periods or requires additional rest under certain circumstances, including during long-distance travel or when working at high altitudes. These procedures also set limits on extended work periods of 14 hours per day or 60 hours per week. A fatigue management plan is required if longer working hours are necessary (see Fatigue Management Procedure S3AM-009-PR).

3.5.4 Fatigue and Driving Safety

The effect of fatigue is both physiological and psychological and can severely impair a driver's judgement. Fatigue can cause lapses in concentration which could prove fatal. Fatigue is not just a problem for drivers on long trips, as drivers can also suffer from fatigue on short trips.

- ✓ After strenuous fieldwork, consider overnight accommodation or vehicle sharing for staff who are not acclimatized to the type of work.

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- ✓ Microsleep can occur with a limited warning, and may be linked to several factors, for example:
    - Microsleep is most likely to occur during times when the circadian rhythm dictates the body should be asleep, such as at dawn, late at night, or in the mid-afternoon (e.g., 1 and 4 am and 1 and 4 pm.).
    - Potential to feel drowsy after a meal.
    - Driving long distances (considered potentially monotonous) even with sufficient sleep.
    - Prolonged sitting and warm ambient temperature may also increase the feeling of sleepiness.
- ✓ If safe to do so, consider undertaking actions to disrupt the microsleep event while identifying a safe place to stop, e.g., open a vehicle window, listen to upbeat music/change music source or ask the passenger (if present) to engage in conversation.
- ✓ Ensure field staff are familiar with the signs of fatigue and mitigation factors.

The most common visible signs of microsleep include the following:

- Eyelid drooping
- Eyelid closure
- Head nodding
- Brief periods of snoring
- Wandering thoughts

If any of the above become apparent, immediately pull over to a safe location and contact your PM or SH&E representative.

3.5.5 Substance Abuse

Drug and alcohol abuse pose a serious threat to the health and safety of employees, clients, and the general public as well as the security of our job sites, equipment and facilities. AECOM is committed to the elimination of illegal drug use and alcohol abuse in its workplace and regards any misuse of drugs or alcohol by employees to be unacceptable. AECOM Substance Abuse Prevention Procedure (S3AM-019-PR) prohibits the use, possession, presence in the body, manufacture, concealment, transportation, promotion or sale of the following items or substances on company premises. Company premises refer to all property, offices, facilities, land, buildings, structures, fixtures, installations, aircraft, automobiles, vessels, trucks and all other vehicles and equipment - whether owned, leased, or used.

- Illegal drugs (or their metabolites), designer and synthetic drugs, mood or mind altering substances, and drug use related paraphernalia unless authorized for administering currently prescribed medication;
- Controlled substances that are not used in accordance with physician instructions or non-prescribed controlled substances; and
- Alcoholic beverages while at work or while on any customer- or AECOM-controlled property.

This policy does not prohibit lawful use and possession of current medication prescribed in the employee's name or over-the-counter medications. Employees must consult with their health care provider about any prescribed medication's effect on their ability to perform work safely and disclose any restrictions to their supervisor.

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Although some states may pass laws legalizing medical or recreational marijuana use, the use, sale, distribution and possession of marijuana are violations of federal law and AECOM policy, and will subject an employee to disciplinary action up to and including termination in accordance with controlling law. In Canada, where medical and recreational marijuana use is legal, employees must still follow Federal and Provincial laws, and AECOM policy with regards to use and possession. Employees found to be in contravention of legal requirements or AECOM policy will be subject to disciplinary action up to and including termination.

3.6 Rewards and Recognition

One of AECOM's Life Preserving Principles is Recognition and Rewards for proactive safety, health and environmentally focused behaviors. All projects are expected to participate in the rewards and recognition programs available on the Corporate and DCS Americas SH&E ecosystem pages. Large, long term projects are encouraged to establish a project specific rewards and recognition program which incorporates project specific goals and activities (template available S3AM-020-FM1). ***All rewards and recognition programs must emphasize the 9 Life Preserving Principles and proactive SH&E activities NOT solely the achievement of lagging metrics ("injury/incident-free" hours, etc.) as those may discourage incident reporting.***

There are several possible appropriate methods of rewarding and recognizing employees and contractors:

1. **Informal** – recognition via verbal acknowledgement, email, spot awards, luncheons, etc.
2. **Formal** – recognition via DCS Americas Programs:
   - AECOM Safety Star Recognition Program
   - AECOM Making a Difference (MAD) Award
   - Executive Challenge Coins





3.7 Hand Safety

The hands are exposed to hazards more than any body part. SH&E Hand Safety Procedure S3AM-317-PR describes requirements and best practices including these notable practices:

- **All personnel shall have gloves in their immediate possession 100%** of the time when in a shop or on a work site. Gloves that address the hazard shall be worn when employees work with or near any materials or equipment that present the potential for hand injury due to sharp edges, corrosives, flammable and irritating materials, extreme temperatures, splinters, etc. Use the Gloves Needs Assessment (S3AM-317-FM1) to help determine the appropriate glove for the hazard(s).

- **Fixed open-blade knives are prohibited** from use during the course of AECOM work. Examples of fixed open-blade knives include pocket-knives, multi-tools, hunting knives, and standard utility knives. For more information about cutting tools, see S3AM-317-ATT1 Safe Alternative Tools.

3.8 Safety Observations

Safety observations are observations made by employees or subcontractors of a condition or behavior which could contribute to an incident, prior to the incident occurring. Observations can also identify positive behaviors or

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interventions which contribute to the prevention of incidents. Large, long-term projects may benefit from the use of LifeGuard™ to track and trend observations on a site level. All other projects should log their observations using IndustrySafe™. Both reporting systems can be accessed on any safety page of Ecosystem or by using the QR codes below from a smartphone/device while off the AECOM network.

IndustrySafe Safety Management Software

LifeGuard

3.9 Newly Hired or Transferred Employees

All newly hired or transferred employees with fewer than 6 months experience working on field projects or an employee who has not completed the required training or received required certifications are considered "Short Service Employees", or "SSEs" (see the Newly Hired or Transferred Employees procedure, S3AM-015-PR). The Project Manager will identify all SSEs working on the project, and each SSE will be assigned to an experienced team member so all activities may be monitored. All SSEs working or visiting a field environment are required to wear a green hard hat for safety and identification purposes. In the event a client has an existing SSEs program, AECOM will defer to the identification system required by the client. Any new employee shall wear the designated SSE identifier until the Project Manager determines the employee has the knowledge, skills, and ability related to the specific hazard on the project.

The project scope of work does **NOT** currently involve SSEs. If it becomes necessary to use one or more SSEs to complete the project scope of work, then they will be evaluated and approved in advance by the AECOM Project Manager prior to mobilizing to site and listed in this HASP.

3.10 Stop Work Authority

AECOM empowers and expects all employees to exercise their Stop Work Authority (see Stop Work Authority Procedure S3AM-002-PR) if an incident appears imminent, or when hazardous behaviors or conditions are observed. A stop work request can be informal if the situation can be easily corrected or may require shutting down operations if revised procedures are necessary to mitigate the hazard. If an AECOM employee observes an imminently hazardous situation on a site controlled by others (i.e., a client-managed contractor), the employee can always stop work for themselves by removing themselves from the situation. Employees also may attempt to stop work to avoid allowing the contractor to come to harm by immediately notifying the contractor foreman or site engineer, or if necessary, the client or party managing the contractor.



No employee should object to the issuance of a stop-work request, nor can any disciplinary action be levied against the employee. All employees must agree that the situation has been mitigated before resuming work. No employee will be disciplined for refusing to work if they feel it is unsafe.

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3.11 Lone Worker Management

AECOM discourages employees from working alone (i.e., where AECOM personnel are out of visual and audio range of others) when performing field tasks (see SH&E Procedure S3AM-314-PR, Working Alone). Note that under no circumstances should Newly Hired or Transferred Employees be permitted to work alone, and lone workers are **NOT** permitted to perform high risk tasks. If lone work is to be performed, a communications/check-in plan must be developed. The scope of work outlined in Section 2.3 **does** involve lone worker operations. Lone workers will be managed as outlined in the table below.

Lone Worker Management Plan

Lone Worker Justification:	The primary scope of work for this HASP is NAPL monitoring and recovery which only requires one worker on-Site to complete the required tasks.		
Lone Worker:	*Role/Position:*	On-Site Personnel	
	Name:	Sunil Samaroo, Megan Dascoli, Adib Rahman or other qualified on-Site personnel as directed by the Project Manager.	
	Contact Number:	908-797-3796, 908-623-0145, 631 – 942 - 9700 respectively	
	Task(s):	▪ NAPL monitoring and recovery THA(s) address lone worker operations: ☒ Yes ☐ No THA(s) are included in Attachment B: ☒ Yes ☐ No	
Check-In Contact:		**PRIMARY**	**ALTERNATE**
	Name:	Melissa Saunders	Peter Cox
	Contact Number:	206-502-7914	978-764-4257
	Title/Relationship:	Project Manager	Alternate AECOM Contact
Check-In Requirements:	*Method(s):*	☐ Voice ☒ Text ☐ Email ☐ In-Person ☐ Lone Worker App ☐ Other: [Specify]	
	Frequency/Time:	Within one hour of arrival and on departure	
	Recordkeeping:	Check-ins to be recorded in field notes	
Response Plan:	Check-In Missed:	• Check-in contact will attempt to reach lone worker again through voice call and follow-up with text.	
	1st Contact Attempt Fails:	1. A backup employee (TBD) will be dispatched.	
	2nd Contact Attempt Fails:	1. Emergency services (911) will be contacted.	

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4. ROLES AND RESPONSIBILITIES

Roles and responsibilities for the project team are defined below. The Project Manager (PM) is ultimately responsible for the development of this HASP and establishing a budget to implement the controls and training required. The PM is also responsible for ensuring that the plan is implemented, that appropriate documentation is generated, and that records are maintained. The SH&E Manager is responsible for reviewing and approving this HASP and assisting with other SH&E matters upon request. A Site Safety Officer may be appointed to oversee implementation of the HASP in the field. All project team members are responsible for reviewing and abiding by this HASP, performing daily (or more frequent) task hazard assessments, stopping work when necessary to correct unsafe behaviors or conditions, and reporting incidents promptly to the PM and AECOM Incident Reporting Hotline.

DCS Americas Incident Hotline: 1-800-348-5046

4.1 Project Manager

The Project Manager (PM) has overall management authority and responsibility for all site operations, including safety. The PM will provide the site supervisor with work plans, staff, and budgetary resources, which are appropriate to meet the safety needs of the project operations. Some of the PM's specific responsibilities include:

- Project start-up activities require appropriate SH&E planning prior to work commencing, including identification of hazards, associated risk, and appropriate controls for each task and operation found in the work scope.
- Completed project risk registers /task hazard assessments shall be incorporated into the Project's HASP.
- Verifying that personnel, to whom this HASP applies, including AECOM subcontractors, have received a copy of it, with ample opportunity to review the document and to ask questions.
- Providing the concurring SH&E Manager with updated information regarding conditions at the site and the scope of site work if changes occur that will affect the accuracy of this HASP.
- Providing adequate authority and resources to the Site Supervisor or Site Safety Officer to allow for the successful implementation of all necessary SH&E Procedures.
- Maintaining regular communications with the Site Supervisor or Site Safety Officer and, when necessary, the AECOM Client SH&E Program Manager.
- Coordinating the activities of AECOM subcontractors and ensuring that they are aware of the pertinent health and safety requirements for these projects, when applicable.
- Conducting Safety System Auditing by way of Management Site Visits and/or Project Manager Self-Assessments on a regular basis.
- Approving amendments to the HASP (in conjunction with the Site Supervisor or Site Safety Officer).
- Coordinating activities with the client as needed to ensure the safe implementation of this HASP.

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4.2 Site Supervisor

The Site Supervisor has the overall responsibility and authority to direct work operations at the job site according to the provided work plans and HASP. The Project Manager may act as the Site Supervisor while on site. The Site Supervisor's responsibilities include:

- Discussing deviations or drift from the work plan with the Site Safety Officer and Project Manager.
- Discussing safety issues with the Project Manager, Site Safety Officer, and field personnel.
- Assisting the Site Safety Officer with the development and implementation of corrective actions for site safety deficiencies.
- Assisting the Site Safety Officer with the implementation of this HASP and ensuring compliance.
- Assisting the Site Safety Officer with inspections of the site for compliance with this HASP and applicable SH&E Procedures.
- Reviewing Project Risk Register/ Task Hazard Assessments and Task Hazard Assessments (THAs) with the work crew.
- Reporting incidents and ensuring incidents and observations are logged into Lifeguard or IndustrySafe.
- Verifying that all operations follow the requirements of this HASP and halting any activity that poses a potential hazard to personnel, property, or the environment.
- Temporarily suspending individuals from field activities for infractions against the HASP pending consideration by the Site Safety Officer, the SH&E Manager, and the Project Manager.

4.3 Site Safety Officer

The Site Safety Officer supports the Site Supervisor in providing a safe work environment. Not all sites will have a designated Site Safety Officer; the decision should be made by the Project Manager and SH&E Manager taking into consideration the complexity and risks of the scope of work. The Site Supervisor may act as the Site Safety Officer on sites without one. The Site Safety Officer's responsibilities include:

- Updating the site-specific HASP to reflect changes in site conditions or the scope of work. HASP updates must be reviewed and approved by the SH&E Manager.
- Inspecting the site for compliance with this HASP and the SH&E Procedures using the appropriate field audit inspection checklist found in IndustrySafe.
- Coordinating with Site Supervisor to review THAs with the work crew.
- Assisting as needed to report incidents and verify that incidents and observations are logged into Lifeguard or IndustrySafe.

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- Working with the Site Supervisor and Project Manager to develop and implement corrective action plans to correct deficiencies discovered during site inspections. Deficiencies will be discussed with project management to determine appropriate corrective action(s).
- Contacting the SH&E Manager for technical advice regarding safety issues.
- Determining emergency evacuation routes, establishing and posting local emergency telephone numbers, and arranging emergency transportation.
- Checking that all site personnel and visitors have received the proper training, orientation and medical clearance prior to entering the site.
- Establishing controlled work areas (as designated in this HASP or other safety documentation).
- Facilitating or co-leading daily tailgate meetings and maintaining attendance logs and records.
- Discussing potential SH&E hazards with the Site Supervisor, the SH&E Manager and the Project Manager.
- Selecting an alternate Site Safety Officer by name and informing him/her of their duties, in the event that the Site Safety Officer must leave or is absent from the site.
- Verifying that all operations follow the requirements of this HASP.
- Issuing a "Stop Work Order" under the conditions set forth in this HASP.
- Temporarily suspending individuals from field activities for infractions against the HASP pending consideration by the SH&E Manager and the Project Manager.

4.4 Employees

Responsibilities of employees associated with this project include, but are not limited to:

- Understanding and abiding by the SH&E Procedures specified in the HASP and other applicable safety policies, and clarifying those areas where understanding is incomplete.
- Providing feedback to SH&E management for continuous improvement relating to omissions and modifications in the HASP or other safety policies and procedures.
- Notifying the Site Supervisor or Site Safety Officer of unsafe conditions and acts.
- Stopping work if there is doubt about how to safely perform a task or if unsafe acts or conditions are observed (including subcontractors or team contractors).
- Speaking up and refusing to work on any site or operation where the SH&E procedures specified in this HASP or other safety policies are not being followed.
- Contacting the Site Supervisor or Site Safety Officer or the SH&E Manager at any time to discuss potential concerns and update the THA in the field to reflect the modifications. Provide THA feedback to the supervisor for continuous improvement

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- Calling the AECOM Hotline if an SH&E incident happens (+1-800-348-5046)
- Provide THA feedback to the supervisor for continuous improvement.

4.5 Subcontractors

No subcontractors are currently engaged on this Site. If it becomes necessary to use one or more subcontractors to complete the project scope of work, they will be evaluated in advance by the AECOM Project Manager and approved by the AECOM Project Manager and Regional SH&E Manager, as appropriate, prior to mobilizing to site, and listed in the Subcontractor section of the HASP Summary.

The requirements for subcontractor selection and subcontractor safety responsibilities are outlined in AECOM Procedure S3AM-213-PR Subcontractor Management. The Project Manager is responsible for determining that the subcontractors being selected have been prequalified to work through the use of Subport or alternately stringent process as specified in the procedure. Each AECOM subcontractor is responsible for assigning specific work tasks to their employees. Each subcontractor's management will provide qualified employees and allocate sufficient time, materials, and equipment to safely complete assigned tasks. In particular, each subcontractor is responsible for equipping its personnel with any required personnel protective equipment (PPE) and all required training.

Each subcontractor that will be contracting any portion of their scope of work is required to obtain authorization to use those subcontractors that were not directly hired by AECOM prior to their mobilization to site. In addition, AECOM direct subcontractor is required to communicate both AECOM and client requirements and expectations to their subcontractors. The AECOM PM is required to confirm that all subcontractors used on the project meet both AECOM and client Safety, Health and Environment (SH&E) Evaluation Criteria, requirements and expectations. This includes confirming that individuals are competent to perform their assigned tasks and duties, obtaining authorization to use one or more short-service employees, and confirming that verification of competency can be provided upon request. In addition, the Project Manager must approve the use of all subcontractors (no matter the level) prior to their mobilization to site.

AECOM considers each subcontractor to be an expert in all aspects of the work operations for which they are tasked to provide, and each subcontractor is responsible for compliance with the regulatory requirements that pertain to those services as well as all other requirements applicable to their work. Each subcontractor is expected to perform its operations in accordance with its own unique safety policies and procedures applicable to work that is exclusive to their activities on the site, and for which they may have superior knowledge. All subcontractor procedures must at a minimum comply with client and AECOM requirements in order to ensure that hazards associated with the performance of the work activities are properly controlled. Copies of any required safety documentation for a subcontractor's work activities will be provided to AECOM for review prior mobilization to the site.

Hazards not listed in this HASP but known to any subcontractor, or known to be associated with a subcontractor's services, must be identified and addressed to the AECOM Project Manager or the Site Supervisor prior to beginning work operations. The Site Supervisor or authorized representative has the authority to halt any subcontractor operations, and to remove any subcontractor or subcontractor employee from the site for failure to comply with established health and safety procedures or for operating in an unsafe manner.

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4.6 Visitors

Authorized visitors (e.g., client representatives, regulators, AECOM management staff, etc.) requiring entry to any work location on the site will be briefed by the Project Manager, Site Supervisor, or Site Safety Officer on the hazards present at that location and sign onto the daily THA as a visitor. Visitors will be escorted at all times at the work location and will be responsible for compliance with their employer's health and safety policies. In addition, this HASP specifies the minimum acceptable qualifications, training and PPE that are required for entry to any controlled work area; visitors must comply with these requirements at all times.

If the site visitor requires entry to any exclusion zone (EZ), but does not comply with the above requirements, the visitor will be denied access to the EZ. If the visitor disregards instructions to remain outside the EZ, work activities will be immediately suspended, and the situation reported and documented.

Unauthorized visitors, and visitors not meeting the specified qualifications, will **NOT** be permitted within established controlled work areas. If unauthorized visitors and/or visitors not meeting the specified qualifications enter a controlled work area and/or EZ, work activities will be immediately suspended, and the situation reported and documented.

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5. TRAINING AND DOCUMENTATION

The following sections describe the standard practices or programs that AECOM will establish to prepare employees to perform work safely and consistent with AECOM policy and Procedures.

5.1 HASP/Site Orientation

The Project Manager shall conduct a project/site-specific HASP orientation prior to the start of field operations, with support as needed by the SH&E Manager, Site Safety Officer, or Site Supervisor. This meeting will involve representatives from all organizations with a direct contractual relationship with AECOM on the job site. Minimum items to be covered are listed in **Attachment E**. Participants will then sign the HASP Personnel Acknowledgement register at the end of the HASP.

5.2 Daily Tailgate Meetings and THA Reviews

The Site Supervisor, Site Safety Officer or designee shall facilitate a tailgate meeting to discuss the specific requirements of this HASP and review the applicable THAs prior to the commencement of daily project activities. Attendance at the daily tailgate meeting is mandatory for all employees and subcontractors at the site contracted to AECOM. Simultaneous operations are encouraged to attend each other's tailgate meetings or at the very least the supervisors shall discuss the coordination of activities and associated hazards of each other's tasks. The supervisor will then convey the information to the work crew. The Tailgate Meeting must be documented by the Site Supervisor or Site Safety Officer on a Daily Tailgate Meeting form, a blank copy of which is included in **Attachment B**.

As part of the daily tailgate meeting, employees and subcontractors will be encouraged to voluntarily warm up and stretch select muscle groups to the best of their ability and within each person's individual limitations. Stretching is particularly beneficial to warm and loosen muscles before repetitive work, manual handling of loads, and when working in cold temperatures or with static postures. The exercises included in Attachment D may be used to facilitate these efforts.

5.3 Worker Training and Qualifications

All personnel at this site must be qualified and experienced in the tasks they are assigned. SH&E Training Procedure S3AM-003-PR establishes the general training requirements for AECOM employees.

Check all required training on the table below. Verify training records of employees and subcontractors.

Site Specific Training Requirements

Training		Applies to
☒	ERP/HASP and Site Orientation	All Employees and Subcontractors
☒	Vehicle/Driver Safety & Defensive Driving	All Employees who drive on behalf of AECOM
☒	Field Safety	Employees visiting the field that does not require HAZWOPER

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Site Specific Training Requirements

Training		Applies to
☒	Speak Up/Listen Up (SULU)	All AECOM field employees and supervisors
☒	First Aid / CPR	Designated employees or employees performing high risk activities and medical attention is more than 4 minutes away
☒	Respiratory Protection & Fit Test	Employees needing to wear respirators
☒	OSHA 10-Hr. Construction Safety (or CSTS 2020 in Canada)	Refer to Section 5.3.1 for guidance
☐	OSHA 30-Hr. Construction Safety	Refer to Section 5.3.1 for guidance
☒	HAZWOPER 40-Hour and 8-Hr. Annual Refresher	On HAZWOPER sites, in EZ, exposed to hazardous contamination
☒	HAZWOPER Supervisor	Employees managing others in HAZWOPER activities or at HAZWOPER Sites
☒	Hazardous Materials Shipping (U.S.)	Employee responsible for shipping HZM/HZW/DG and/or signing manifests
☐	Transportation of Dangerous Goods (CAN)	Employees responsible for shipping/transporting regulated hazardous materials that exceed regulatory requirements
☒	Annual Medical Surveillance / Clearance	Employees working in an exclusion zone and the regulatory required exposure limit **is** exceeded for 30 or more days a year
☐	Biennial Medical Surveillance / Clearance	Working in an exclusion zone more than 30 days a year and the regulatory required exposure limit is **NOT** exceeded
☐	Under Bridge Inspection Unit (UBIU) AECOM University module	Employees working in a UBIU
☒	All-Hands Coronavirus Training:	All Employees performing work during the COVID-19 Pandemic
☐	Local and/or Client Requirements:	[If applicable, specify]

5.3.1 OSHA 10-Hr. (or CSTS 2020)/OSHA 30-Hr. Training

OSHA 10 (or CSTS 2020 in Canada) and OSHA 30 training is required for projects with construction, demolition or construction/industrial-like hazards. "Construction//industrial-like hazards" occur on sites where the focus is **not** construction/industrial activities, but where our scope includes work activities involving work at heights, confined space, hot work, and/or lifting/hoisting loads or work around heavy construction equipment or "yellow iron." Examples of heavy construction equipment include excavators, bull dozers, graders, articulated dump trucks, pile drivers, and large air or mud rotary drill rigs. Smaller equipment like bobcats, road worthy commercial trucks, and hollow-stem auger drill rigs would not be considered heavy construction equipment.

This training is needed if this type of work is being performed within our work area or if it may impact our work area. It is not applicable if our work area is separated from the construction/demolition/industrial area with enough distance or physical barriers that fully prevent exposure of our team to those hazards. This includes projects where we serve as Inspectors, or any work where our employees are exposed to construction/industrial site hazards.

OSHA 30 hr. training is required for supervisors in the United States. The term "supervisor" has many different

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meanings. The requirement to complete the OSHA 30 hr. course will be based on field supervisory roles and responsibilities, not administrative supervision roles. Field supervisors required to take the OSHA 30 course are defined as those individuals who provide work direction and leadership directly to AECOM field personnel and/or our subcontractors for construction/demolition activities or tasks that have construction/industrial-like hazards. These supervisors must be knowledgeable of construction hazards and controls because they are responsible for:

- Field implementation of a construction/demolition scope of work;
- Controlling performance on the job site;
- Evaluating and controlling hazards & preventing site safety risks; and
- Intervening to prevent unsafe actions or conditions of employees, clients, and subcontractors related to construction/demolition hazards.

5.4 Competent Person

A competent person is an employee who, through education, training, and experience, has knowledge of applicable regulatory requirements, is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

AECOM's Competent Person Designation Procedure, S3AM-202-PR, explains the roles, responsibilities and procedures of naming a competent person. Complete the table below and include an S3AM-202-FM1 Competent Person Designation Form for each AECOM competent person (subcontractors to use an equivalent process). The following activities require and have been assigned a competent person:

Competent Person Log

Activity / Area of Competency		Name of Person (Affiliation) **Note: Subcontractor may provide this person**
☐	Asbestos	
☐	Assured Equipment Grounding Conductor	
☐	Blasting & Explosives	
☐	Concrete & Masonry Construction	
☐	Confined Spaces	
☐	Control of Hazardous Energy (Lockout-Tagout)	
☐	Crane Assembly / Disassembly	
☐	Cranes & Derricks	
☐	Demolition	
☐	Electrical Wiring Design & Protections	
☐	Elevated Work Platforms & Aerial Lifts	
☐	Fall Protection	
☒	Hearing Protection	Sunil Samaroo, Megan Dascoli
☒	Heavy Equipment	Sunil Samaroo, Megan Dascoli

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Competent Person Log

Activity / Area of Competency		Name of Person (Affiliation) **Note: Subcontractor may provide this person**
☐	Ionizing Radiation	
☐	Lead	
☐	Material Hoists & Personnel Hoists	
☒	Respiratory Protection	Sunil Samaroo, Megan Dascoli, Adib Rahman
☐	Rigging Equipment	
☐	Scaffolds	
☐	Stairways & Ladders	
☐	Steel Erection	
☒	Trench & Excavations	Sunil Samaroo, Megan Dascoli
☐	Underground Construction	
☐	Welding & Cutting	

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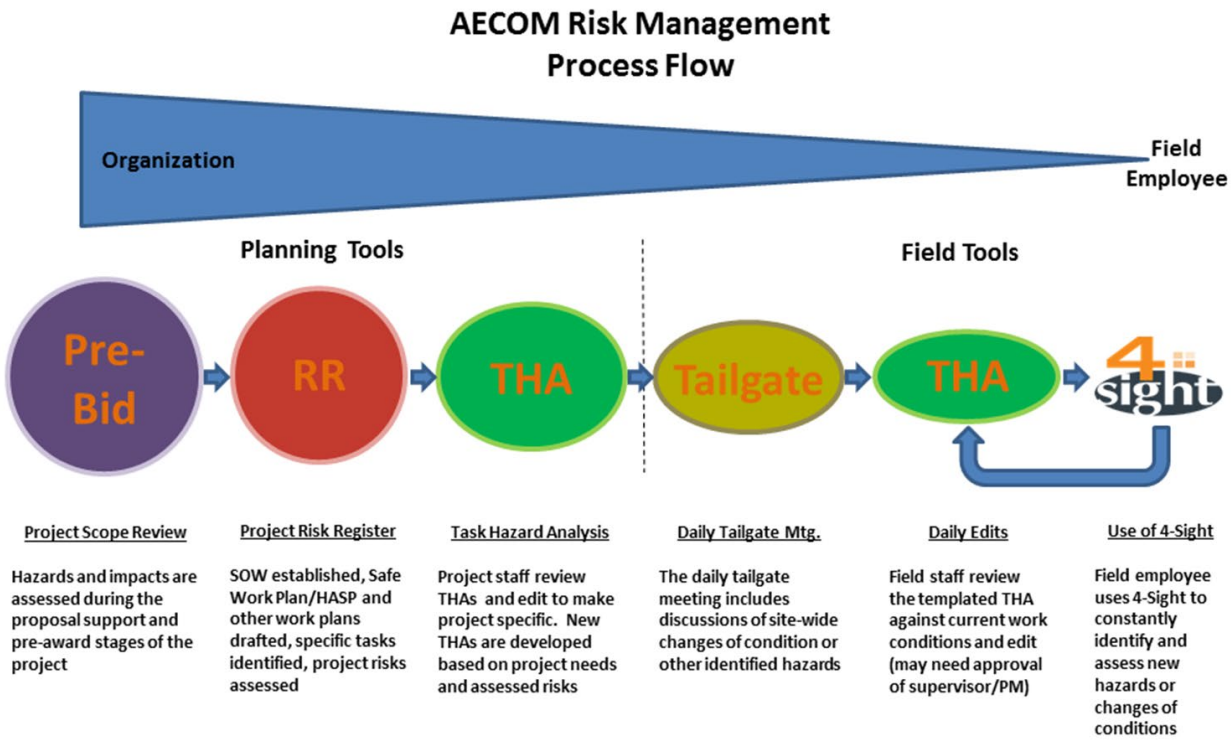
6. HAZARD ASSESSMENT AND CONTROL

AECOM has adopted an approach to hazard assessment and control that incorporates both qualitative and quantitative methods to identify hazards and the degree to which they may impact employees and AECOM operations. See S3AM-209-PR, Risk Assessment and Management, for details regarding AECOM's process. This approach is illustrated below and described in the following section.



6.1 SH&E Procedures

All AECOM SH&E procedures, in their controlled copy version, are available on the internal SH&E Policy and Procedures ecosystem page. Programmatic procedures referenced in this document (for example SH&E Training) do no need to be printed for inclusion in this HASP. The applicable field procedures checklist is in the Physical Hazards section below and procedures are included in **Attachment C**.

6.2 Task Hazard Assessments (THAs) and Daily Tailgate Meeting Form

THA forms (a blank version is located in S3AM-209-PR) shall be prepared for each task to be performed as part of the scope of work. This includes driving to the site, parking, and walking as well as the hazards, associated risk, and appropriate controls for all other work activities. The DCS Americas Templated THA Library may also be used to find

previously approved THAs, though these should be modified to be project and site-specific. The preparer shall have one THA form for each task in the Scope of Work found in this work plan (**Attachment B)** and shall also include blank copies.

In the field, all employees and visitors shall review the daily the THAs and complete and sign the Daily Tailgate Meeting Form S3AM-209-FM5. Many times, when employees arrive in the field, situations are different than originally planned for or additional job steps are required. The THA asks workers update or 'dirty up' the THA in the 'On-Site Edits' rows to assess the risks presented by the changed condition and requires the worker to describe steps to reduce the risk. If the hazard(s) cannot be successfully mitigated, the work is **NOT** allowed to proceed.

6.2.1 Hazard Categories

THAs should include consideration of the following hazard categories when identifying hazards and task specific controls:

Category	Definition
	A biological hazard is any living organism that could cause irritation, allergic reaction, bites, stings, illness, infection, or other injury.
	A chemical hazard is any chemical substance that could potentially cause harm to humans, equipment, or the environment either through contact, ingestion, absorption, inhalation, or reaction.
	Electrical hazards are present whenever there is potential for contact with an electric charge.
	Gravitational force can cause tools, equipment, materials, and people to fall either to the same level or from heights to the earth or a lower surface.
	A mechanical hazard when there is energy within the components of a mechanical system within an otherwise stationary piece of equipment/machinery.
	Objects or substances that can move or are moving not due to gravity create a motion hazard. Motion hazards also include body motions and positioning such as bending, stretching, kneeling, etc.
	Noise hazards are sounds that may prevent effective communication or cause hearing loss.
	Any physical matter such as gases, liquids, and springs that is compressed or under a vacuum creates a pressure hazard.
	Radiation hazards include both ionizing and non-ionizing energy emitted from radioactive elements or sources.
	Thermal hazards can cause injury or damage due to their temperature.

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6.3 4 Sight

When preparing hazard assessments and throughout the day workers should use 4-Sight. This is a mental process through which workers ask themselves (and each other) four questions designed to effectively assess hazards. Using these questions during each task, especially those without established THAs, will help workers identify hazards and condition changes so that they can control them or stop work to seek assistance.



- **What am I about to do?**
- **What could go wrong?**
- **What could be done to make it safer?**
- **What have I done to communicate the hazard?**

6.4 Speak Up/Listen Up

All AECOM employees have a responsibility to help create the environment where the expectation is Safety for Life. Speak Up/Listen Up (SULU) is a technique to steward jobsite safety by utilizing 4-Sight as a basis for safety feedback conversations. SULU has two main parts:

- **Speak Up** where employees use three simple steps when providing feedback to others about unsafe acts:
    - Ask to discuss their hazard assessment or 4-Sight for the task;
    - Get a commitment from the employee to apply the hazard controls and perform the task according to the accepted procedures; and
    - Follow up to ensure the employee is working safely

- **Listen Up** where employees use two simple steps when responding to safety feedback:
    - Listen – Focus on the message, not the messenger; and
    - Commit to performing the task the safer way

SULU conversations should happen consistently throughout the workday to create clear expectations of how work should be performed. All employees should recognize safe work behaviors in order to reinforce them and keep them going. An occasional correction is much more effective when employees are frequently encouraged and positively recognized for their safe actions. Managers and supervisors should be having SULU conversations during site visits and ensure peer to peer and site supervisor to crew SULU conversations are being held.

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7. PHYSICAL AND BIOLOGICAL HAZARD ASSESSMENT

A physical hazard is a hazard that threatens the physical safety of an individual; contact with the hazard typically results in an injury. The following table summarizes the physical hazards or activities containing physical hazards present at the site and the associated procedures that address protection and prevention of harm.

All checked procedures MUST be included in **Attachment C** for implementation and reference. The following hazards and their site specific description are anticipated based on the scope of work and project site:

Hazard/ Activity (Note: Text in this column links to procedure)	**Site Specific Description** (Where, What Phase of Work, Frequency, Etc.)	**Applicable Procedure**
☐ Abrasive Blasting		S3AM-335-PR
☐ Aerial Work Platforms		S3AM-323-PR
☐ All-Terrain Vehicles		S3AM-319-PR
☐ Blasting and Explosives		S3AM-336-PR
☒ Bloodborne Pathogens	First aid providers	S3AM-111-PR
☐ Cofferdams		S3AM-344-PR
☒ Cold Stress	Continuous exposure when ambient air temperature is below 32 °F (0 °C) **or** when ambient air temperature is below 50 °F (10 °C) with wet/damp conditions.	S3AM-112-PR
☐ Compressed Air Systems and Testing		S3AM-337-PR
☒ Compressed Gases	Calibration gas canisters	S3AM-114-PR
☐ Concrete Work		S3AM-338-PR
☐ Confined Spaces		S3AM-301-PR
☒ Corrosive Reactive Materials	Handling pre-preserved bottle ware for sampling	S3AM-125-PR
☐ Cranes and Lifting Devices		S3AM-310-PR
☐ Demolition		S3AM-339-PR
☐ Diving (scientific and commercial)		S3AM-334-PR
☒ Drilling, Boring & Direct Push Probing	Groundwater well rehabilitation work	S3AM-321-PR
☒ Electrical Safety	Working with generators and batteries	S3AM-302-PR
☐ Excavation & Trenches		S3AM-303-PR
☐ Fall Protection		S3AM-304-PR
☒ Flammable and Combustible Liquids	Gasoline used in cars/trucks; portable generator	S3AM-126-PR
☐ Gauge Source Radiation		S3AM-122-PR
☒ Hand and Power Tools	Drilling; Accessing monitoring wells	S3AM-305-PR

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Hazard/ Activity (Note: Text in this column links to procedure)	Site Specific Description (Where, What Phase of Work, Frequency, Etc.)	Applicable Procedure
☒ Hazardous Waste Operations	Generating hazardous and remediation-derived waste (RDW)	S3AM-117-PR
☒ Heat Stress	Continuous exposure when ambient air temperature is above 80 °F (26.6 °C) and a standard work uniform is worn **or** when ambient air temperature is above 70 °F (21.1 °C) and impermeable chemical protective clothing is worn.	S3AM-113-PR
☒ Heavy Equipment	Working alongside drilling equipment	S3AM-309-PR
☐ High Altitude		S3AM-124-PR
☒ Highway and Road Work	Working alongside roadways and sidewalks	S3AM-306-PR
☐ Hoists Elevators and Conveyors		S3AM-343-PR
☐ Hot Work		S3AM-332-PR
☐ Ladders		S3AM-312-PR
☐ Lockout Tagout		S3AM-325-PR
☐ Machine Guarding Safe Work Practice		S3AM-326-PR
☐ Marine Safety and Vessel Operations		S3AM-333-PR
☒ Material Storage	Storage of materials in field storage unit	S3AM-316-PR
☐ Mine Site Activities		S3AM-341-PR
☐ Mining Operations		S3AM-345-PR
☐ Noise		S3AM-118-PR
☐ Non-Ionizing Radiation		S3AM-121-PR
☐ Overhead Lines		S3AM-322-PR
☒ Pandemic Virus	Potential exposure during travel and field task(s)	SR1-003-PR2
☐ Powder-Actuated Tools		S3AM-327-PR
☐ Powered Industrial Trucks		S3AM-324-PR
☐ Radiation		S3AM-120-PR
☐ Railroad Safety		S3AM-329-PR
☒ Respiratory Protection	Removing free product from wells. Will be needed if action level is exceeded.	S3AM-123-PR
☐ Scaffolding		S3AM-311-PR
☐ Steel Erection		S3AM-340-PR
☐ Temp. Floors, Stairs, Railings, Toe-boards		S3AM-342-PR
☒ Underground Utilities	Manual preclearing prior to drilling	S3AM-331-PR
☐ Underground Work		S3AM-330-PR
☒ Wildlife, Plants and Insects	During field work; Pay particular attention for ticks.	S3AM-313-PR
☒ Working Alone	Groundwater sampling/well maintenance and NAPL gauging and recovery work.	S3AM-314-PR

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Hazard/ Activity (Note: Text in this column links to procedure)	Site Specific Description (Where, What Phase of Work, Frequency, Etc.)	Applicable Procedure
☐ Working on and Near Water		S3AM-315-PR

7.1 Pandemic Virus

COVID-19 is a disease that results from infection of the virus identified as SARS-CoV-2. SARS-CoV-2 is a Coronavirus, one of a large family of viruses found in both animals and humans. Some infect people and are known to cause illness ranging from the common cold to more severe diseases such as Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS) with symptoms such as fever, cough, and shortness of breath. Key AECOM resources can be found at the AECOM Ecosystem Coronavirus Information Center on the Ecosystem homepage or at this link, the Coronavirus Smart Card, and the AECOM Pandemic Procedure: SR1-003-PR2. Additional resources can be found at the following non-AECOM websites:

- Center for Disease Control and Prevention (CDC).
- World Health Organization (WHO).

The following National Grid guidance is provided in **Attachment G**:

- National Grid Safety Procedure, A-116 COVID-19 Health & Safety Plan, Rev. No. Initial dated 4/28/2020.
- National Grid Pandemic Plan Protocol dated 3/18/2020.

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8. CHEMICAL HAZARD ASSESSMENT

A chemical hazard is a type of occupational hazard caused by exposure to chemicals in the workplace. Exposure to chemicals in the workplace can cause acute or long-term detrimental health effects. Potential exposure to chemical hazards on AECOM projects can come from several sources including materials brought on site to perform work, constituents of concern found in environmental media under investigation, and simultaneous operations being performed at the site by the property owner/third parties.

8.1 Potential Exposure Pathways

Occupational exposure to chemical hazards associated with the work activities could potentially occur by two primary routes (inhalation and skin contact) and one indirect route (incidental ingestion). These exposure pathways are discussed below.

8.1.1 Inhalation

The primary risks associated with AECOM's scope of work pertain to potential exposure to airborne contaminants and explosion hazards. Constituents that potentially pose an occupational concern to employees by the inhalation route are carbon monoxide, hydrogen sulfide, methane, and volatile organic compounds. Air monitoring may be performed in the work area and within the employee's breathing zone to assess the need to implement appropriate control measures or stop work. In addition, air monitoring will be performed at the source to assess potential explosion hazards. See Section 9, Air Monitoring for additional information regarding the air monitoring requirements for this project.

8.1.2 Skin Contact (Absorption)

Personnel handling residual product or waste and associated equipment may be exposed to chemical hazards by skin contact or adsorption. However, exposure is expected to be limited since workers will be required to wear appropriate PPE (i.e., appropriate work gloves, body clothing, and/or face shield).

8.1.3 Ingestion

Personnel handling residual product or waste and associated equipment, including project hazardous materials, may be exposed by incidental ingestion. Typically, this exposure occurs if proper PPE was not used or personal hygiene was not practiced. Personal protection against exposure via ingestion can be accomplished by performance of proper decontamination procedures when exiting contaminated work areas as well as using the correct PPE.

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8.1.4 Sources of Potential Chemical Exposures

Depending on the source of potential chemical hazard and the likelihood of exposure, certain measures will be taken to protect AECOM employees as specified below.

☐	Exposure to chemical hazards is **NOT** anticipated
☐	Hazardous chemicals will be used to perform the work (see Section 8.2)
☒	Exposure to constituents of concern found in environmental media is likely (See Section 8.3)
☐	Exposure to chemical hazards is possible due to activities of the site owner or other parties (see Section 8.4)

8.2 Hazardous Materials Communication

Hazardous materials that will be used on the site to perform the work can include a variety of products including sample preservatives, grout, concrete, paints, adhesives, decontamination solutions, etc. Safety data sheets (SDSs) must be available for all hazardous products that will be stored or used on the site that exceed usual household quantities.

Their properties, hazards, and associated required controls will be communicated to all affected staff and subcontractors in accordance with the requirements of AECOM Procedure S3AM-115-PR Hazardous Materials Communication including these key elements:

- All personnel shall be briefed on the hazards of any chemical product they use and shall be aware of and have access to the Safety Data Sheets (SDS).
- All containers on site shall be properly labeled to indicate their contents. Labeling on any containers not intended for single-day, individual use shall contain additional information indicating potential health and safety hazards (flammability, reactivity, etc.).

In addition, any employee or organization (contractor or subcontractor) intending to bring any hazardous material onto this AECOM-controlled work site must first provide a copy of the item's SDS to the Site Supervisor or Site Safety Officer for review and filing. The Site Supervisor or Site Safety Officer will maintain copies of all SDS on site and in **Attachment F**. SDS may not be available for locally obtained products, in which case an alternate form of product hazard documentation will be acceptable.

See S3AM-110-PR, Toxic and Hazardous Substances, for information on planning, training, monitoring, and details on several specific chemicals (Benzene, Cadmium, Chromium, Hydrogen Sulfide, Lead, and Silica).

8.3 Constituents of Concern

Based on information obtained from historical investigations and other sources, the chemicals in the table below are known or suspected to be present at the site.

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Summary of Hazardous Properties of Contaminant Exposure Hazards

Notes: **PEL……..Permissible Exposure Limit** **IP……..Ionization Potential**
TLV……..Threshold Limit Value **eV……..Electron Volt**

Chemical Name	Media	Primary Routes of Exposure	PEL	TLV	IP (eV)
Metals					
Arsenic	Soil, Wastewater	Dermal	0.5 mg/m^3	0.2 mg/m^3	n/a
Chromium VI	Soil	Dermal	0.005 mg/m^3	0.005 mg/m^3	n/a
Cyanide	Soil	Dermal	5 mg/m^3	5 mg/m^3	n/a
Lead	Soil.	Dermal	0.05 mg/m^3	0.05 mg/m^3	n/a
Mercury	Soil	Dermal	0.1 mg/m^3	0.025 mg/m^3	n/a
Selenium	Soil	Dermal	0.2 mg/m^3	0.2 mg/m^3	n/a
Other Common Site COCs					
Benzene	Soil, Wastewater	Inhalation	1 ppm	0.5 ppm	9.25
Coal tar pitch hydrocarbons PAH	Soil, Wastewater	Inhalation	0.2 mg/m^3	0.2 mg/m^3	n/a
Ethylbenzene	Soil, Wastewater, Vapor	Inhalation	100 ppm	20 ppm	8.77
Toluene	Soil, Wastewater	Inhalation	200 ppm	20 ppm	8.82
Xylene	Soil, Wastewater	Inhalation	100 ppm	100 ppm	8.45, 8.56

8.3.1 Decontamination

All possible and necessary steps shall be taken to reduce or minimize contact with chemicals and contaminated/impacted materials while performing field activities. Decontamination steps are outlined in Section 4.7 of the Hazardous Waste Operations procedure S3AM-117-PR. Some key elements are as follows:

- All persons and equipment entering the EZ shall be considered contaminated, and thus, must be properly decontaminated prior to exiting to clean areas of the site.
- Avoid reactions between the solutions and contaminated materials. Review the applicable SDS.
- All contaminated PPE and decontamination materials shall be contained, stored and disposed of in accordance with site-specific requirements determined by site management.
- Use caution while working around decontamination stations, including the decontamination pad, which may be a slip or trip hazard.
- Use disposable equipment when possible and practical.
- All employees performing equipment decontamination shall wear the appropriate PPE to protect against exposure to contaminated materials. The level of PPE may be equivalent to the level of PPE required in the EZ. Other PPE may include splash protection, such as face-shields and splash suits, and knee protectors.

All decontaminated equipment shall be visually inspected for contamination prior to leaving the Contaminant Reduction Zone (CRZ). The decontamination area will be covered with plastic sheeting that will be replaced when torn or heavily soiled at the end of each shift.

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Decontamination Procedures & Equipment

Procedure	Equipment Needed
• Remove all equipment, sample containers, and field notes to the CRZ. • Obtain decontamination solutions and decontaminate the tools (shovels, auger flights, etc.) by brushing them under a water rinse. A high-pressure steam cleaner also may be used for decontamination. All waste and spent decontamination solutions will be properly contained. • Remove disposable booties, or scrub boots with a stiff bristle brush and water, when necessary. Washtubs and chairs will be provided. • Remove outer gloves (and boot covers, if used). • Remove Tyvek® coveralls; discard in provided container. • Remove hardhat and eye protection. • Remove respirator. • Remove inner gloves. • Wash hands and face.	Alconox solution Deionized water Brushes Plastic sheeting

Equipment Decontamination Procedures

Type Equipment	Decontamination Solution	Procedure
Respirator	Alconox, solution and deionized water	**Washing:** Disassemble and wash with an Alconox solution in deionized water. A stiff bristle (not wire) brush may be used. **Rinsing:** Rinse in deionized water to remove all traces of detergent. This is important to prevent dermatitis. **Disinfecting:** Thoroughly rinse or immerse in a sanitizer provided by the manufacturer. **Final Rinsing:** Rinse thoroughly in clean water to remove all traces of disinfectant. **Drying:** Drain and dry by hanging by the straps from racks or by towel drying with clean, soft cloths or paper towels.
Water quality probe, oil water interface probe, down-hole water sampling pumps, reusable sampling tools/equipment	Alconox solution and deionized water	**Washing:** Disassemble and wash with an Alconox solution in deionized water. **Rinsing:** Rinse in deionized water to remove all traces of detergent.
Drilling Equipment/Tools	High-pressure steam cleaner	Apply steam cleaner to used equipment/tools.

Waste Handling for Decontamination

Waste Streams/Products	Disposal Procedures
Wash Water	Contain in 55-gallon drums, seal drums and stage drums in temporary location pending transport off-Site for treatment/ disposal.
Used PPE	
Spent plastic sheets/consumables from decontamination procedures	

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8.4 Site Chemical Hazards Outside AECOM Control

AECOM frequently performs work at Client sites that are engaged in chemical manufacturing or use chemicals as part of the manufacturing process. These types of operations can potentially expose AECOM and AECOM subcontractors to chemicals. The following mitigation measures should be applied to all work performed on these sites.

- Be familiar with the facility emergency alarms/alerts
- Know where the assembly areas are for each area of proposed site activity (note that assembly areas may be dependent on the direction of the prevailing wind)
- Be familiar with the products used on site and the appropriate response measures (may differ based on location on site)
- Discuss the above as part of daily tailgate meetings.

The client or host facility/site does not engage in chemical manufacturing or use chemicals as part of their manufacturing process. Therefore, a potential exposure to site chemical hazards outside of AECOM's control is not anticipated.

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9. AIR MONITORING

Depending on the contaminants of concern, the products used to perform the work, or third-party operations, sampling or monitoring may be required within the work area on site to detect the presence and relative levels of chemical or particulate hazards. The data collected throughout monitoring shall be used to determine the appropriate levels of PPE. Monitoring shall be in accordance with Exposure Monitoring Procedure S3AM-127-PR and specified in the work permit and/or THA for the tasks. Key elements of the procedure include:

- Calibration of monitoring equipment and/or daily bump tests to verify calibrations and confirm alarm function.
- Documenting the results of calibration and/or daily bump tests.
- Documenting the results of monitoring activities.
- Personal monitoring and result evaluation must be directed by a Certified Industrial Hygienist or Certified Safety Professional.

Potential exposure to chemical hazards from sources including materials brought on site to perform work, constituents of concern found in environmental media under investigation, and/or simultaneous operations being performed at the site by the property owner/third parties are reasonably anticipated to have the potential to result in vapors, fumes, aerosols, mists, and/or airborne particulates/dusts at or near permissible exposure limits. Therefore, air monitoring that will be implemented is described below.

9.1 Real-Time Exposure Measurements/Equipment

Monitoring shall be performed within the work area on site in order to detect the presence and relative levels of toxic substances. The data collected throughout monitoring shall be used to determine the appropriate levels of PPE. Monitoring shall be conducted as specified in the work permit and THA as work is performed. All instrumentation needs to be rated intrinsically safe to prevent fire or explosion.

A PID is required for work zone monitoring during NAPL monitoring and recovery activities. In instances where intrusive activities are to be completed (i.e. drilling), monitoring using a PID and Particulate Monitor is required.

Instrument		Manufacturer/Model	Substances Detected
☒	Photo Ionization Detector (PID)	RAE Systems mini-RAE Photovac Microtip HNu Model Hnu (min. 10.6 eV bulb)	• Petroleum hydrocarbons • Organic Solvents
☐	Multi or 4 Gas Detectors	RAE Systems Multi-RAE	• Lower Explosive Limit • Oxygen • Carbon Monoxide • Hydrogen Sulfide
☐	Combustible Gas Indicator (CGI) *May be combined with individual or multi-gas detectors.*		• Explosivity

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Instrument		Manufacturer/Model	Substances Detected
☒	Particulate Monitor	MIE Model PDM-3 mini-RAM; TSI DustTrak Aerosol Monitor with a PM-10 impactor	• Aerosols, mist, dust, and fumes
☐	Noise Meter	3M	• dB

9.2 Health and Safety Action Levels

An action level is a point at which increased protection is required due to the concentration of contaminants in the work area or other environmental conditions. The concentration level (above background level) and the ability of the PPE to protect against that specific contaminant determine each action level. The action levels are based on concentrations in the breathing zone.

If ambient levels are measured which exceed the action levels in areas accessible to unprotected personnel, necessary control measures (barricades, warning signs, and mitigation actions to limit, etc.) must be implemented prior to commencing activities at the specific work area.

Personnel should also be able to upgrade or downgrade their level of protection with the concurrence of Site Supervisor or Site Safety Officer or the Safety Manager.

Reasons to Upgrade:	▪ Known or suspected presence of dermal hazards; ▪ Occurrence or likely occurrence of gas, vapor, or dust emission; or ▪ Change in work task that will increase the exposure or potential exposure to hazardous materials.
Reasons to Downgrade:	▪ New information indicating that the situation is less hazardous than was originally suspected; ▪ Change in site conditions that decrease the potential hazard; or ▪ Change in work task that will reduce exposure to hazardous materials.

9.3 Monitoring Procedures

The monitoring procedures shown below are general guidelines for sampling activities. In general, readings are considered actionable if sustained readings are observed for 5 minutes or more or if intermittent peaks are seen in excess of 1 time the response level. A reading in excess of action level outlined below will require additional ventilation (natural or mechanical) for 30 minutes, followed by re-monitoring.

Monitoring Procedures and Action Levels

Parameter	Zone Location and Monitoring Interval	Response Level	Response Activity
Volatile Organic Compounds (VOCs) and volatile hydrocarbons (total by PID)	Breathing zone, continuously during tasks where exposure to VOCs and volatile hydrocarbons is possible	< 5 ppm	Continue monitoring, may continue work in required PPE.
		5- 25 ppm (sustained for 5 minutes)	**STOP WORK** and notify Project Manager. Investigate the cause of elevated VOC measurements and identify measures to reduce concentrations (cover impacted soils, ventilation, etc.). Work activities shall only continue once levels have decreased to or below 5 units above background. If levels continue above 5 units, only

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Monitoring Procedures and Action Levels

Parameter	Zone Location and Monitoring Interval	Response Level	Response Activity
			individuals who are medically qualified to wear respiratory protection are permitted to continue work activities with Project Manager approval. Don Level C PPE (organic vapor respirator cartridges), continue monitoring, and initiate continuous air monitoring for benzene.
		> 25 ppm (sustained for 5 minutes)	Cease work, exit, and contact the Site Safety Officer, Site Supervisor, and Project Manager.
Particulates (PM-10)	Breathing zone during intrusive activities	100 µg/m^3 above upwind level	Continue monitoring, modify work methods or implement dust control techniques. Continue work in the required PPE.
		150 µg/m^3 above upwind level	**STOP WORK** and exit the work area or confined space Contact the Site Safety Officer, Site Supervisor, and Project Manager

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10. PERSONAL PROTECTIVE EQUIPMENT

PPE is considered the last line of defense in hazard control. PPE is meant to protect workers when all other methods (elimination, substitution, engineering, and administrative) have been exhausted. All employees must be trained in the proper use and maintenance of PPE. See Procedure S3AM-208-PR, Personal Protective Equipment.

A PPE assessment (see S3AM-208-FM1) can be performed to help determine PPE requirements. PPE upgrades for individual tasks or steps of a task are to be identified in the appropriate THA(s).

10.1 Site Minimum Personal Protective Equipment

Unless otherwise excluded by an approved Management of Change (MoC), the following personal protective equipment is required by AECOM and/or client procedures and requirements and shall be worn on site outside of designated "Safe Zones", such as offices and parking lots. Do **NOT** downgrade the PPE specified in the THA and/or this HASP without review and approval from SH&E Manager.

Site Minimum PPE [1]

✓ Hard hat	✓ Safety-toe work boots
✓ Safety glasses with side shields (may be clear or shaded)	✓ Long pants
✓ Reflective Vest	✓ Shirt with long sleeves

10.2 Additional Personal Protective Equipment Needed on Site

The following PPE is required by the host facility, task hazard assessment (THA), or prescribed upgrades in response to air monitoring response (action) levels.

Head / Ears ***(select all that apply)***	
☐ Climbing helmet	☒ Earplugs (during drilling)
☐ Hard hat with chin strap	☐ Over-ear hearing protection (i.e., muffs)
☐ Wide brimmed hard hat	☐ Dual hearing protection (earplugs **and** muffs)
☐ Insect net	☐ Other: [specify]

Face / Eyes ***(select all that apply)***	
☐ Spoggles (Safety glasses with foam liner for dust protection)	☐ Face shield (impact)
☐ Chemical goggles	☒ Face shield (splash)
☐ Welding mask/goggles	☐ Other: [specify]

[1] All PPE must meet applicable ANSI, ASTM, or MSHA standards as applicable.

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Hands ***(select all that apply)***

☒ Abrasion, cut and/or puncture resistant	☐ Chemical resistant:
☐ Impact resistant	☒ Nitrile
☒ Leather	☐ PVC
☐ Mechanics	☐ Rubber/Latex
☐ Other: [specify]	☐ Other: [specify]

Legs / Feet ***(select all that apply)***

☒ High ankle boots	☐ Rubber boots
☐ Metatarsal guards	☐ Waders
☐ Electrically resistant boots	☐ Snake gaiters **or** chaps
☐ Puncture-resistant boots or insoles	☐ Disposable boot covers **or** booties
☐ Other: [specify]	

Body ***(select all that apply)***

☒ Sunscreen	☐ Personal flotation device (PFD):
☒ Insect repellent with DEET	☐ Type I ☐ Type II ☐ Type III
☐ Permethrin applied to clothing	☐ Type V – Auto-inflate with Type II performance
☒ Disposable coveralls	☐ Type V – Mustang Suit
☐ Flame Retardant Clothing (FRC):	☐ Fall Protection:
☐ Rating: [specify]	☐ Full body harness
☐ Weight: [specify]	☐ Single lanyard with self-locking D-ring
☐ Rating and weight not specified by client or facility	☐ Double lanyard with self-locking D-rings
☒ High-visibility clothing:	☐ Self-retracting lifeline with self-locking D-ring
☐ ANSI Class II	☐ Shock absorber
☐ ANSI Class III	☐ Lad-safe or similar device
☒ Not specified by client or facility	☐ Suspension trauma straps
☐ Other:	☐ Self-rescue kit
☐ Other:	☐ Other: [specify]

Respiratory Protection ***(select all that apply)***

☒ Air-Purifying Respirator (APR):	☐ Filtering Facepiece Respirator (FFR) - **Required Use**		
☐ Full-Face	☐ N95	☐ N99	☐ N100
☐ Half-Face	☐ R95	☐ R99	☐ R100
☒ Cartridge: Organic vapor	☐ P95	☐ P99	☐ P100
☐ Supplied Air Respirator:	☐ Other: [Specify]		
☐ Self-Contained Breathing Apparatus (SCBA)	☒ **FFR / Face Covering / Face Mask – Voluntary Use**		
☐ Air-Line Respirator			

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Equipment ***(select all that apply)***

☒ Air and Noise Monitoring	☒ Weather, Heat and Cold Stress Monitoring:
☐ Dosimeter	☐ Portable weather station **or** meter
☒ See Section 9.1 above	☒ Smart phone with weather app
☐ Other:	☐ Wet Bulb Globe Thermometer (WBGT)
☐ Communication Beyond Cell Phones	☐ Other: [specify]
☐ Portable, hand-held radio	☐ Wildlife / Wilderness Survival:
☐ Satellite phone	☐ Air horn
☐ Other: [specify]	☐ Bear spray
☒ Traffic / Work Area Controls:	☐ Emergency Rations
☒ See Section 11.1 below	☐ Emergency Shelter(s)
☐ Other:	☐ Other: [specify]
☒ Fire Control / Protection:	☐ Other:
☒ 5 lb. ABC, Qty = 1 (AECOM Fleet Vehicles)	☐ [specify]
☐ 10 lb. ABC, Qty = 1 (Subcontractor Drill Rig)	☐ [specify]
☐ [specify]	☐ [specify]
☒ First Aid Kit(s):	☐ [specify]
☒ Type III, Class A, Qty= 1	☐ [specify]
☐ Type [?], Class [?], Qty= [#]	☐ [specify]

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11. SITE CONTROL

The purpose of site control is to protect the public from inadvertently coming into contact with site hazards and to protect AECOM employees being impacted by hazards. This section details the equipment and actions needed to promote optimal site control.

11.1 Site Work Zones

Site layout and site control need to be coordinated to achieve a productive work environment and efficient work process while minimizing exposure of employees and the public to hazards associated with the work. Consider the following items when planning the site layout and controls:

- "Line of Fire" hazards- overhead utilities, falling/ tipping equipment, release of energy/ pressure, flying debris
- Noise, dust, odor suppression
- Contamination containment and decontamination area layout
- Traffic control for site vehicles/ equipment (public traffic control requires Traffic Control Plan)
- Restricted access for areas requiring special training, skills, or certifications
- Restriction of work near railroads
- Presence or creation of excavations
- Loading/unloading areas
- Portable restrooms
- Dumpsters and bins
- Equipment lay down
- Heavy equipment parking
- Overnight safety and security needs

Check the description of the site controls **already** in place:

☐ Work area is within a facility/property with secure and restricted access provided by client or third party
☐ Work area is enclosed within a facility/property, but access is not restricted via locks, guards, or gates
☒ Work area is on a property that is open, but access by the public is unlikely
☐ Work area is on a property that is open and access by the public is likely
☐ Work area is in a roadway or right of way of a roadway (Traffic Control Plan required S3AM-306-PR)
☐ Work area is on or near railroad, including right of way, active lines and crossings
☐ Other: [Insert description]

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Check and describe the site controls that need to be added to protect the public and the AECOM work team.

Control Item		Description of Type and Application
☐	Fence	
☐	Locks	
☐	Barricades	
☒	Cones	Cones will be applied if working adjacent to a road.
☒	Tape	Caution tape will be used to establish a barrier around the work zone during drill rig use.
☒	Hole Covers	Boreholes left open overnight will be covered with a steel plate or other acceptable means.
☐	Other:	

11.2 Simultaneous and Neighboring Operations

As stated in Section 2.2, the New York City Parks department and their contractors occupy North 12th Street. The 50 Kent Avenue property is currently subject to construction works associated with park redevelopment and construction is scheduled for completion in April 2022.

Simultaneous and neighboring operations often present a need for added coordination and communication to address hazards that are presented by multiple operations. If additional unexpected hazards from third party operations do manifest themselves, the appropriate operations and controls will be addressed in the THAs.

Simultaneous Operations – Within the Site

☒ Yes, see table below for details
☐ None, not applicable

Activity	Company	Contact Person (Activity Lead)	Contact's Phone Number	Addressed in THA(s)
Park construction at 50 Kent Ave	Stantec	Anna Schmiedicke	929 284-0606	☒ Yes ☐ No
				☐ Yes ☐ No
				☐ Yes ☐ No

Simultaneous Operations – Neighboring Sites

☐ Yes, see table below for details
☒ None, not applicable

Activity	Company	Contact Person (Activity Lead)	Contact's Phone Number	Addressed in THA(s)
				☐ Yes ☐ No
				☐ Yes ☐ No
				☐ Yes ☐ No

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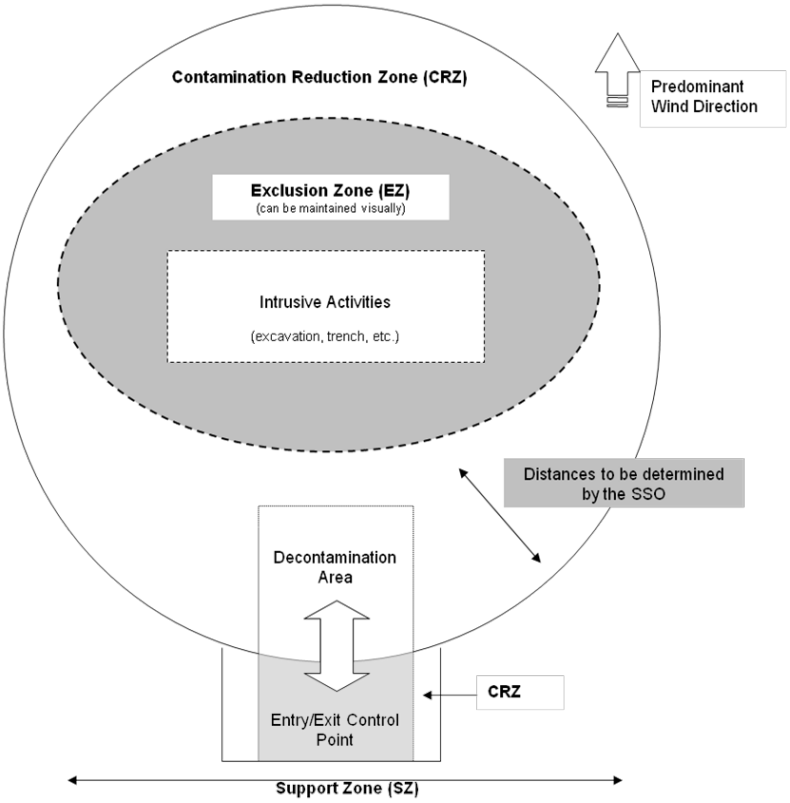
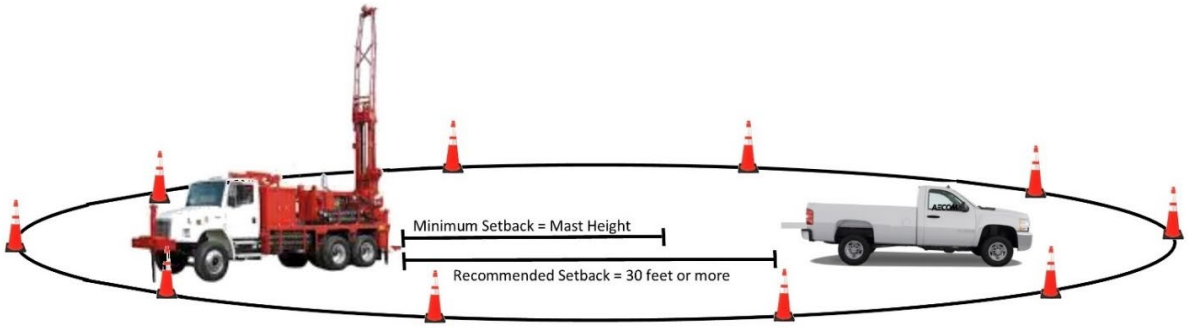
11.3 Site Control Map/Diagram

As individual tasks within the scope of work vary in location and scope (i.e., N. 12th Street vs. N 11th Street, etc.), a single diagram showing the EZ, CRZ, muster location, etc. is not practical. Such controls will be established on a location by location basis based on scope.

11.3.1 Example Exclusion Zone Layout



11.3.2 Example Work Area Layout



11.4 Site Security

All equipment will be stored and secured off-Site at the end of each workday. If a piece of equipment cannot leave the Site, then that piece equipment will be secured as not to be stolen or tampered (i.e. locked).

11.5 Client and/or Host Facility-Specific Safety Requirements

Client-specific health and safety guidelines are included in A**ttachment G** of this HASP. All site activities must be performed in accordance with client-specific requirements and procedures.

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12. EMERGENCY RESPONSE

Any situation that has resulted or poses an imminent threat to persons, property and/or the environment constitute an emergency an require immediate action by the individual discovering and/or involved in the situation. Immediate actions start with the signaling of an emergency that is accompanied by a ceasing of site activities (i.e., Stop Work). When safe to do so, immediate actions will be taken to prevent an imminent risk from resulting in an incident and/or minimize the potential for an escalation in the severity of the incident. Immediate actions for reasonably credible emergency situations or scenarios are described within the following sections.

12.1 Communication – Method(s) of Signaling an Emergency

In addition to verbal communication amongst the field team, the following methods of communicating or signaling an emergency will be used:

☒ **Cell Phone**	☐ **Hand Signal**	☐ **Radio**	☐ **Satellite Phone**

12.2 Muster and Shelter-in-Place Locations

In the event of an emergency situation or imminent threat persons, property and/or environment, workers will report to the appropriate muster and/or shelter-in-place location. Workers will remain at the muster or shelter-in-place location until a headcount is completed and any "all clear" is issued by the proper authority for the site, unless it is unsafe to remain at that location.

Primary Muster Location:	**Corner of Kent Avenue and North 12th Street opposite the Site** (refer Figure 1-2 attached)**.**
Secondary Muster Location:	Corner of Kent Avenue and North 11th Street (refer Figure 1-2 attached).

12.3 Location of Emergency Equipment

Site personnel will be made aware of the location of emergency equipment that can aid in the response to an emergency situation or imminent threat to persons, property and/or the environment during the site orientation, daily toolbox safety meetings, and/or crew reviews.

Item(s)	Item Description	Location(s)
First Aid Kit	Type III, Class A	• AECOM field vehicle
Fire Extinguisher	5 lb. ABC 10 lb. ABC	• AECOM field vehicle • Subcontractor Drill Rig

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Item(s)	Item Description	Location(s)
Spill Kit	Absorbent pads to be taken to Site for NAPL recovery events	• AECOM field vehicle

12.4 Emergency Responders and Resources

In the event of a **life-threatening or critical emergency**, AECOM employees should immediately engage emergency responders and/or resources, as appropriate, to the type of emergency. Steps should be taken to meet and escort emergency responders and/or resources to location of the emergency whenever possible.

Emergency Responders

Site Resource(s):	N/A	N/A
Fire:	New York City Fire Department Bureau of Fire Communication	EMERGENCY: 911 NON- EMERGENCY: 718-624-3752
Medical Transport:	EMT will determine appropriate medical transport	911
Police:	New York City Police Department 94th Precinct	EMERGENCY: 911 NON-EMERGENCY: 718-383-3879
Poison Control:	Poison Control	800-222-1222
Pollution Emergency:	NYSDEC Spill Hotline	800-457-7362
INFO TRAC:	AECOM's Account Number: 74984	800-535-5053

Utility and Pipeline Owners (For utility and pipeline related emergencies only)

Utility/Pipeline Name	Provider/Facility Owner	Contact No.
Gas/ Electric	ConEd	800-752-6633
Gas	National Grid	800-752-6633
Phone/Internet	Verizon AT&T	718-977-8130 914-397-3744
Water	New York City Department of Environmental Protection Bureau of Water Distribution	718-595-6616
Sewer	New York City Department of Environmental Protection Sewer Regulation and Control	718-286-2610
Cable	CableVision Systems of New York TimeWarner Cable Company	718-975-1713 718-888-4261
Call Before You Dig	Utility One-Call Locating	811

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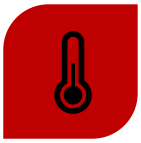
12.5 Fitness for Duty and Illness Reporting During the Pandemic

AECOM employees should always live our life-preserving principle of "Fitness for Duty", which requires employees to stay home from work when they are sick, as they are not "Fit for Duty" when ill. During times of pandemic, the importance of this step is increased. If you experience signs/symptoms of illness (see images below) or find out that you have come into contact with a person who has been confirmed positive with the Coronavirus, notify the site supervisor and the project manager, your Area, Regional, or Business Line SH&E Manager, and go home and/or stay home. Notify the AECOM Incident Reporting Hotline (**1-800-348-5046)** and/or the AECOM Nurse Line (**1-512-419-5016).** Managers will work with the local SH&E and/or Resiliency teams to respond according to the AECOM Pandemic Procedure: SR1-003-PR2.

 FEVER	 TIREDNESS, CONFUSION	 DRY COUGH	 SHORTNESS OF BREATH
 NASAL CONGESTION, SORE THROAT OR RUNNY NOSE	 BLUE LIPS OR FACE	 PERSISENT PAIN OR PRESSURE IN THE CHEST	 IF ANY OF THESE SYMPTOMS ARE IDENTIFIED, SEEK MEDICAL ATTENTION!

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13. NOTIFICATIONS AND REPORTING

NOTE! In the event of a life threatening emergency, call 911 FIRST. A life threatening emergency can include:

- Loss of consciousness
- Seizures
- Uncontrolled loss of blood
- Heat Stroke
- Head or spinal cord injury
- Severe allergic reaction
- Abdominal trauma
- Difficulty breathing
- Cardiac arrest
- Broken bones

Once immediate actions have been taken, if safe to do so, notifications (verbal) and reporting (written) must be immediately completed. Notifications serve to engage additional resources in the management of the emergency and initiate additional processes such as medical case management, spill response, incident investigation, etc. Reporting initiates the formal documentation process and supports the development of key learnings to prevent a reoccurrence.

13.1 Initial Notifications

The person observing and/or involved with the emergency or incident is required to make the following initial notifications as soon as reasonably possible:

Call #1 – AECOM Site Supervisor or Site Safety Officer

Role	Person Assigned to Role	Contact No. Primary	Contact No. Alt.
Primary Site Supervisor:	Sunil Samaroo Megan Dascoli Adib Rahman *or other qualified on-Site personnel as directed by the Project Manager	M: 908-797-3796 M: 908-623-0145 M: 631-942-9700	Melissa Saunders M: 206-502-7914
If unavailable, Alternate Site Supervisor:	Sunil Samaroo Megan Dascoli Adib Rahman *or other qualified on-Site personnel as directed by the Project Manager	M: 908-797-3796 M: 908-623-0145 M: 631-942-9700	Melissa Saunders M: 206-502-7914
If unavailable, Site Safety Officer:	Sunil Samaroo Megan Dascoli Adib Rahman *or other qualified on-Site personnel as directed by the Project Manager	M: 908-797-3796 M: 908-623-0145 M: 631-942-9700	Melissa Saunders M: 206-502-7914
Note: D = Direct Office Phone; M = Mobile Phone, O = Office Phone, R = Radio, and S = Satellite Phone			

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Call #2 – DCS Americas Incident Reporting Hotline

1-800-348-5046

DIRECT TOLL-FREE	Hours of Operation: 24 Hours/Day; 7 Days/Week

For injuries and illnesses, you should be transferred by the hotline to the AECOM Occupational Nurse:

AECOM Occupational Nurse

1-512-419-5016

DIRECT	Hours of Operation: 24 Hours/Day; 7 Days/Week

Call #3 – Affected Employee's Direct Supervisor

Employees are encouraged to program their direct supervisor's phone numbers into their cell phone.

Call #4 – Vehicle Management or Insurance Provider *(Vehicle Motor Vehicle Accidents Only)*

Employees involved in motor vehicle accidents or who have discovered property damage caused to motor vehicles should call the appropriate party:

ARI Fleet Management *(Fleet vehicles only)*

1-800-422-7647

DIRECT TOLL-FREE	Hours of Operation: 24 Hours/Day; 7 Days/Week

Rental Company *(Rental vehicles only)*

Refer to your rental agreement for contact numbers and hours of operation

Personal Insurance Provider *(Personal vehicles used for business travel only)*

Refer to your personal insurance policy for contact numbers and hours of operation

13.2 Client-Specific Notifications

Per the *National Grid Incident Reporting Requirements* and flow chart in **Attachment A**, "*The Incident Reporter will notify the Project-Specific National Grid Project Manager verbally within 1 hour of the incident*". This is for all incidents, not just "significant" ones.

Role	Person Assigned to Role	Contact No. Primary	Contact No. Alt.
Primary Client Contact Person:	Donald Campbell	M: 347-452-5973	D: 718-963-5453
If unavailable, Alternate Client Contact Person:	William Ryan	M: 516-790-1660	D: 516-545-2586
Note: D = Direct Office Phone; M = Mobile Phone, O = Office Phone, R = Radio, and S = Satellite Phone			

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13.3 Additional Internal AECOM Notifications

The AECOM Site Supervisor will make the following additional internal notifications. If the AECOM Site Supervisor cannot be reached or is not capable of making the notifications, the notifications will be made by an alternate AECOM Site Supervisor or AECOM Site Safety Officer.

13.3.1 AECOM Project Management

Role	Person Assigned to Role	Contact No. Primary	Contact No. Alt.
AECOM Project Manager:	Melissa Saunders	M: 206-502-7914	D: 212-377-8637
If unavailable, AECOM Project Mgr. Alternate:	Peter Cox	M: 978-764-4257	D: 978-905-2168
Note: D = Direct Office Phone; M = Mobile Phone, O = Office Phone, R = Radio, and S = Satellite Phone			

The Project Manager will perform any additional internal notification requirements based on the requirements of their region, business line, or client account.

13.3.2 AECOM Safety, Health and Environment (SH&E) Management

Role	Person Assigned to Role	Contact No. Primary	Contact No. Alt.
Client Acct. SH&E Mgr.:	William Ryan	M: 516-790-1660	D: 516-545-2586
If unavailable, Area SH&E Manager:	Pete Wray	M: 302-660-9178	D: 302-318-2880
If unavailable, Regional SH&E Manager:	Candice Johnson	D: 416-407-9661	-
Note: D = Direct Office Phone; M = Mobile Phone, O = Office Phone, R = Radio, and S = Satellite Phone			

13.4 Subcontractor and/or Third-Party Contacts

No subcontractors are currently engaged on this Site. If the scope requires subcontractors, the HASP will be updated to include subcontractor contact details.

All third-party contacts are to be contacted via the National Grid PM unless advised otherwise.

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13.5 Internal Reporting

13.5.1 Incident and Near Miss Reporting

All incidents and near misses (i.e., incidents without consequences), regardless of type and perceived severity, must be reported within **IndustrySafe** (AECOM's SH&E Database) within the timeframes listed below:

Incident Type	IndustrySafe Reporting Timeframe
Significant Incident, including any injury to an AECOM employee or Subcontractor	Within **4 hours**
All Other Incidents	Within **24 Hours**
Note: Only the basic facts, who, what, when, where and how, are needed to complete the initial IndustrySafe report. SH&E Managers will assist you in updating the report as additional information becomes available.	

Significant incidents include:

- Fatality;
- Amputation;
- Hospitalization for treatment for more than 24 hours (admission);
- Any single event resulting in more than one employee requiring medical treatment or more than one employee being away from work for more than 3 days;
- Any SH&E-related Consent Agreement/Order/Lawsuit or enforcement action seeking more than $10,000 or alleging criminal activity;
- Any spill or release of a hazardous material that is reportable to a regulatory agency;
- Any Notices of Violation resulting from not operating within a regulatory agency permit/license or consent;
- Any incident resulting in property damage expected to exceed $10,000 United States dollars (USD);
- Any security-related incident that could have caused significant harm to an AECOM employee; and/or
- Any near miss event that may have resulted in any of the above consequences, but because of "luck" did not result in harm to persons, property or the environment.

Other incidents include:

- Any injury or illness to an AECOM employee or subcontractor, even if it does not require medical attention, including non-work-related injuries/illnesses that have become significantly aggravated by the work environment;
- An injury to a member of the public or client representative occurring on an AECOM-controlled work site;
- Re-occurring conditions such as back pain or cumulative trauma disorders (e.g., carpal tunnel syndrome);
- Fire, explosion or flash that is not an intended result of a planned event (e.g., remediation process, laboratory procedure);

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- Any incident involving company-owned, rented or leased vehicles (including personal vehicles used for company business); and/or
- Any failure to comply with requirements of a regulatory permit issued to AECOM.

13.5.2 Safety Observation Reporting

All safety observations must be reported within **IndustrySafe™ or Lifeguard™** (AECOM's SH&E Databases), as dictated by the AECOM Project Manager, in a timely manner. It is recommended that safety observations are reported within 7 to 14 days of the observation.

13.5.3 SH&E Database Access

Incidents, near misses, and audits/inspections must be entered into **IndustrySafe™**, which is one of AECOM's SH&E Databases. Safety observations may also be entered into **IndustrySafe™** at the AECOM Project Manager's discretion. **IndustrySafe™** can be accessed via the SH&E Page on Ecosystem when you are in the office or connected to the AECOM network via VPN. IndustrySafe may also be accessed from your smartphone/device, if equipped with a QR Code Reader App, using the QR Code to the right.

↑ Incidents, Near Misses, Audits/Inspections and Safety Observations ↑

Safety observations may also be entered into **Lifeguard™**, which is one of AECOM's SH&E Databases, at the AECOM Project Manager's discretion. **Lifeguard™** can be accessed via the SH&E Page on Ecosystem when you are in the office or connected to the AECOM network via VPN. **Lifeguard™** may also be accessed from your smartphone/device, if equipped with a QR Code Reader App, using the QR Code to the right.

↑ Safety Observations ↑

13.5.4 Reporting Assistance

If your field schedule, access to internet, and/or limited cellular phone coverage have the potential to impact timely incident, near miss, and/or safety observation reporting, please contact your AECOM Project Manager and/or SH&E Manager for assistance.

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14. RESPONSE PLANS: REASONABLE CREDIBLE EMERGENCY SCENARIOS

Based on site history, operations, and setting along with the approved scope of work, the following emergency scenarios have been determined to be reasonably credible to occur. Immediate actions and post-emergency follow-up actions, when applicable, are discussed below for each reasonably credible emergency scenario.

14.1 Injuries and Illnesses

14.1.1 Immediate Actions

14.1.1.1 Engage Medical Resources

In the event of a **life-threatening or critical emergency**, AECOM employees should **dial 911 or the site-specific number** for the emergency responder and follow the recommended instructions. After dialing 911 or the site-specific number and in **less serious situations**, an injured employee or a co-worker should contact the **Incident Hotline at 1-800-348-5046** to ensure that the employee receives the best care at the best time (i.e., within the first hour following an injury or potential injury). By contacting the Incident Hotline, the worker can be connected with AECOM's nurses for first aid advice. If recommended by the nurse, the supervisor or a co-worker should drive the injured employee to the project-designated clinic or hospital.

14.1.1.2 Care for the Injured or Ill Person(s)

Employees trained in first aid, CPR and/or Automated External Defibrillators (AED) should render initial care in a manner consistent with their training. This care should be provided until the injury or illness is resolved (i.e., first aid cases) or transportation to the appropriate medical facility is arranged and present on the site (i.e., treatment beyond first aid incidents).

First Aid, CPR and AED Trained Personnel

Name	Company	Contact No.	1st Aid	CPR	AED
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐

14.1.1.3 Transport to Nearest Medical Facility for Treatment

For injuries and illnesses that require treatment beyond first aid, the injured/ill person(s) shall be transported to the nearest medical facility for treatment. For life-threatening or critical emergencies, Emergency Medical Services (EMS) should handle the transport. EMS will determine the hospital to which the injured/ill person(s) will be transported. The AECOM Field Supervisor and/or Site Safety Officer shall confirm with EMS the final destination of the injured/ill

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persons. The nearest hospital equipped for emergency medical care, driving directions and map are provided in **Attachment A**.

For less serious situations, the AECOM Site Supervisor, AECOM Site Safety Officer (SSO) and/or their designee shall transport and accompany the injured/ill person(s) to the nearest Occupational Clinic (preferred) or hospital, if an occupational clinic is not available, not within a reasonable driving distance, or cannot be reached during their hours of operation. The nearest occupational clinic, driving directions and map are provided in **Attachment A**.

14.1.1.4 Engage AECOM Occupational Nurse with Medical Treatment Provider

The AECOM Site Supervisor, AECOM SSO or their designee who is accompanying the injured/ill person(s) to the medical treatment facility shall notify the AECOM Occupational Nurse of the situation, communicate the destination of the injured/ill person(s) and assist the nurse in connecting with the medical treatment provider to facilitate medical case management.

14.1.2 Follow-Up Actions

Outside of notifications and reporting, the AECOM Site Supervisor, AECOM SSO or their designee shall coordinate the post-treatment transportation of injured/ill person(s).

14.2 Motor Vehicle Breakdowns and Flat Tires

If safe to do so, remove the car from the traveled way. To the extent possible, AECOM personnel should **NOT** change flat tires or perform similar repairs.

- For rental vehicles, contact the rental company
- For fleet vehicles, contact **ARI Fleet Management**: **1-800-422-7647**
    - **Prompt 1 – Roadside Assistance**
    - **Prompt 3 – Maintenance Management**
- For personal vehicles used on AECOM business, contact an emergency provider.

14.3 Motor Vehicle Collisions

All vehicles should be rented through Carson Wagonlit Travel (accessible via Ecosystem) to ensure that AECOM insurance is included in the rental rate. All other insurances should be declined. AECOM's rental vehicle insurance policy for National/Enterprise or Avis can be found on the DCS Americas United States or Canada travel pages. **Drivers MUST print and carry the applicable insurance policy for the rental. For company owned vehicles, drivers MUST also print and carry proof of insurance.**

14.3.1 Immediate Actions (Recommended Responses)

- Assess the situation and move all occupants (except the injured) out of further harm's way.
- If safe to do so, remove the car from the traveled way.

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- Call 911, if necessary
    - If appropriate, wait for police to arrive before moving vehicles.
- Provide insurance information to other drivers if necessary or requested and collect the same:
    - Driver's Information:
        - Name and contact number
        - Driver's license number, expiration date and issuing state/province
        - Insurance policy number, carrier/provider and provider's contact number
    - Vehicle Information:
        - Make, model and year
        - License plate/tag number and issuing state/province
        - Owner's name, address and contact number
    - Passenger's Information:
        - Name and contact number
    - Witness Information:
        - Name and contact number
- If possible, obtain names and phone numbers of witnesses.
- Sketch the accident scene and/or take photographs of the scene, if possible and **safe to do so**.
- Take photographs of the damage to vehicles and property, if possible and **safe to do so**.
- If police are **NOT** on scene, file an accident report at the local police station.

NOTE: DO NOT ADMIT LIABILITY, AGREE TO PAY FOR DAMAGE, OR SIGN A DOCUMENT RELATED TO AN INCIDENT EXCEPT AS REQUIRED BY LAW.

14.3.2 Follow-Up Actions

14.3.2.1 Police Report

- If the police were **NOT** on scene, file an accident report at the local police station.
- Include a copy of the police report with the IndustrySafe report (upload report to IndustrySafe).

14.3.2.2 Drug and Alcohol (D&A) Testing

Driver's that may have caused or contributed to motor vehicle collisions resulting in $2,500 U.S. Dollars (USD) or more in damage to individuals, vehicles and/or property shall undergo drug and alcohol testing. The AECOM Site Supervisor, AECOM SSO or designee shall:

- Contact Lindsay Scammell at **1-804-515-8552** to coordinate the drug and alcohol testing;
- Accompany and transport the driver to and from the D&A testing facility; and

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- Coordinate transportation for the driver pending the results of the D&A testing.

14.4 Environmental Spills/Releases

AECOM employees are not expected to take action or to participate in rescues or responses to chemical releases (including of petroleum products) beyond the initial discovery of the release and immediate mitigation actions such as closing a valve, placing absorbents, and notifying the client and or public emergency response system (911), unless there is a contractual provision for this response and specially trained employees.

14.4.1 Immediate Actions – Reportable Quantity Regulatory Agency Notifications

All environmental spills or releases of hazardous materials (e.g., fuels, solvents, etc.), whether in excess of the Reportable Quantity or not, will be reported according to the incident reporting procedure. Spills should be reported to National Grid per the *National Grid Incident Reporting Requirements* and flow chart in **Attachment A** . In determining whether a spill or release must be reported to a regulatory agency, the Site Supervisor or qualified worker will assess the quantity of the spill or release and evaluate the reporting criteria against the state-specific reporting requirements, applicable regulatory permit, and/or client-specific reporting procedures. Reporting to the regulating agency may be done by National Grid. **If reporting to a US state or Federal regulatory agency is required, AECOM has 15 minutes from the time of the spill/release to officially report it. In Canada, spills notification varies by Province. Employees should review the local regulatory requirement, document it in this plan and communicate it to all personnel.**

Chemical-specific United States (U.S.) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Reportable Quantities for the known chemicals onsite are shown in the table below.

Hazardous Substance	Regulatory Synonyms	Final RQ (lbs.)
1,1,1-Trichloroethane	TCA	1,000
Arsenic	N/A	1
Benzene	N/A	10
Cadmium	N/A	10
Carbon Tetrachloride	N/A	10
Chromium	N/A	5,000
Ethyl Benzene	N/A	1,000
Lead	N/A	10
Mercury	N/A	1
Methyl Ethyl Ketone	MEK	5,000
Nickel	N/A	100
Pentachlorophenol	PCP	10
Selenium	N/A	100
Tetrachloroethylene	Perchloroethylene, PCE	100
Toluene	N/A	1,000

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Hazardous Substance	Regulatory Synonyms	Final RQ (lbs.)
Trichloroethylene	Trichloroethene, TCE	100
Xylene	N/A	100

CERCLA RQ's can be found at: http://www.epa.gov/oem/docs/er/302table01.pdf

The spill containment program addresses the following site-specific information:

- Potential hazardous substance spills and available controls;
- Initial notification and response;
- Spill evaluation and response; and
- Post-spill evaluation.

14.4.2 NYSDEC Petroleum Spill Requirements

All petroleum spills that occur at the site must be reported to National Grid first. National Grid may report the spill to the NYSDEC Spill Hotline (1-800-457-7362) within 2 hours of discovery, except spills which meet all of the following criteria:

- The quantity is known to be less than 5 gallons; and
- The spill is contained and under the control of the spiller; and
- The spill has not and will not reach the State's water or any land; and
- The spill is cleaned up within 2 hours of discovery.

A spill is considered to have not impacted land if it occurs on a paved surface such as asphalt or concrete. A spill in a dirt or gravel parking lot is considered to have impacted land and is reportable.

NYSDEC's Spill Regulations/Guidelines can be found at: https://www.dec.ny.gov/chemical/8692.html

The spill containment program addresses the following site-specific information:

- Potential hazardous substance spills and available controls;
- Initial notification and response;
- Spill evaluation and response; and
- Post-spill evaluation.

14.4.3 Immediate Actions – Spill Evaluation and Response

The Field Lead/Site Supervisor and/or SSO are responsible for evaluating spills and determining the appropriate response. When this evaluation is being made, the spill area is isolated and demarcated to the extent possible. When an incidental release occurs, clean-up personnel receive instructions in a pre-clean-up meeting as to spill conditions, PPE, response activities, decontamination, and waste handling.

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The procedures of the Emergency Response section of this HASP are immediately implemented when the spill is determined to require emergency precautions and action, if necessary, to protect those outside the clean-up area, notification of the appropriate authorities is made. The table in Section 14.4.1 lists the spill conditions that trigger notification of Federal, state, and local agencies.

The following are general measures that response/clean-up personnel take when responding to a spill:

- To minimize the potential for a hazardous spill, hazardous substances, control/absorbent media, drums and containers, and other contaminated materials are properly stored and labeled.
- When a spill occurs, only those persons involved in overseeing or performing spill containment operations will be allowed within the designated hazard areas. If necessary, the area will be roped or otherwise blocked off. Unauthorized personnel are kept clear of the spill area.
- Appropriate PPE is donned before entering the spill area.
- Appropriate spill control measures are applied during spill response.
- Whenever possible without endangerment of personnel, the spill is stopped at the source or as close to the source as possible.
- Ignition points are removed if fire or explosion hazards exist.
- Surrounding reactive materials are removed.
- Drains or drainage in the spill area are blocked or surrounded by berms to exclude the spilled waste and any materials applied to it.
- Provisions are made to contain and recover a neutralizing solution, if used.
- Small spills or leaks from a drum, tank or pipe will be evacuate an appropriate distance in all directions to allow clean-up and to prevent employee exposure.
- For small spills, sorbent materials such as sand, sawdust, or commercial sorbents are placed directly on the spill to prevent further spreading and aid in recovery.
- Spill area sprayed with appropriate foam where the possibility of volatile emissions exists.
- If the spill results in the formation of a toxic vapor cloud, from vaporization, reaction with surrounding materials, or the outbreak of fire, further evacuation may be required.
- To dispose of spill waste, all contaminated sorbents, liquid waste, or other spill clean-up will be placed in small quantities in approved drums for proper storage or disposal as hazardous waste. The weight of the drums shall not exceed the chemical-specific weight listed in the table above.
- Spills that cannot be managed safely by on-site personnel will require support from National Grid's emergency contractor, Miller Environmental. If this is the case, call the National Grid Project Manager and the AECOM Project Manager to organize additional help.

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14.4.4 Post Spill Evaluation

As part of the incident investigation and reporting documentation, a written spill response report shall be prepared at the conclusion of clean-up operations. Additional report information required by National Grid is outlined in **Attachment A.** The report will include, at a minimum, the following information:

- Date of spill incident;
- Cause of incident;
- Spill response actions;
- Any outside agencies involved, including their incident reports; and
- Lessons learned or suggested improvements.

The spill area is inspected to ensure the area has been satisfactorily cleaned. The use of surface and air sampling is utilized in this determination as necessary. The root cause of the spill shall be examined, and corrective steps taken to ensure the engineering and control measures in place have performed, as required. If alternative precautions or measures are needed, they are made available and implemented.

All durable equipment placed into use during clean-up activities is decontaminated for future utilization. All spill response equipment and supplies are re-stocked as required.

14.5 Fire

AECOM employees are not expected to attempt to put out fires. Stop work; notify all AECOM personnel, move upwind and contact 911 and/or emergency response at the site. If employees have been properly trained in the operation of a fire extinguisher, they may attempt to put out a small fire, provided that the following conditions are met:

- The fire must be small (i.e., smaller than a trash can) and in its early stages;
- The employee must have an escape route;
- The employee must be trained and know they have the right type of extinguisher;
- The employee must be safe from toxic gases; and
- There must be no hazardous conditions that could quickly accelerate the fire (i.e., presence of chemicals, especially dry grass, etc.).

Above all, if in doubt, the employee must **NOT** attempt to fight the fire.

14.6 Environmental Impacts

AECOM strives to avoid or control environmental impacts from our operations through planning and implementation of best practices as well as preparing responses to react to environmental incidents. Environmental Compliance procedure S3AM-204-PR provides details on permitting and planning requirements.

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Potential Environmental Impacts

Type	Description of Hazard and Permit or Control Being Implemented
☒ **Hazardous Waste Management**	All hazardous wastes generated during site activities are to be contained in appropriately labelled 55-gallon drums, sealed and staged in a temporary location pending transport off-Site for treatment/ disposal. A drum pick-up is to be scheduled with National Grid's waste transport and disposal contractor for each day of waste generation. Waste drums are not to be left on-site overnight. Detail regarding hazardous waste containers, transport and disposal is provided in the document titled *NAPL Recovery Plan for the 50 Kent Avenue Property, Brooklyn, Kings County, New York* and dated February 2020 (AECOM, 2020). It is noted that AECOM is not authorized to sign shipping papers for the work covered by this HASP.

AECOM will take the appropriate steps to mitigate environmental impacts by implementing the controls listed above and addressing any spills or fires as outlined in Sections 14.4 and 14.5, respectively.

14.7 Inclement Weather

Inclement weather includes but is not limited to heavy rain or storms and associated floods, heavy winds, lightning, snowstorms and blizzards, and sandstorms and haboobs. Weather conditions which are normal or expected can cause hazards, such as cold weather in winter or excessive heat in the summer. The best approach to preventing exposure to these hazards is project planning. Where possible, plan to perform work at seasonably appropriate times of the year. Starting several days to a week prior to field work, begin reviewing projected weather forecasts to determine if work should be delayed, or accelerated, to avoid days with higher chances of inclement weather. Weather conditions can change rapidly. Therefore, field personnel and the project managers should be prepared to utilize Stop Work Authority if uncontrolled hazardous situations develop. Additional precautionary measures for reasonably foreseeable weather conditions are provided below.

14.7.1 Ambient Temperature (Heat and Cold)

Heat and cold stress may vary based upon work activities, PPE/clothing selection, geographical locations, and weather conditions. Where possible, plan work to avoid the hottest (or coldest) part of the day. To reduce the potential of developing heat/cold stress, be aware of the signs and symptoms of heat/cold stress and watch fellow employees for signs of heat/cold stress. Use vehicles or covered area for shelter and take breaks as needed.

14.7.1.1 Hot Weather

In hot weather and/or work area conditions, keep hydrated, prevent over exposure to the sun with clothing or use of sun cream and take frequent breaks out of the sun. Use the "buddy system" to monitor effects of heat stress as it can be difficult to identify the impacts of heat in yourself. Create shaded work areas if appropriate. Use a strong sunscreen and wear a full-brimmed hat when in the sun to protect the back of the neck and shoulders. Refer to SH&E Procedure S3AM-113-PR1, Heat Stress, for more information.

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14.7.1.2 Cold Weather

In cold/wet weather and/or work area conditions, be aware of potentially slippery surfaces (wet or icy). Wear boots with good tread and carefully select your walking path to eliminate or reduce the need to traverse wet or icy surfaces. Wear warm / waterproof clothing and take breaks in a warm location. If heavy snows or icy weather are anticipated, consider your driving route prior to leaving for the site or returning at the end of the day. It may be necessary to stop work earlier in the day to allow time to return to lodging if road conditions are at risk of deteriorating. Refer to SH&E Procedure S3AM-112-PR1, Cold Stress, for more information.

14.7.2 Storms

Heavy or unexpected storms, whether they be rain, snow, or wind, represent a changed condition in which multiple hazards could be present. Stormy weather increases hazards at the job site by making travel more treacherous, both on foot and in vehicles. Visibility can be reduced. Manual tasks become more difficult as conditions worsen, increasing the chances of injury. Mental states may deteriorate increasing the risks of hazards attributable to frustration or exhaustion. Other hazards may exist; for example, winds could cause objects to blow away or strike workers or equipment or blow dust or debris into eyes. For these reasons, be aware of changing weather conditions and be prepared to stop-work to secure the project site and depart prior to storms whenever possible. If storms suddenly develop, remember that the loss of equipment or materials is far preferable to taking risks of injury by attempting to demobilize when storms are active.

14.7.3 Lightning

One of the most serious weather threats is lightning. A two-tier notification system consisting of alerts and stand downs shall be used to allow ample time for field teams to cease their activities, secure the work area, and seek shelter.

14.7.3.1 Immediate Actions – Alerts and Stand Downs

Alerts are issued by AECOM Site Supervisor and/or AECOM Site Safety Office when inclement weather, including lightning is detected within 50 miles (80 km) of the site. Alerts indicate that work crews should be prepared to cease all field activities and secure the work area. Stand Downs are issued by AECOM Site Supervisor and/or AECOM Site Safety Officer when inclement weather is detected within 30 miles (50 km) of the work area. Stand downs indicate that all work crews shall immediately cease all field activities and seek shelter. Stand downs remain in effect until the inclement weather has passed. For thunderstorms, the stand down will remain in effect for a minimum of 30 minutes following the last detection of lightning.

14.7.3.2 Immediate Actions - Guidance for Lightning

Go Indoors: Remember the phrase, "**When thunder roars, go indoors**." If you see lightning and cannot count to 30 before hearing thunder, the lightning is too close for comfort. Find a safe, enclosed shelter when you hear thunder. Safe shelters include homes, offices, shopping centers, and hard-top vehicles with the windows rolled up.

Crouch Close to the Ground and Separate: If you are caught in an open area, crouch down in a ball-like position (**feet and knees together**) with your head tucked and hands over your ears so that you are down low with minimal contact with the ground. **Do NOT lie down**. Lightning causes electric currents along the top of the ground that can

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be deadly over 100 feet away. Crouching down is the best combination of being low and touching the ground as little as possible.

Separate: If you are in a group during a thunderstorm, separate from each other. This separation will reduce the number of injuries if lightning strikes the ground.

If a person is struck by lightning:

- Call 911 or other Emergency Services Contact.
- Assess the scene to ensure that continuing risk to rescuers does not exist if lightning strikes. For other electrical-related emergencies (non-lightning), ensure the source of electricity has been deenergized.
- Check to see if the victim is breathing and proceed with CPR if victim is not breathing.

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15. PERSONAL ACKNOWLEDGEMENT AND DISCLAIMER

By signing below, the undersigned acknowledges that he/she has reviewed the AECOM Health and Safety Plan for the **National Grid Williamsburg** site. The undersigned also acknowledges that he/she has been instructed in the contents of this document and understands the information pertaining to the specified work and will comply with the provisions contained therein. The employee understands that they are **NOT** to perform any work that they have not been adequately trained for and that they are to stop work if it is unsafe to proceed. Finally, the employee understands to notify the Site Supervisor and the **Incident Hotline at 800-348-5046** for any incident, ***including ANY injury even if no first aid or medical treatment is required.***

Print Name	Signature	Organization	Date

15.1 Disclaimer

This HASP, and each of its provisions, is applicable only to, and for use only by, AECOM, its affiliates, and its subcontractors. Any use of this Plan by other parties, including, without limitation, third-party contractors on industrial sites or projects where AECOM is providing engineering, construction management, or similar services, without the express written permission of AECOM, will be at that party's sole risk, and AECOM Corporation shall have no responsibility. The existence and use of this Plan by AECOM shall not be deemed an admission or evidence of any acceptance of any safety responsibility by AECOM for other parties unless such responsibility is expressly assumed in writing by AECOM in a specific project contract.

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FIGURES

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Universal Health and Safety Plan Template (S4[DCS]AM-209-FM2-C)
Revision 11 June 16, 2020
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APPROXIMATE SCALE IN FEET

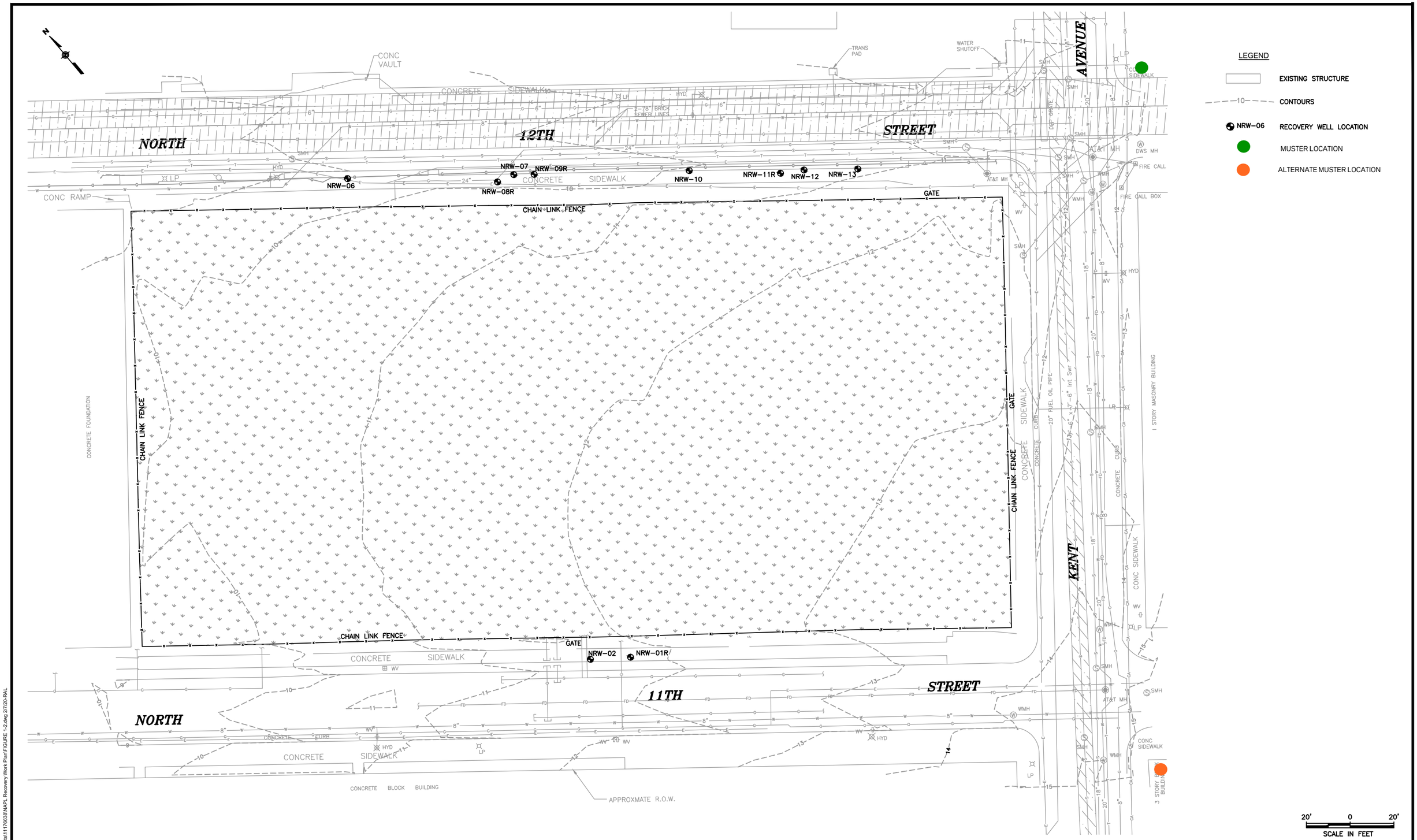
2000 0 2000

AG20745-111176638-071812-GCM

AECOM

50 KENT AVENUE PARCEL OF THE
WILLIAMSBURG WORKS FORMER MGP SITE
BOROUGH OF BROOKLYN, NEW YORK
SITE LOCATION MAP

FIGURE 1-1



AECOM

NATIONAL GRID
FORMER WILLIAMSBURG MGP SITE
BROOKLYN, KINGS COUNTY, NEW YORK

HEALTH & SAFETY PLAN

NAPL RECOVERY WELL & MUSTER LOCATIONS

DATE: FEBRUARY 2020

FIGURE 1-2

\\URSBuffalo.us.ie.urs\Buffalo\Projects\11176638\NAPL Recovery Work Plan\FIGURE 1-2.dwg 2/7/20-RAL

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ATTACHMENT A

Hospital and Clinic Directions/Maps

Incident Reporting and Response Flow Chart

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Instructions: Hospital and Occupational Clinic Locating

A-1: NEAREST HOSPITAL

Woodhull Medical Center, Ph: 1-718-963-8000

Address:	760 Broadway		
City:	Brooklyn		
State/Province:	NY	**Postal/Zip Code:**	11206
Estimated Travel Time:	20 minutes	**Distance:**	2.4 miles

DRIVING DIRECTIONS

- Head northeast on Kent Ave toward North 12th St
- Take Lorimer St to Metropolitan Ave
- Turn right onto North 14th St
- North 14th St turns left and becomes Nassau Ave
- Turn left onto Bedford Ave
- Turn right onto Lorimer St
- Turn left onto Metropolitan Ave
- Turn right at the first cross street onto Leonard St
- Turn left onto Broadway (pass McDonalds on the right)
- Turn right onto Flushing Ave
- Turn left, arrived at destination

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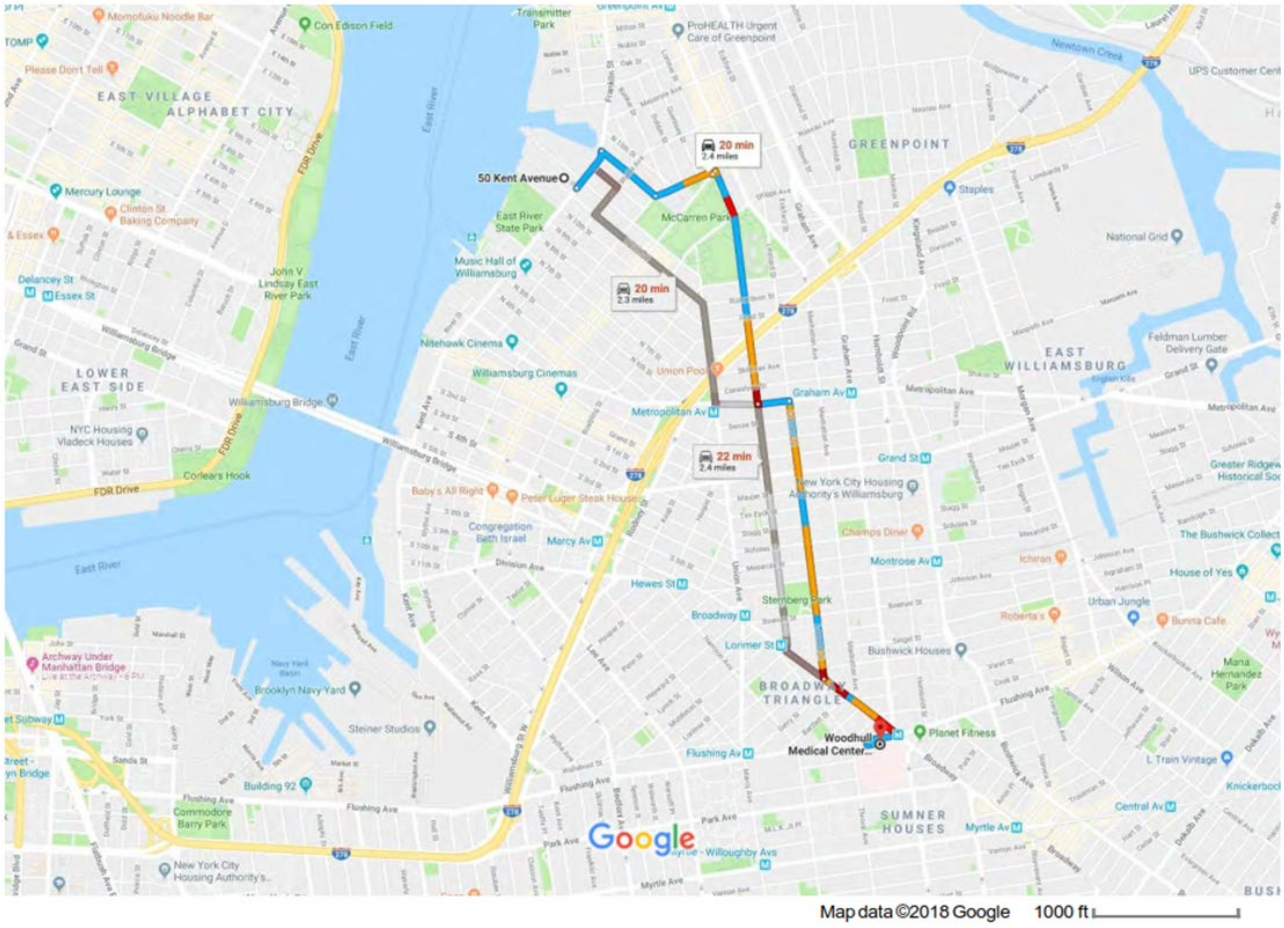
MAP TO HOSPITAL



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A-2: NEAREST OCCUPATIONAL CLINIC

CityMD, Ph: 1-718-414-2013

Address:	154 North 7th St		
City:	Brooklyn		
State/Province:	NY	**Postal/Zip Code:**	11249
Estimated Travel Time:	6 minutes	**Distance:**	0.6 miles
Business Hours:	7 days a week, 8AM-8PM		

DRIVING DIRECTIONS

- Head northeast on Kent Ave toward North 12th St
- Turn right onto North 13th St
- Turn right at the first cross street onto Wythe Ave
- Turn left onto North 7th St
- Arrived at destination on right.

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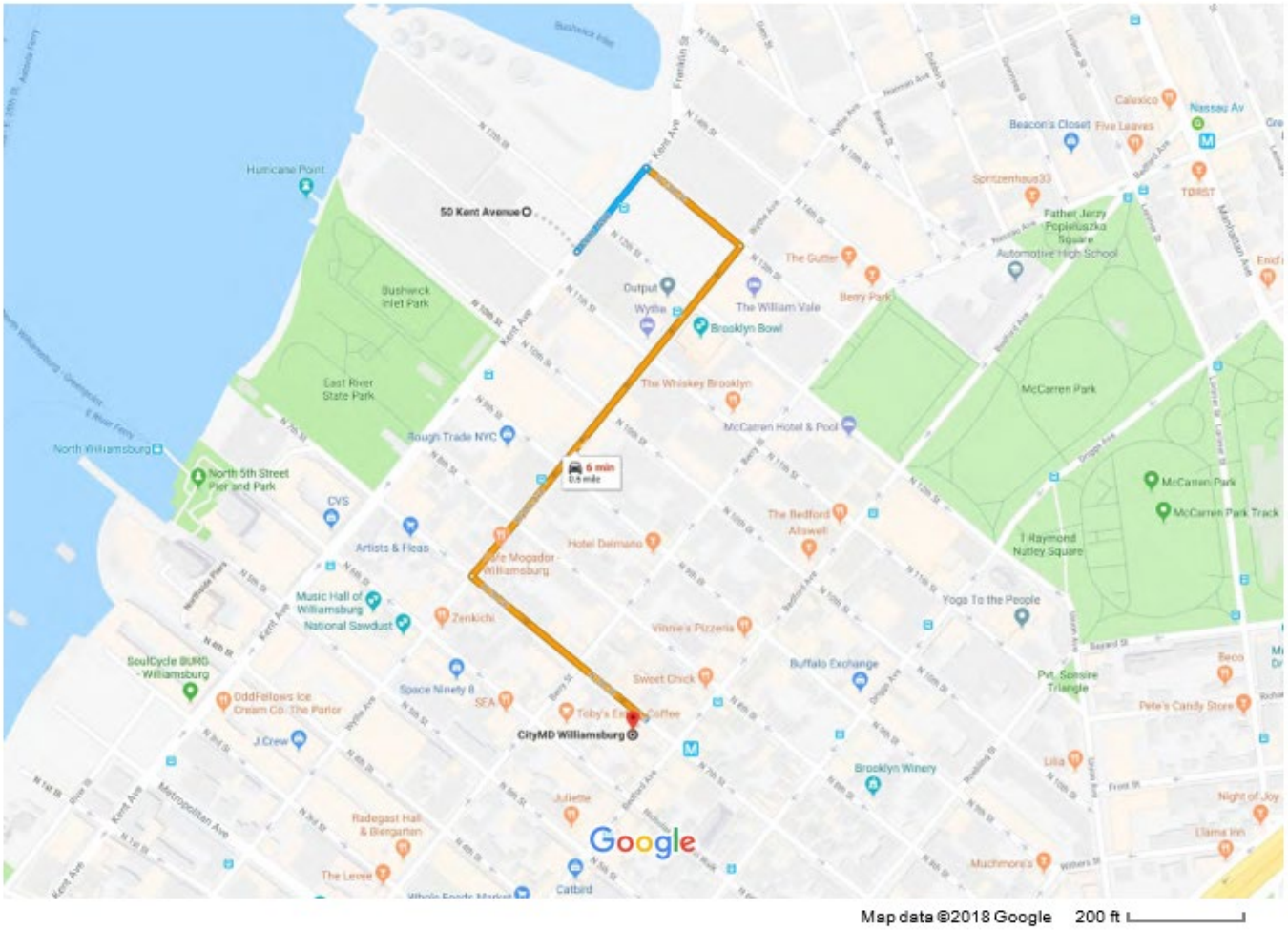
MAP TO OCCUPATIONAL CLINIC



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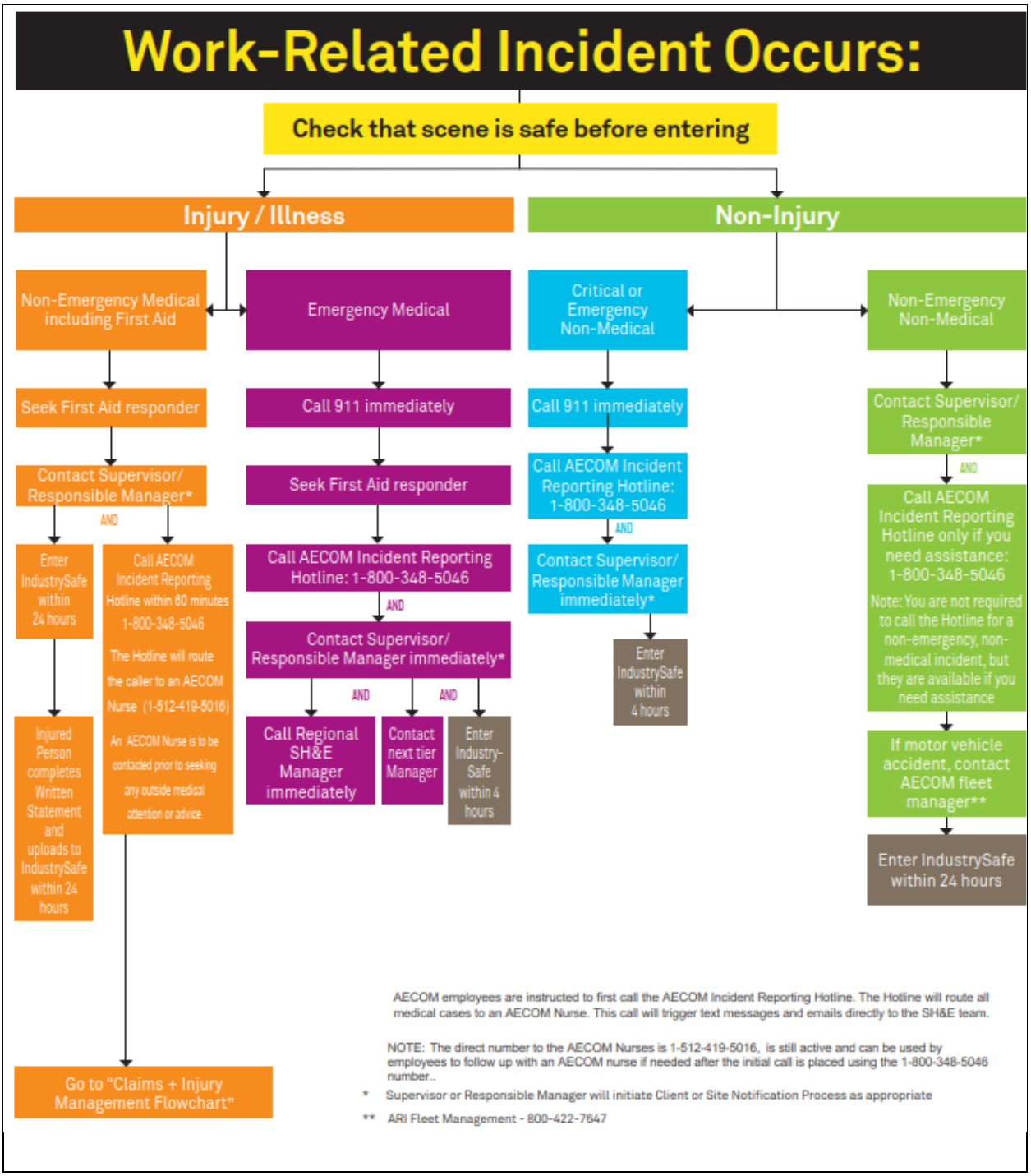
A-3: INCIDENT REPORTING AND RESPONSE FLOW CHART



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ATTACHMENT B

Task Hazard Assessment (THA) and Tailgate Meeting Forms

Each discrete task being performed during the project (i.e., Driving, Inspection, Sample Collection, etc.) requires a Task Hazard Assessment (THA; form S4[DCS]AM-209-FM6-A). If you don't have a THA for a task, obtain or develop one. The DCS Americas Templated THA Library may also be used to find previously approved THAs.

The THAs MUST be reviewed at the start of each shift and signed by all staff involved in the operation. The THAs should be consulted and updated throughout the day if conditions change using the 'On-Site Edits' lines.

Insert Task Hazard Analyses here. Include these documents after this cover sheet in the final HASP.

The preparer shall download a sufficient number of blank copies of the Tailgate Meeting Form (S3AM-209-FM5) to use each day of fieldwork, and blank THA forms so that new task can be performed, if not covered by previously-prepared THAs. A THA must be in hand prior to starting to perform work on any task.

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B-1: TASK HAZARD ASSESSMENT INSTRUCTIONS

Each unique task or work group should have their own THAs. If workers have a THA for their task(s) in hand, they should simply review it and document the site-specific edits in red pen in the appropriate section. If workers do ***NOT*** have a THA for all tasks to be performed, a THA must be obtained or drafted *prior to starting work* on that task. Use additional pages as needed.

- Identify the basic steps of the task that must be performed in order and their associated hazards. Identify controls or barriers to mitigate each identified hazard.
- Clearly identify any **STOP WORK** triggers
- Document stop work and change management if conditions/ scope changes.
- Use 4-Sight to identify and mitigate site-specific hazards throughout the day. Modify the THA as needed. Contact site supervisors or the PM for any significant scope changes or changes of expected conditions.
- All THAs shall be 3 pages (maximum) or less (preferred). If they are longer, the task is too broad.
- All hazards will use standardized nomenclature (Hazard Wheel), should be specific, detail how someone could be hurt, and what the outcome could be.
- All actions to mitigate hazards must be specific, clearly aligned with its respective hazard and not generic. Avoid words such as "*proper", "correct*", or "*appropriate*"). Use specifics and numerical values (i.e., wear disposable nitrile gloves, stand back 6 feet/1.8 meters, take a 10 minute break every hour).
- PPE cannot be the only line of defense - PPE is always the last line of defense, so think through what other controls (engineering, administrative, etc.) could mitigate hazards.

Discuss as Applicable and Modify THA as Needed

Note: Check ☐ if reviewed or mark N/A			
1	Biological, Chemical, Electrical, and Physical Hazards	☒ Reviewed	☐ N/A
2	Decontamination Procedures	☒ Reviewed	☐ N/A
3	Ergonomics- Lifting, Body Position	☒ Reviewed	☐ N/A
4	Lock Out/ Tag Out	☐ Reviewed	☒ N/A
5	Short Service Employees- visual identifier and mentor/ oversight assignment	☐ Reviewed	☒ N/A
6	Simultaneous/ Neighboring Operations	☒ Reviewed	☐ N/A
7	Slip/ Trip/ Fall Hazards	☒ Reviewed	☐ N/A
8	Specialized PPE Needs	☒ Reviewed	☐ N/A
9	Traffic Control	☒ Reviewed	☐ N/A
10	Waste Management/ Decontamination	☒ Reviewed	☐ N/A
11	Weather Hazards/ Heat Stress/ Cold Stress	☒ Reviewed	☐ N/A
12	Changes in Personnel, Equipment/Machinery, Methods and Materials	☒ Reviewed	☐ N/A
13	Work Permit requirements (identify):	☐ Reviewed	☒ N/A
14	Other (describe):	☐ Reviewed	☒ N/A

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B-1: TASK HAZARD ASSESSMENT INSTRUCTIONS (Continued)

Using the Matrix:

1. Identify basic steps of the task and associated hazards.
2. Calculate the initial risk rating.
3. Identify control measure to eliminate or reduce the hazard's risk and calculate the residual risk rating.
4. If the risk rating (after controls are implemented) cannot be reduced to 4 or lower, additional approvals are needed before the activity can begin.

Severity – Potential Consequences				
	People	**Property Damage**	**Environmental Impact**	**Public Image/Reputation**
Catastrophic	Fatality, Multiple Major Incidents	>$1M USD, Structural collapse	Offsite impact requiring remediation	Government intervention
Critical	Permanent impairment, Long term injury/illness	>$250K to $1M USD	Onsite impact requiring remediation	Media intervention
Major	Lost/Restricted Work	> $10K to $250K USD	Release at/above reportable limit	Owner intervention
Moderate	Medical Treatment	> $1K to $10K USD	Release below reportable limit	Community or local attention
Minor	First Aid	</=$1K USD	Small chemical release contained onsite	Individual complaint

Probability		
Frequent	Expected to occur during task/activity	9/10
Probable	Likely to occur during task/activity	1/10
Occasional	May occur during the task/activity	1/100
Remote	Unlikely to occur during task/activity	1/1,000
Improbable	Highly unlikely to occur, but possible during task/activity	1/10,000

Probability	**Severity**				
	5 - Catastrophic	4 – Critical	3 – Major	2 – Moderate	1 - Minor
5 – Frequent	25	20	15	10	5
4 – Probable	20	16	12	8	4
3 – Occasional	15	12	9	6	3
2 – Remote	10	8	6	4	2
1 - Improbable	5	4	3	2	1

Risk Rating (Probability x Severity)	Risk Acceptance Authority
1 to 4 (Low)	Risk is tolerable, manage at local level
5 to 9 (Medium)	Risk requires approval by Operations Lead/Supervisor & Safety Manager
10 to 25 (High)	Risk requires the approval of the Operations Manager & Safety Director

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B-2: PROJECT TASK HAZARD ASSESSMENTS (THAs)

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Task Hazard Assessment – DCSA

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Task Name:	NAPL Recovery	**Control #:**	01

Project Name:	National Grid Williamsburg	**Client:**	National Grid	**Date:**	June 6, 2021
Permits Required? (list):	No	**Work Location:**	50 Kent Ave, Williamsburg, Brooklyn		

This THA must be fully reviewed with all staff members. All job steps, hazards, work practices, and PPE are clearly understood and have been implemented. All necessary revisions have been written on the THA.

Required PPE:	☒ Hard Hat ☒ Safety Glasses ☒ HiVis Vest ☒ Safety Toe Boots ☒ Gloves:		☐ Hearing Protection	☒ Other: Long pants and shirts with sleeves; Tyvek® coveralls; Face covering.
Tools & Equipment:	PID	Interface Probe	Pump (Peristaltic or Inertial Hydrolift [i.e. Waterra])	Hand Tools for Well Access

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
1. Travel to and from Site	1a. Simultaneous Operations (50 Kent Ave construction scheduled for completion April 2022)	10	1a. AECOM Project Manager to provide advance notice of arrival to site to Construction Manager (Anna Schmiedicke, Stantec, 929 284-0606). 1b. Check in at the site office to notify arrival and follow directions as provided by the Construction Manager (or delegate). Discuss AECOM work for the day and confirm work areas.	4
	1b. Car accident/ property damage	10	1c. Plan route prior to travel; Allow adequate travel time; Be mindful of pedestrians and bikers; Follow road rules; Be aware of road conditions and surroundings; Note the bike lane running along Kent Ave when entering and exiting the site and look both ways.	4
	1c. Fatigue/fitness to work	10	1d. Ensure fit to work and well rested.	4
	1d. Lone Worker	10	1e. Check in with PM within 1hr of arrival to Site and on departure.	4

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Task Hazard Assessment – DCSA

AECOM Imagine it. Delivered.

Task Name: NAPL Recovery	**Control #:** 01

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
On-Site Edits:				
2. Unloading Equipment and Set Up Work Area	2a. Traffic	8	2a. Secure suitable parking location to safely unload equipment; Only move equipment between the parked vehicle and the adjacent sidewalk; Do not cross the road carrying equipment.	4
	2b. Slips, trips and falls	6	2b. Keep walking route free of trip hazards; Place equipment in work area demarcated with traffic cones.	2
	2c. Back or body strain from improper lifting	6	2c. Bend knees when lifting and keep load close to body; Refer Manual Handling Procedure.	2
On-Site Edits:				
3. NAPL Gauging	3a. Traffic	8	3a. Demarcate work area within the sidewalk with traffic cones; Keep work area as far away from curb as possible; Do not stand on edge of curb, work from within the sidewalk.	4
	3b. Slips, trips and falls	6	3b. Set up work area and demarcate work area with traffic cones; Keep work area free of trip hazards; Maintain good housekeeping during works.	2
	3c. Back or body strain from bending down	6	3c. Bend knees when lifting and keep load close to body; Refer Manual Handling Procedure.	2
	3d. Exposure to NAPL and vapors	4	3d. Ensure PPE is worn; Stand up-wind of groundwater well; Monitor work area with PID continuously; **STOP WORK** if reading exceeds 5- 25 ppm sustained for 5 minutes (refer Section 9.3 of HASP)	2
On-Site Edits:				

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Task Hazard Assessment – DCSA

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Task Name: NAPL Recovery	**Control #:** 01

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
4. Pumping NAPL	4a. Traffic	8	4a. Demarcate work area within the sidewalk with traffic cones; Keep work area as far away from curb as possible; Do not stand on edge of curb, work from within the sidewalk.	4
	4b. Slips, trips and falls	6	4b. Set up work area and demarcate work area with traffic cones; Keep work area free of trip hazards; Maintain good housekeeping during works.	2
	4c. Back or body strain from bending down.	6	4c. Bend knees when lifting and keep load close to body; Refer Manual Handling Procedure.	2
	4d. Spill from tubing	4	4d. Double check all connections before pumping NAPL; Have spill pads available and ready to contain any releases.	2
	4e. Exposure from splashes during pumping	4	4e. Ensure PPE is worn; Be mindful of potential for splashes and keep face away.	2
	4f. Exposure to odors and vapor from NAPL	4	4f. Ensure PPE is worn; Stand up-wind of groundwater well; Monitor work area with PID continuously; Cover drum with lid at all times; **STOP WORK** if reading exceeds 5- 25 ppm sustained for 5 minutes (refer Section 9.3 of HASP).	2
	4g. Spill or release of contaminated water	3	4g. Have spill pads available and ready to contain any releases.	2
On-Site Edits:				
5. Breakdown of Work Area	5a. Traffic	8	5a. Do not stand on edge of curb, work from within the sidewalk.	4
	5b. Slips, trips and falls	6	5b. Keep work area free of trip hazards; Make sure area is free of all equipment prior to moving to next location.	2

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Task Hazard Assessment – DCSA

AECOM Imagine it. Delivered.

Task Name:	NAPL Recovery	Control #:	01

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	Potential Hazards *How could you be hurt? What would the injury be?*	Risk *(initial)*	Critical Actions To Mitigate Hazards *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	Risk *(final)*
	5c. Back or body strain from bending down.	6	5c. Bend knees when lifting and keep load close to body; Refer Manual Handling Procedure.	2
	5d. Spill or release of contaminated water	3	5d. Have spill pads available and ready to contain any releases.	2
On-Site Edits:				

Additional Notes:

NAPL recovery is performed as a Lone Worker. Ensure compliance with Section 3.11 of the HASP (Lone Worker Management).

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Task Hazard Assessment – DCSA

AECOM Imagine it. Delivered.

Task Name:	NAPL Recovery	Control #:	01

All Employees:

STOP WORK if uncertain about safety or if a hazard or additional precaution is not recorded on the THA.

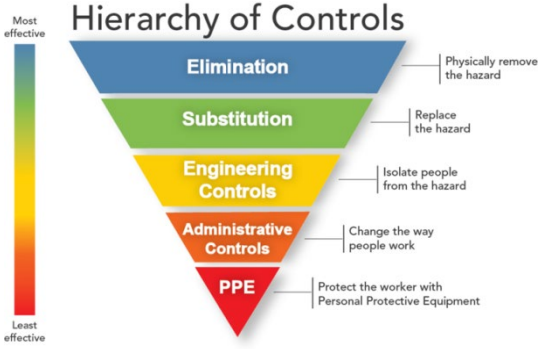
Be alert, recognize and communicate any changes in scope, personnel or conditions at the worksite to the supervisor.

Use **4-Sight**, AECOM's last minute risk assessment process continuously throughout the day by asking yourself and your co-workers to assess your task, hazards, and mitigations. Amend the THA when needed.

- ***What am I about to do?***
- ***What can go wrong?***
- ***What can be done to make it safer?***
- ***What have I done to communicate the hazards?***

For a more thorough identification of hazards, ask "What else could go wrong?" using the Hazard Categories





- ***Most hazards need more than one control***
- ***What should you do? Stack your controls***
- ***PPE can NEVER be your only means of protection***

Worker Sign On	
I participated in the on-site review and fully understand the content of this Task Hazard Assessment.	
Printed Name	**Signature**
1. Supervisor:	
2.	
3.	
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Visitor Acknowledgement
Visitors review task hazards and acknowledge understanding
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Submit a new THA for addition to the DCSA THA Library or send THA improvement suggestions to DCSA.THA.Library@AECOM.com
Include a copy of the new THA or a photo of the THA modifications as appropriate.

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Task Hazard Assessment

AECOM Imagine it. Delivered.

Task Name:	Preparations for Travel when Driving (fleet, rental and personal vehicles) to Minimize Coronavirus Exposure	Control #:	Rev # 1 (6/12/2020)

Project Name:	Various	Client:	Various	Date:	
Permits Required? (list):		Work Location:			

THIS THA MUST BE FULLY REVIEWED AND ACKNOWLEDGED DAILY BY ALL AECOM STAFF and AECOM SUBS ON-SITE

All job steps, hazards, work practices & PPE are to be clearly understood and implemented. All necessary revisions have been written on the THA.

Required PPE:	☐ Hard Hat ☐ Safety Glasses ☐ HiVis Vest ☐ Safety Toe Boots ☒ Gloves: ☐ Hearing Protection ☐ Other: _____
	Additional materials and supplies required: Potable water and soap (preferable) or hand sanitizer w/ 70% alcohol Disinfectant wipes Tissues Disposable gloves Face coverings/face masks One Gallon Zip Lock Bags Safety goggles Disinfectant spray List of Cleaning Products to Kill Coronavirus
Tools & Equipment:	

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions to Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
1. Planning the trip	1a. Potential exposure to Coronavirus	4	1a. Map route in advance to utilize the least populated route of travel. Avoid entering public places. If traveling more than 250 miles in one direction, develop a Journey Management Plan and be sure to add controls for protection against Coronavirus.	2
On-Site Edits:				
2. Preparing vehicle for driving	2a. Possible exposure from touching contaminated surfaces, tools, equipment and materials in vehicle.	8	2a. If feasible, use your personal vehicle or procure a fleet vehicle or a rental car (contact rental car company in advance) that hasn't been driven in the past 72 hours and always clean and disinfect the vehicle in accordance with the V**ehicle Cleaning THA** prior to driving. If possible, park the vehicle with the windows closed facing the sun (on sunny days), to allow the vehicle to heat up for 2-3 hours.	4

Task Hazard Assessment

AECOM Imagine it. Delivered.

Task Name:	Preparations for Travel When Driving	Control #:	Error! Reference source not found. **Rev # 1 (6/12/2020)**

On-Site Edits:					
3. Driving to and from destination	3a. Possible exposure from passengers	8	3a. Limit to one person per vehicle whenever possible. If a passenger must ride with you, limit to one passenger and have them sit in the rear passenger side seat. Crack and/or open windows and use fan to recirculate air.	4
On-Site Edits:					
4. Stopping for fuel, restroom breaks and food	4a. Possible exposure due to contact with members of the general public at gas stations, convenience stores, restrooms, etc.	**12**	4a. Plan trip to eliminate the need to stop for food, fuel or restroom breaks. If you must stop, avoid entering public places if possible. For refueling, don face covering and disposable gloves. When finished, doff disposable gloves, dispose of in trash receptacle and wash hands with soap and water or hand sanitizer with at least 70% alcohol. If you must enter public places, practice social distancing and wear a face covering. If you must use public restrooms, don disposable gloves prior to entering, doff and dispose of in trash receptacle when exiting. Wash hands with soap and water for at least 20 seconds or use a hand sanitizer before and after entering public places and restrooms. Have soap and water, antibacterial hand wipes or spray, 70% + alcohol hand sanitizer available.	4
On-Site Edits:					
5. Out of town work	5a. Exposure at hotels	**12**	5a. Where logistically feasible, if a project extends beyond a day's duration, plan on traveling home rather than staying in a hotel if this can be done within AECOM's fatigue management program. Book through CWT and in known chains to ensure maximum cleanliness, even if the hotel needs to be a further distance from the site. Call the hotel ahead of your stay to find out what controls (i.e. cleanliness, disinfection, face cover required, etc.) they have in place for their guests. If long stay, there may be other options to consider such as Airbnb (full house) to minimize contact with people. Ask for room on the first floor to avoid using the elevator if possible. Maintain social distance (minimum six feet) with people. Do not touch anything if not needed in your hotel or room as the first measure. If in doubt of cleanliness of the accommodation, bring it up to the accommodation responsible person. Wipe down all touch point surfaces in hotel room with disinfectant or alcohol wipes. Put a "do not disturb" sign on door handle to prevent hotel staff from entering room to clean during the day. If possible, open window(s) for circulation. Wipe down window handles prior to opening and use gloves to open. Refrain from using hotel room coffee machines. Wash hands frequently.	4

Task Hazard Assessment

AECOM Imagine it. Delivered.

Task Name:	Preparations for Travel When Driving	Control #:	Error! Reference source not found. **Rev # 1 (6/12/2020)**

On-Site Edits:					

Additional Notes:

Where required, supplies (i.e., disinfectant spray/wipes, soap/hand sanitizer, nitrile gloves) should be made available prior to starting work. Request re-supply if stock runs low.

Use disinfectant products that contain at least 70% alcohol. Use alcohol-based hand sanitizer that contains at least 60% alcohol. Wash hands with soap and water whenever available. Remember that soap (including bar soap) is generally available and is considered superior to hand sanitizer or disinfectant wipes/spray. If disinfectants are unavailable, prepare diluted bleach solution as described in Step 6 and use in their place.

If any staff are showing any possible symptoms of or have been in recent direct contact with others showing symptoms of CORONAVIRUS, **STOP WORK**. Notify the site supervisor and the project manager and go home and/or stay home. Contact the AECOM Incident Reporting Hotline (1-800-348-5046) and/or the AECOM Nurse Line (1-512-419-5016).

A list of common symptoms to look out for can be found here:
AECOM Guidance for Coronaviruses

Visit the CDC webpage on cleaning and disinfecting procedures: CDC Guidance for Community and Residential Cleaning-Disinfection for Coronavirus

A list of approved disinfectants for use against SARS-CoV-2, the cause of CORONAVIRUS, is available here: US EPA List of Disinfectants Effective Against Coronaviruses

Revision Log

Version	Issued / Revised By	Date	Revision Summary
THA Revisions			
0	Scott Dietz	June 1, 2020	Original version
1	Scott Dietz	June 12, 2020	Added “Out of town work”

Task Hazard Assessment

AECOM Imagine it. Delivered.

Task Name:	Preparations for Travel When Driving	Control #:	Error! Reference source not found. **Rev # 1 (6/12/2020)**

Project-Specific Revisions			

Task Hazard Assessment

AECOM Imagine it. Delivered.

Task Name:	Preparations for Travel When Driving	Control #:	Error! Reference source not found. **Rev # 1 (6/12/2020)**

All Employees:

STOP WORK if uncertain about safety or if a hazard or additional precaution is not recorded on the THA.

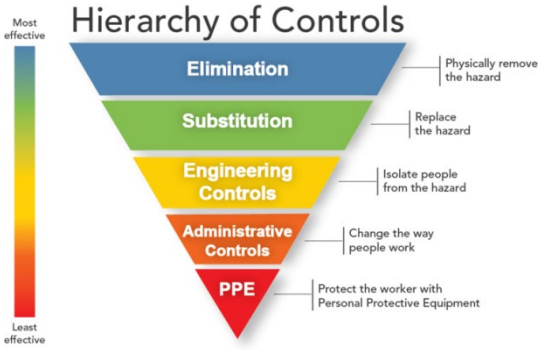
Be alert, recognize and communicate any changes in scope, personnel or conditions at the worksite to the supervisor.

Use **4-Sight**, AECOM's last-minute risk assessment process continuously throughout the day by asking yourself and your co-workers to assess your task, hazards, and mitigations. Amend the THA when needed.

- ***What am I about to do?***
- ***What can go wrong?***
- ***What can be done to make it safer?***
- ***What have I done to communicate the hazards?***

For a more thorough identification of hazards, ask "What else could go wrong?" using the Hazard Categories





- ***Most hazards need more than one control***
- ***What should you do? Stack your controls***
- ***PPE can NEVER be your only means of protection***

Worker Sign On	
I participated in the on-site review and fully understand the content of this Task Hazard Assessment.	
Printed Name	**Signature**
1. Supervisor:	
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Visitor Acknowledgement
Visitors review task hazards and acknowledge understanding
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Submit a new THA for addition to the DCSA THA Library or send THA improvement suggestions to DCSA.THA.Library@AECOM.com

Task Hazard Assessment

AECOM Imagine it. Delivered.

Task Name:	Preparations for Travel When Driving	Control #:	Error! Reference source not found. **Rev # 1 (6/12/2020)**

Include a copy of the new THA or a photo of the THA modifications as appropriate.

Task Hazard Assessment

AECOM Imagine it. Delivered.

Task Name:	Field and Field Office – Precautions for Coronavirus	**Control #:**	Rev # 6 (6/17/2020)

Project Name:	Various	Client:	Various	**Date:**	
Permits Required? (list):	Essential Services Letter required for travel if required by ocal ordinance	**Work Location:**			

THIS THA MUST BE FULLY REVIEWED AND ACKNOWLEDGED DAILY BY ALL AECOM STAFF and AECOM SUBS ON-SITE

All job steps, hazards, work practices & PPE are to be clearly understood and implemented. All necessary revisions have been written on the THA.

Required PPE:	☒ Hard Hat ☒ Safety Glasses ☒ HiVis Vest ☒ Safety Toe Boots ☐ Gloves: ☐ Hearing Protection ☐ Other: _____
	For certain tasks (see THA below) the following are required: Potable water and soap (preferable) or hand sanitizer w/ 60% alcohol Disinfectant wipes Tissues Nitrile gloves Safety goggles Coveralls Disinfectant spray List of Cleaning Products to Kill Coronavirus Face covering when you are not able to maintain 6' social distance or where required by client or government order. Face coverings can be made from household materials by using needles, thread, cloth, tee-shirts, bandanas, etc. KN95, N95, dust/face masks are also acceptable. Local requirements may vary. https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/diy-cloth-face-coverings.html PPE Note: Consider checking sources such as gas stations and specialty markets, as these may have equipment or materials not available at general grocery stores.
Tools & Equipment:	

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions to Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
1. Fitness for Duty check (performed at home prior to work)	1a. Being unfit for duty – impacted by illness including coronavirus	12	1a. Ensure you are fit for duty Are you or have you been in any of these situations? ➢ I have had close contact with a confirmed case or a symptomatic person under investigation for coronavirus in the last 14 days. ➢ A doctor requested me to be tested for coronavirus or instructed me to self-quarantine? ➢ A member of my household or someone I was in close contact within the last 14 days experienced some of the following symptoms: fever, cough, shortness of breath, fatigue, sore throat, chills, gastro-intestinal disease or diarrhea, loss of taste/smell. ➢ I have or previously had some of the following symptoms in the last 7 days: fever or chills, cough, shortness of breath or difficulty breathing, fatigue, muscle or body ache, headache, new loss of taste/smell, sore throat, congestion or runny nose, nausea or vomiting, or diarrhea..	4

Task Hazard Assessment

AECOM Imagine it. Delivered.

Task Name:	General Field Work and Office Work	Control #:	Error! Reference source not found.

			➢ Where required, my temperature check today shows a fever, without the use of fever reducing medications in the last 24 hours? (100.4 F [37.8C] or above or exceeding criteria required by local order or client requirements). **If response is a YES, then do not access the workplace**. If AECOM employee, contact your Supervisor and the AECOM Nurse at **512-419-5016** for advice. **If response is a NO or Yes, but released by AECOM nurse, you can proceed to work**. You may be asked to check your temperature again when you arrive to your workplace.	
On-Site Edits:				
2. Travel by vehicle or air required	2a. Being in an enclosed space with poor air circulation in close contact with other people.	**12**	2a. For Vehicle travel, review the "Preparations for Travel when Driving (fleet, rental and personal vehicles) to Minimize Coronavirus Exposure" THA for driving and the "Preparations for Travel when flying to Minimize Coronavirus Exposure" for flying.	4
On-Site Edits:				
3. General Field Work	3a. Working Around Others	**12**	3a. **Personnel must maintain at least 6-foot distance from each other** (see note below if this seems to be unachievable)**.** Practice social distancing at tailgate meetings, in break rooms and job trailers. Completely avoid (if possible) or limit the number of people in job trailers and other confined areas at any one time so that this distance can be maintained. If possible, hold meetings outside. If indoors, open window(s) for circulation. Wipe down window handles prior to opening. Even when practicing social distancing, we must limit the amount of people in any one group to less than 10 people. Clean all surfaces of your hands often with soap and water for at least 20 seconds. If soap and water are not readily available, use a hand sanitizer that contains at least 60% alcohol. Cover all surfaces of your hands, including around and under fingernails and rub them together until they feel dry. When using hand sanitizer, be sure your hands are completely dry prior to touching any objects or surfaces. Wear safety glasses or goggles and avoid contact/touching of face, eyes, nose, and mouth. Cover your mouth and nose with a tissue when you cough or sneeze or use the inside of your elbow. Throw used tissues in the trash. Immediately wash or sanitize your hands. **NOTE**: . Face coverings will also be worn where clients, states or municipalities require them. If you feel your task cannot be performed by maintaining social distancing, face coverings will be worn in combination with additional behavioral or PPE controls. If additional guidance is required, contact your SH&E manager to discuss the use of additional controlsPlease keep in mind, face coverings alone will not protect you from Coronavirus, so additional controls must be added. If the need arises to enter a personal residence, **prepare a separate task specific THA** for this task.	4
	3b. Handling Shared Equipment and Tools	**12**		

Task Hazard Assessment

AECOM Imagine it. Delivered.

Task Name:	General Field Work and Office Work	Control #:	Error! Reference source not found.

	3c. Exposure during Lunch and Bathroom Breaks	12	3b. Wipe down and disinfect equipment before use with soap/water or disinfectant wipes. Wear disposable gloves when wiping surfaces down with disinfectant. Regularly wash hands when handling tools or equipment. Wash hands before eating or drinking. 3c. Be sure to wash hands with soap/water whenever a bathroom is nearby. At minimum, do so during bathroom and lunch breaks. Use a paper towel to open door handle when exiting bathroom. If using outside toilet facilities (i.e. Porta Johns), wash hands with soap and water or hand sanitizer both before and after opening/closing the door. Where possible, employees are encouraged to pack meals and snacks as needed for the project duration and avoid visiting stores and restaurants. If necessary, modify your schedule to avoid restaurants and public restrooms during peak, i.e., crowded, periods to minimize contact with the public. Use drive-through service for food pick-up if available.	4
	3d. Lack of food/water/supplies	4	Avoid eating lunch as a group, if you must, do so outside or in a space with windows open (wipe down windows prior to opening). Maintain 6 feet or more and do not share dishes (e.g., bag of chips, communal salad bowl, etc.) Refrain from sharing a field office coffee pot. Many locations may have shortages of food, water, or supplies or closed restaurants. Bring food, water, and supplies to allow you to work a full shift without additional provisions.	1
On-Site Edits:				
4. Office Work	4a. Working around others	12	4a. Work from home when possible. Clean hands often with soap and water for at least 20 seconds after using the restroom, after you have been in a public place, before and after eating or after blowing your nose, coughing, or sneezing. If soap and water are not readily available, use a hand sanitizer that contains at least 60% alcohol. Cover all surfaces of your hands, including around and under fingernails, and rub them together until they feel dry. Cover your mouth and nose with a tissue when you cough or sneeze or use the inside of your elbow. Throw used tissues in the trash. Immediately wash or sanitize your hands. Sit at least six feet apart from others. Change workstations and meeting room setup to accommodate this social distancing. Even if you are practicing social distancing, we must still limit groups of people to less that 10. Do not eat or hang out in common areas. Maintain social distancing during tailgate meetings and/or THA reviews, supervisor should seek verbal agreement from all and note this rather than passing pen and clipboard around for signature. Avoid passing round other items such as sign-in sheets as well. Make hand-sanitizers, sanitizing wipes, and other hygienic supplies readily available.	4
	4b. Encountering frequent "touch points" and handling shared equipment	12	4b. Wipe down keyboards, mouse, phone, headset/headphones, any other "touch points". Limit contact of shared items. Wipe down surfaces before contacting them. Wash hands after handling or wear disposable gloves.	4

Task Hazard Assessment

AECOM Imagine it. Delivered.

Task Name:	General Field Work and Office Work	Control #:	Error! Reference source not found.

			In reception areas, use your own pen to sign in and out of offices. Remove unnecessary items such as business card holders, communal candy jars, etc. Work with facilities to assign someone to clean AND disinfect frequently touched surfaces daily. Follow the manufacturer's instructions for all cleaning and disinfection products (e.g., concentration, application method and contact time.	
On-Site Edits:				

Additional Notes:

Where required, supplies (i.e., disinfectant spray/wipes, soap/hand sanitizer, nitrile gloves) should be made available prior to starting work. Request re-supply if stock runs low.

Use disinfectant products that contain at least 70% alcohol. Use alcohol-based hand sanitizer that contains at least 60% alcohol. Wash hands with soap and water whenever available.
Remember that soap (including bar soap) is generally available and is considered superior to hand sanitizer or disinfectant wipes/spray.

Common touch points and surfaces include but are not limited to:

- Arms on chairs
- Tabletops
- Doorknobs and handles
- Countertops
- Elevator Buttons
- Coffee Pots
- Refrigerator / microwave / dishwasher / toaster handles
- Water Dispensers
- Cabinet and file drawer knobs / handles
- Shared office supplies such as staplers, paper cutters, scissors, packaging tape dispensers, writing utensils
- Phone receivers, keypads
- Copier / printer / fax control buttons
- Sink faucets
- Light switches

Task Hazard Assessment

AECOM Imagine it. Delivered.

Task Name:	General Field Work and Office Work	Control #:	Error! Reference source not found.

If any staff are showing any possible symptoms of or have been in recent direct contact with others showing symptoms of CORONAVIRUS, **STOP WORK**. Notify the site supervisor and the project manager and go home and/or stay home. Contact the AECOM Incident Reporting Hotline (1-800-348-5046) and/or the AECOM Nurse Line (1-512-419-5016), and notify the Area SH&E Manager. A list of common symptoms to look out for can be found here: AECOM Guidance for Coronaviruses
Visit the CDC webpage on cleaning and disinfecting procedures: CDC Guidance for Community and Residential Cleaning-Disinfection for Coronavirus.
A list of approved disinfectants for use against SARS-CoV-2, the cause of CORONAVIRUS, is available here: US EPA List of Disinfectants Effective Against Coronaviruses

Revision Log

Version	Issued / Revised By	Date	Revision Summary
THA Revisions			
0	Amanda Lanning & Kelly Dwyer	March 23, 2020	Original version
1	Patrick Walz	March 26, 2020	Added new Step 1, Fitness for Duty Check. Modified language related to stopping work when PPE supplies are unavailable. Added instructions for making diluted bleach solution. Modified vehicle use instructions to allow long-term rental and fleet vehicle use.
2	Scott Dietz	April 2, 2020	Added new Step 5, Traveling/Out of Town Work
3	Patrick Walz & Joan Root	April 13, 2020	Modified language related to hotel stays. Moved instructions for making diluted bleach solution from PPE section to Step 6 and added hazards and mitigations. Added note regarding requirements for face coverings to PPE section, and added tips for obtaining sources of PPE.
4	Scott Dietz, Kelly Dwyer, Patrick Walz, & Devon Molitor	May 1, 2020	Added revision log. Modified language related to office cleaning to clarify that facilities should be contacted to arrange office cleaning. Modified Step 3 to clarify social distancing requirements and added “note” with steps to take when not possible.
5	Walz, Dietz, Dwyer, Indorato, Gregory, Molitor, Cooter	May 5, 2020	Modified the Fit for Duty language, removed requirement to wear nitrile gloves when driving and opening/closing doors and windows, modified language if AECOM personnel must enter a personal residence.
6	Walz, Dietz, & Shelley Brown	June 17, 2020	Modified the symptoms of coronavirus, removed language regarding travel and hotel stays and provided link to new travel THAs which cover those topics in greater detail. Various additional minor modifications to text and formatting. Modified initial risk ratings.
Project-Specific Revisions			

Task Hazard Assessment

AECOM Imagine it. Delivered.

Task Name:	General Field Work and Office Work	Control #:	Error! Reference source not found.

All Employees:

STOP WORK if uncertain about safety or if a hazard or additional precaution is not recorded on the THA.

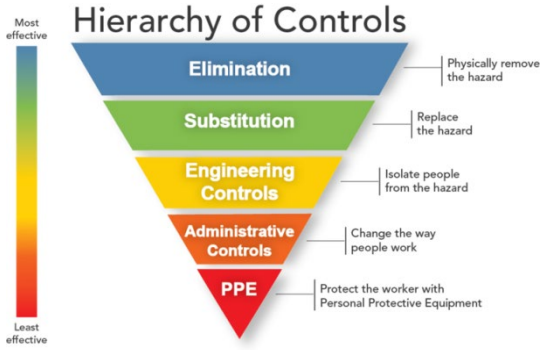
Be alert, recognize and communicate any changes in scope, personnel or conditions at the worksite to the supervisor.

Use **4-Sight**, AECOM's last-minute risk assessment process continuously throughout the day by asking yourself and your co-workers to assess your task, hazards, and mitigations. Amend the THA when needed.

- ***What am I about to do?***
- ***What can go wrong?***
- ***What can be done to make it safer?***
- ***What have I done to communicate the hazards?***

For a more thorough identification of hazards, ask "What else could go wrong?" using the Hazard Categories





- ***Most hazards need more than one control***
- ***What should you do? Stack your controls***
- ***PPE can NEVER be your only means of protection***

Worker Sign On	
I participated in the on-site review and fully understand the content of this Task Hazard Assessment.	
Printed Name	**Signature**
1. Supervisor:	
2.	
3.	
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Visitor Acknowledgement
Visitors review task hazards and acknowledge understanding
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Submit a new THA for addition to the DCSA THA Library or send THA improvement suggestions to DCSA.THA.Library@AECOM.com

Task Hazard Assessment

Task Name:	General Field Work and Office Work	Control #:	Error! Reference source not found.

Include a copy of the new THA or a photo of the THA modifications as appropriate.

Task Hazard Assessment

AECOM Imagine it. Delivered.

Task Name:	Coronavirus Vehicle Cleaning THA	**Control #:**	Rev # 1 (6/1/2020)

Project Name:	Various	Client:	Various	**Date:**	
Permits Required? (list):		**Work Location:**			

THIS THA MUST BE FULLY REVIEWED AND ACKNOWLEDGED DAILY BY ALL AECOM STAFF and AECOM SUBS ON-SITE

All job steps, hazards, work practices & PPE are to be clearly understood and implemented. All necessary revisions have been written on the THA.

Required PPE:	☐ Hard Hat ☒ Safety Glasses ☐ HiVis Vest ☐ Safety Toe Boots ☒ Nitrile Gloves: ☐ Hearing Protection ☐ Other: See list below _____
	Disposable gloves, in proper size for operator(avoid latex due to allergy concerns) Face coverings or mask Safety Glasses
Tools & Equipment:	Paper towels Trash container/bags Safety glasses Small bucket of water Dish soap Disinfectant spray or wipes List of Cleaning Products to Kill Coronavirus Note: Many of the same household cleaners (such as non-bleach, unscented, non-chlorinated disinfectant cleaners and wipes) that kill coronaviruses on hard surfaces at home can also clean most car interiors without causing damage. Alcohol solutions that contain at least 70 percent alcohol are effective against coronavirus, according to the CDC. Nearly every interior surface of a vehicle can be cleaned with isopropyl alcohol. Vigorous washing with soap and water can also destroy the coronavirus. Soap and water are safe for most car interiors. **Warning!** • Don't use bleach or hydrogen peroxide on the inside of the vehicle. • Don't use scented wipes or wipes containing bleach. • Don't use ammonia-based cleaners on car touch screens or dashboards, as they can damage anti-glare and anti-fingerprint coatings. • Never combine cleaning chemicals as doing so may lead to toxicity. • If using alcohol, avoid any potential source of sparks/ignition. **DO NOT SMOKE!**

Task Hazard Assessment

AECOM Imagine it. Delivered.

Task Name:	Coronavirus Vehicle Cleaning THA	Control #:	Error! Reference source not found.

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	Potential Hazards *How could you be hurt? What would the injury be?*	Risk *(initial)*	Critical Actions to Mitigate Hazards *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	Risk *(final)*
1. Plan for cleaning/disinfecting	1a. Exposure to harsh disinfectants	8	1a. Read the Safety Data Sheet or warnings/precautions on the label. Wear the PPE specified. At a minimum, gloves and safety glasses shall be worn.	4
	1b. Not having the supplies necessary to perform the task (inadequate cleaning	8	1b. Confirm that you have the necessary supplies and equipment before proceeding. If possible, prepare a supply kit with all necessary cleaning/disinfecting prior to travel.	4
	1c. Damaging vehicle interior surfaces	8	1c. Consult the owners manual to verify how to clean the various surfaces. Some surfaces may be adversely impacted by certain cleaners and by an excess application of water.	4
On-Site Edits:				
2. Prepare the vehicle for cleaning	2a. Inadequate cleaning because of obstructed surfaces	6	2a. Don gloves and safety glasses. Open all vehicle doors and remove all trash, water bottles, tools, equipment, etc., that are not part of the vehicle. Clean or discard as appropriate.	4
On-Site Edits:				
3. Inspect the vehicle and clean if necessary	3a. Insufficient cleaning due to excessively soiled surfaces	8	3a. Inspect the vehicle interior for any visibly soiled surfaces. If these are identified, clean those surfaces with a few drops of dish detergent in a bucket of water using a clean cloth.	4
	3b. Damaging electronics	6	3b. Avoid using excess water onto the surfaces	4
On-Site Edits:				
4. Disinfect frequent touch points **(see Additional Notes section for list)**	4a. Accidental transfer of coronavirus to others.	8	4a. Disinfect all frequently touched surfaces using the disinfectant identified. Consult the Additional Notes section for a list of surfaces to be considered.	4
	4b. Improperly applying disinfectant and ruining vehicle surfaces	10	4b. Test on small, inconspicuous surface first. Apply disinfectant in accordance with the instructions. Avoid excessive application.	4

Task Name:	Coronavirus Vehicle Cleaning THA	Control #:	Error! Reference source not found.

		4c. Eye, skin, or inhalation exposure to disinfectant	10	4c. Apply disinfectant in accordance with the directions. Wear PPE as required.	4
On-Site Edits:					
5. Hold time		6a. Eye, skin or lung irritation from residual disinfectant	8	6a. Keep the vehicle doors open for 10-15 minutes after disinfecting to allow the vehicle to air out. If possible, park the vehicle with the windows closed facing the sun (on sunny days), to allow the vehicle to heat up for 2-3 hours.	2
		6b. Frequent changeover of vehicles	8	6b. To the extent feasible, all vehicles should have a 72-hour wait/hold time between different drivers. Currently, the Coronavirus is believed to survive up to 72 hours on certain hard surfaces. Waiting 72-hours further minimizes the risk of exposure.	4
On-Site Edits:					

Additional Notes:

Surfaces can be a source of COVID-19 exposure and sharing vehicles can result in different people touching the surfaces of the vehicle.
Vehicles should be cleaned and disinfected **before use, after use, and when changing drivers**.
The cleaning should be conducted by the **vehicle operator**.
Cleaning supplies shall be stored in each vehicle to allow for periodic cleaning before and after use and during the day, as needed.

Common touch points and surfaces on vehicles include but are not limited to the following:

- Center console
- Dashboard surface
- Glove box,
- Inside door handles
- Keys/key fob
- Outside door handles
- Overhead console
- Parking brake handle

Task Name:	Coronavirus Vehicle Cleaning THA	Control #:	Error! Reference source not found.

- Rear view mirror
- Seat belts buckles
- Seat control
- Shift lever
- Steering wheel
- Sun visors
- Radio controls
- Touch screens

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A list of common symptoms to look out for can be found here:
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Revision Log

Version	Issued / Revised By	Date	Revision Summary
THA Revisions			
1	Lisa Rygiel	June 1, 2020	Original version
Project-Specific Revisions			

Task Hazard Assessment

AECOM Imagine it. Delivered.

Task Name:	Coronavirus Vehicle Cleaning THA	Control #:	Error! Reference source not found.

Task Hazard Assessment

AECOM Imagine it. Delivered.

Task Name:	Coronavirus Vehicle Cleaning THA	Control #:	Error! Reference source not found.

All Employees:

STOP WORK if uncertain about safety or if a hazard or additional precaution is not recorded on the THA.

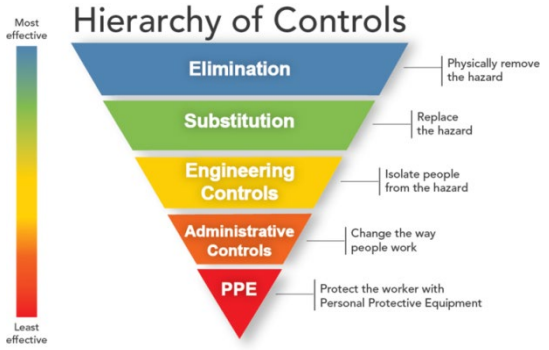
Be alert, recognize and communicate any changes in scope, personnel or conditions at the worksite to the supervisor.

Use **4-Sight**, AECOM's last-minute risk assessment process continuously throughout the day by asking yourself and your co-workers to assess your task, hazards, and mitigations. Amend the THA when needed.

- ***What am I about to do?***
- ***What can go wrong?***
- ***What can be done to make it safer?***
- ***What have I done to communicate the hazards?***

For a more thorough identification of hazards, ask "What else could go wrong?" using the Hazard Categories





- ***Most hazards need more than one control***
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Worker Sign On	
I participated in the on-site review and fully understand the content of this Task Hazard Assessment.	
Printed Name	**Signature**
1. Supervisor:	
2.	
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Visitor Acknowledgement
Visitors review task hazards and acknowledge understanding
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Submit a new THA for addition to the DCSA THA Library or send THA improvement suggestions to DCSA.THA.Library@AECOM.com

Task Hazard Assessment

AECOM Imagine it. Delivered.

Task Name:	Coronavirus Vehicle Cleaning THA	Control #:	Error! Reference source not found.

Include a copy of the new THA or a photo of the THA modifications as appropriate.

B-3: BLANK THA AND DAILY TAILGATE MEETING FORMS

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AECOM

Americas

Daily Tailgate Meeting

S3AM-209-FM5

Instructions: Conduct meeting prior to sending crews to individual tasks. Require attendance of all AECOM employees and subcontractors. Invite personnel from simultaneous operations for coordination purposes. Review scope of work and briefly discuss required and applicable topics**. This meeting is a daily refresher, not a full orientation**. Task-specific discussions associated with Task Hazard Assessment (THA) follow this meeting at the task location immediately before individual task is started.

AECOM Supervisor Name: **Phone Number:**	
AECOM SH&E Rep. Name: **Phone Number:**	
Meeting Leader:	

Date:	**Project Name/Location:**	**Project Number:**
Today's Scope of Work:		

Muster Point Location:	**First Aid Kit Location:**	**Fire Extinguisher Location:**	**Spill Kit Location:**

1. Required Topics	**2. Discuss if Applicable to Today's Work**
☐ Fitness for Duty requirements, all sign in / sign out ☐ Required training (incl. task specific) completed and current ☐ SH&E Plan onsite - understood, reviewed, signed by all (incl. scope, preplanning hazard assessments / risk registers, controls, procedures, requirements, etc.) ☐ Task Hazard Assessments (THAs) are to be reviewed and completed for each task immediately prior to conducting ☐ STOP WORK Right & Responsibility- all task changes/changed conditions re-assess with THA ☐ Requirement to report to supervisor any injury, illness, damage, near miss, unsafe act / condition ☐ Emergency Response Plan – including muster point, first aid kit, fire extinguisher, clinic/hospital location ☐ Personal Protective Equipment (PPE) - Required items per hazard assessments in good condition / in use by all ☐ Equipment/machinery inspected (documented as required) and in good condition - operators properly trained/certified ☐ Work area set up and demarcation/ barricades in place to protect workers, site staff, and the public ☐ Required checklists/records available, understood (describe): ☐ Lessons Learned / SH&E improvements (describe):	☑ ■ **Check ☑ as reviewed or mark ■ as not applicable** ☐ ☐ Biological/ Chemical / Electrical Hazards ☐ ☐ Ergonomics - Lifting, Body Position ☐ ☐ Lock Out/ Tag Out Short Service Employees - visual identifier and mentor/ oversight assignment ☐ ☐ Simultaneous/ Neighbouring Operations ☐ ☐ Slip/ Trip/ Fall Hazards ☐ ☐ Specialized PPE Needs ☐ ☐ Traffic Control ☐ ☐ Waste Management/ Decontamination ☐ ☐ Weather Hazards / Heat Stress / Cold Stress ☐ ☐ Subcontractor Requirements (e.g., JHAs, THAs, procedures, reporting, etc.) ☐ ☐ Work Permits / Plans required (e.g., Fall Protection, Confined Space, Hot Work, Critical Lifts, etc.); in place, understood (identify/attach): ☐ ☐ Other Topics (describe/attach): ☐ ☐ Client specific requirements (describe):

3. Daily Check Out by Site Supervisor	
Describe incidents, near misses, observations or Stop Work interventions from today:	Describe Lessons Learned/ Improvement Areas from today:

The site is being left in a safe condition and work crew checked out as fit unless otherwise specified as above.

Site Supervisor Name	**Signature**	**Date** **Time** **(at end of day / shift)**

Worker Acknowledgement / Sign In Sign Out sheets applicable to this meeting are on reverse and, if applicable, attached.

All employees:

- **STOP WORK if concerned / uncertain about safety / hazard or additional precaution is not recorded on the THA.**
- **Be alert and communicate any changes in personnel or conditions at the worksite to the supervisor.**
- **Reassess task, hazards, & mitigations on an ongoing basis; amend the THA if needed.**

SITE WORKERS (including AECOM Contractors and Subcontractors): Your signature below means that you understand:

* The requirement to participate in creating, reviewing, & updating hazard assessments (THA) applicable to your task(s).
* The hazards & control measures associated with each task you are about to perform.
* The permit to work requirements applicable to the work you are about to perform (if it includes permitted activities).
* That no tasks or work is to be performed without a hazard assessment.
* Your authority & obligation to "Stop Work" intervene, speak up/ listen up.

Your initials (right columns) certify that you arrived & departed fit for duty, & have reported all incidents/near misses; meaning:

* You are physically and mentally fit for duty and have inspected your required PPE to ensure satisfactory condition.
* You are not under the influence of any type of medication, drugs, or alcohol that could affect your ability to work safely.
* You are aware of your responsibility to immediately report any illness, injury (regardless of where or when it occurred), or impairment/fatigue issue to the AECOM Supervisor.
* You signed out as fit / uninjured unless you have otherwise informed the AECOM Supervisor.

Print Name & Company	Signature	Initials & Sign In Time	Initials & Sign Out Time
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit

(Attach additional Site Worker sign-in/out sheets if needed) Identify number of attached sheets: _____

SITE VISITOR / SITE REPRESENTATIVE

Name	Company Name	Arrival Time	Departure Time	Signature

Task Hazard Assessment – DCSA

AECOM Imagine it. Delivered.

Task Name:		**Control #:**	

Project Name:	National Grid Williamsburg	**Client:**	National Grid	**Date:**	
Permits Required? (list):		**Work Location:**	50 Kent Ave, Williamsburg, Brooklyn		

This THA must be fully reviewed with all staff members. All job steps, hazards, work practices, and PPE are clearly understood and have been implemented. All necessary revisions have been written on the THA.

Required PPE:	☒ Hard Hat ☒ Safety Glasses ☒ HiVis Vest ☒ Safety Toe Boots ☒ Gloves: _____ ☐ Hearing Protection ☐ Other: _____
Tools & Equipment:	

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
1.	1a.		1a.	
On-Site Edits:				
2.	2a.		2a.	
On-Site Edits:				
3.	3a.		3a.	
On-Site Edits:				

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Task Hazard Assessment – DCSA

AECOM Imagine it. Delivered.

Task Name:		Control #:	

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
4.	4a.		4a.	
On-Site Edits:				
5.	5a.		5a.	
On-Site Edits:				
6.	6a.		6a.	
On-Site Edits:				
7.	7a.		7a.	
On-Site Edits:				

Additional Notes:

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Task Hazard Assessment – DCSA

AECOM Imagine it. Delivered.

Task Name:		Control #:	

All Employees:

STOP WORK if uncertain about safety or if a hazard or additional precaution is not recorded on the THA.

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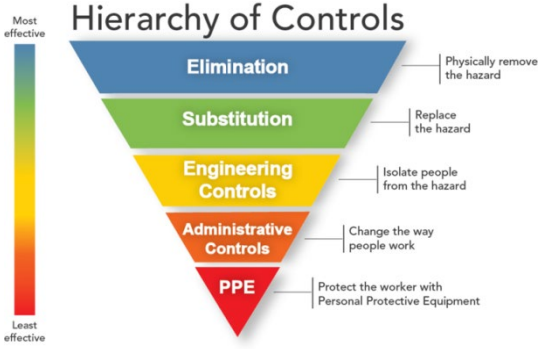

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Worker Sign On	
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Include a copy of the new THA or a photo of the THA modifications as appropriate.

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ATTACHMENT C

AECOM SH&E Procedures

All AECOM SH&E Procedures, in their controlled copy version, are available on the internal SH&E Policy and Procedures ecosystem page.

Programmatic procedures referenced in this document (for example SH&E Training) **DO NOT** need to be printed for inclusion in this HASP. Only procedures that are needed for field activity reference and application **MUST** be printed in full and included in this section.

Copy the Field Procedure Checklist from the Physical and Biological Hazards Section 7 to become your table of contents for these attachments. Include only those procedures checked as applicable to this project.

Hazard/ Activity (Note: Text in this column links to procedure)	**Site Specific Description** (Where, What Phase of Work, Frequency, Etc.)	**Applicable Procedure**
☐ Abrasive Blasting		S3AM-335-PR
☐ Aerial Work Platforms		S3AM-323-PR
☐ All-Terrain Vehicles		S3AM-319-PR
☐ Blasting and Explosives		S3AM-336-PR
☒ Bloodborne Pathogens	First aid providers	S3AM-111-PR
☐ Cofferdams		S3AM-344-PR
☒ Cold Stress	Continuous exposure when ambient air temperature is below 32 °F (0 °C) **or** when ambient air temperature is below 50 °F (10 °C) with wet/damp conditions.	S3AM-112-PR
☐ Compressed Air Systems and Testing		S3AM-337-PR
☒ Compressed Gases	Calibration gas canisters	S3AM-114-PR
☐ Concrete Work		S3AM-338-PR
☐ Confined Spaces		S3AM-301-PR
☒ Corrosive Reactive Materials	Handling pre-preserved bottle ware for sampling	S3AM-125-PR
☐ Cranes and Lifting Devices		S3AM-310-PR
☐ Demolition		S3AM-339-PR
☐ Diving (scientific and commercial)		S3AM-334-PR
☒ Drilling, Boring & Direct Push Probing	Groundwater well rehabilitation work	S3AM-321-PR

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AECOM Global

Pandemic Procedure

SR1-003-PR2

1. Purpose and Scope

Providing the requirements for preparation and planning for potential pandemic emergencies that may occur while AECOM staff are working.

Applies to all AECOM staff working inside and outside an AECOM office, including location and project environments as well as business related travel.

2. Background

2.1 Pandemic

A pandemic virus emerges because of a process called antigenic shift, which causes an abrupt or sudden and major change in flu-like viruses. Public health officials closely monitor the movement of flu-like viruses through avian and swine populations. The public health fear is that the virus may obtain the ability to shift and incorporate the ability to infect humans directly through human-to-human contact. At that point, the threat of a regional epidemic, or a global pandemic may be realized.

Flu-like viruses can weaken the immune system, making the person more vulnerable to serious infections such as pneumonia, or can worsen chronic medical conditions. Public health officials watch both avian and swine flu outbreaks closely to monitor potential for an antigen shift and progression to a human transmissible disease.

Government health agencies continually monitor flu-like viruses and other diseases worldwide. Human cases are reported and updated by the World Health Organization (WHO) and U.S. Centers for Disease Control (CDC). This information is used by responsible government agencies for planning and response actions as required to minimize the spread and effects of disease outbreaks. It is important that information provided by CDC or WHO is made available to employees when there is potential for impact on work conditions or local community health.

2.1.1 Swine Influenza

Influenza A (H1N1) is a flu virus of swine origin that first caused illness in March and April, 2009. Influenza A (H1N1) flu spreads in the same way that regular seasonal influenza viruses spread, mainly through the coughs and sneezes of people who are sick with the virus, but it may also be spread by touching infected objects and then touching your nose or mouth. Influenza A (H1N1) is now established in human populations as a seasonal influenza virus. There is an Influenza A vaccine available for humans.

2.1.2 Avian Influenza

Avian influenza (bird flu) occurs mainly in wild birds but can spread to domestic birds and can cause outbreaks. Human cases are rare but have occurred from direct close contact with infected birds and poultry or contaminated materials. There is no vaccine available for humans related to this virus at this time.

2.1.3 Coronavirus

Coronavirus (COVID-19) is the result of a virus identified as SARS-CoV-2. Coronaviruses are large family of viruses found in both animals and humans. Some infect people and are known to cause illness ranging from the common cold to more severe diseases such as Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS) with symptoms such as fever, cough and shortness of breath. There currently is no human vaccine available for this virus.

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2.2 Flu-Like Contingency Planning

2.2.1 Roles & Responsibilities of Governing Agencies

2.2.1.1 Global Health Monitoring

The WHO coordinates health issues for the United Nations and provides leadership on global health matters. The WHO assists member nations with recommendations regarding global pandemics and declares global pandemic phases to help organizations to plan for the impacts. The major phases are:

a. Phase 1:	No viruses circulating among animals have been reported to cause infections in humans.
b. Phase 2:	An animal influenza virus circulating among domesticated or wild animals is known to have caused infection in humans and is therefore considered a potential pandemic threat.
c. Phase 3:	An animal or human-animal flu-like reassortment virus (the process by which viruses swap gene segments) has caused sporadic cases or small clusters of disease in people but has not resulted in human-to-human transmission sufficient to sustain community-level outbreaks. Limited human-to-human transmission may occur under some circumstances, for example, when there is close contact between an infected person and an unprotected caregiver.
d. Phase 4:	There is verified human-to-human transmission of an animal or human-animal flu-like reassortment virus able to cause “community-level outbreaks.” The ability to cause sustained disease outbreaks in a community marks a significant upwards shift in the risk for a pandemic. Any country that suspects or has verified such an event should urgently consult with WHO so that the situation can be jointly assessed, and a decision made by the affected country if implementation of a rapid pandemic containment operation is warranted. Phase 4 indicates a significant increase in risk of a pandemic but does not necessarily mean that a pandemic is a forgone conclusion.
e. Phase 5:	There is human-to-human spread of the virus into at least two countries in one WHO region. While most countries will not be affected at this stage, the declaration of Phase 5 is a strong signal that a pandemic is imminent and that the time to finalize the organization, communication, and implementation of the planned mitigation measures is short.
f. Phase 6:	The pandemic phase is characterized by community level outbreaks in at least one other country in a different WHO region in addition to the criteria defined in Phase 5. Designation of this phase will indicate that a global pandemic is under way.
g. Post-peak period:	During the post-peak period, pandemic disease levels in most countries with adequate surveillance will have dropped below peak observed levels. The post-peak period signifies that pandemic activity appears to be decreasing; however, it is uncertain if additional waves will occur and countries will need to be prepared for a second wave.
h. Post-pandemic period:	Flu-like disease activity will have returned to levels normally seen for seasonal flu-like illness. At this stage, it is important to maintain surveillance and update pandemic preparedness and response plans accordingly. An intensive phase of recovery and evaluation may be required.

2.2.1.2 Country Specific Pandemic Plans

Most nations have developed pandemic plans that include monitoring the regional spread of disease, the recommended medical practices, and related guidance. AECOM operations outside the US must keep abreast of country specific requirements and recommendations.

2.2.1.3 United States

The federal government is responsible for coordinating a nationwide flu-like pandemic response.

a. The U.S. Department of Homeland Security coordinates all non-medical support and response actions.

b. The Department of Health and Human Services (HHS) coordinates overall public health and medical emergency response. Under Executive Order 13295 (revised April 1, 2005), the Secretary of Health and Human Services has the authority for apprehension, detention and conditional release of individuals to prevent the spread of a flu-like illness caused by a novel or re-emergent flu-like virus that causes or has the potential to cause a pandemic. Under HHS, the CDC is responsible for controlling the introduction and spread of infectious diseases and provides information to help health care providers, public health officials and the public. CDC's Division of the Strategic National Stockpile (SNS) distributes antiviral drugs, personal protective equipment, and respiratory protection devices to all 50 states and U.S. territories to help them respond to outbreaks.

c. Under the Department of Defence (DOD) Directive 6200.3, military facilities require identification of a Public Health Emergency Officer who coordinates Military Treatment Facilities emergency response plans with local emergency planning.

2.2.1.4 State and Local Governments

Each state has authority to manage and respond to pandemic conditions. It is important that projects and offices contact their local and state governments for emergency contact information.

3. Procedure and Responsibilities

AECOM Managers, HR (Human Resources), SH&E (Safety, Health and Environment) including Occupational Health, Legal Counsel, and Resilience Coordinators will collaborate and drive efforts to plan for, respond to, manage and recover from pandemic disruption to the business. This collaboration may also require input and cooperation from various other support functions who should be consulted in a timely fashion in order to expedite a return to normal business operations or to provide alternate solutions such as remote work. In the event of a declared Stage 5 or Stage 6 of a Pandemic event, the AECOM Managers, HR, SH&E, Occupational Health, Legal Counsel and Resilience Coordinators will make decisions and take necessary steps to protect the business from the pandemic, up to, and including, travel bans to/from certain areas, telecommuting, and other decisions as needed for business continuity with a focus on the health and welfare of the employee. Local Resilience Teams will take the lead in responding to pandemic-related business disruptions with overarching guidance provided by Global Resilience.

3.1 Corporate Roles and Responsibilities

AECOM offices will be prepared to respond to either a global, national or regional pandemic condition in accordance with the Organizational Resilience Standard - AECOM Global. The standard provides the common platform to organize mission-critical, Resilience Teams to prepare for, actively navigate and / or recover from significant business disruptions. It also provides the context for plans and procedures to minimize any impact on AECOM's business in terms of severity and duration.

3.1.1 Prevention and Containment

a. If a pandemic condition exists or is imminent within a local office or field location, consult the location specific Emergency Response Plan (ERP) or Business Continuity Plan for immediate response guidelines.

b. Upon notification from State Emergency Planning agency that a national or regional pandemic condition exists or is reasonably expected to occur, the facilities and administration teams working with the SH&E Department will provide sufficient and accessible infection control supplies in all local affected business locations in keeping with AECOM's Infectious Disease and Pandemic Cleaning Instruction - AECOM Global.

c. Face masks may be supplied, if recommended by WHO/CDC. Supplies of anti-viral medications will not be stockpiled, distributed, or administered unless specified by community health administrators.

d. Annual influenza vaccinations are encouraged.

e. As applicable, communications through email or intranet, training programs, or work place postings may be utilized to provide information concerning prevention and containment. Information may include, but is not limited to:

   i. Initial symptoms of the disease, disease prevention techniques, how to respond if an individual suspects infection and when return to work is appropriate after the illness.

   ii. Personal practices and habits for minimizing exposure, such as: frequent hand washing, avoiding exposing other employees when sick, annual flu vaccinations if appropriate, and consulting a personal physician to determine personal risk.

   iii. Social distancing techniques such as minimizing large group gatherings, reducing employee face-to-face meetings through the use of video / phone conferencing/ Microsoft Teams, and eliminating unnecessary travel during severe outbreaks.

   iv. Flexible worksite and flexible work hours options should be implemented as appropriate.

   v. Employees shall notify their supervisor if they are going to miss work because of illness. Information concerning sick leave and health benefits can be obtained through the employee's HR representative, by consulting applicable policies and procedures specific located on the AECOM Integrated Management Systems (IMS) platform, and through MyHR.

   vi. As applicable, business and meeting travel may be limited to "business essential" only.

   vii. Management will notify any applicable clients or suppliers of potential business impacts that may be experienced as a result of a pandemic. Management will update clients/suppliers once operations are restored to full capacity.

3.1.2 Anti-Viral Medication

a. Media coverage of flu-like outbreaks has focused on the availability of oral anti-viral medications (not vaccines). These prescription medications are known to help with treating uncomplicated flu-like virus effects in limited applications. There are potential side effects of the drugs, and some viruses have shown resistance to the drug.

b. Based on this information, unless legally mandated by a country's government, AECOM will not attempt to stockpile sources of anti-viral drugs to be used for employees in the event of a pandemic. Resources of these drugs may be maintained by a country's National Strategic Stockpile.

c. Employees should contact their personal health care provider regarding recommendations for support medications that may be necessary in the event of a flu pandemic.

3.2 General AECOM Employee Guidelines

3.2.1 Employee Illness

a. Employees should report the illness to your Supervisor immediately.

b. Employees who are ill with flu-like symptoms (Fever >100.4 F/38 C, cough, shortness of breath0 should stay home. If they have a fever, they should stay home until at least 24 hours after they are free of fever without the use of fever reducing medications.

c. Employees should not travel if they are ill.

d. Employees who become sick during work hours should immediately go home.

e. Employees at higher risk of complications, or who become seriously ill, should contact their health care provider immediately.

3.2.2 Employee Family Member Illness

a. Employees who are well but who have a family member at home with the flu may choose to stay home or can go to work as usual. Employees with ill family members should monitor their health daily before coming to work and stay home if they become ill.

b. Employees who choose to stay home to care for ill family members should contact their supervisor or HR representative to discuss flu-related issues such as using sick time/paid time off or if telecommuting is an option.

c. Employees should not bring an ill family member with them to the office, even for brief periods.

3.2.3 Supervisors

a. If an employee calls in sick because of the flu or a flu-like illness, the supervisor is to advise them to stay home. Expect employees to be out of work for 3-5 days (in most cases). Additional quarantine may be required based on the recommendations of CDC / WHO.

b. Should the supervisor be informed by the employee that he/she has the flu or flu-like symptoms, the supervisor should report the employee illness to HR and SH&E representative only, maintaining the employee's privacy.

c. Because symptoms may not appear until after an incubation period, (24 hours prior to symptoms), the supervisor should try to account for any close contacts (3ft/1m for 30 minutes) the affected employee might have had in order to evaluate if co-workers may have been exposed. Report the potential exposure of co-workers to your HR or SH&E representative.

d. Do not allow employees with the flu or flu-like symptoms to remain at work. In-office quarantine (isolation) of an employee with flu-like symptoms (e.g., work in a secluded office area) is not permitted.

Important Reminder: **The names of employees who are ill with the flu are CONFIDENTIAL and can only be discussed with HR representatives or company nurses.**

3.2.4 HR or SH&E Representatives

a. During Phase 5 and 6 of a potential / actual Pandemic, the SH&E representative will track cases of flu illness at your location using the Coronavirus Affected Employee Form obtained from the AECOM Occupational Health Nurse and submit to nurse@aecom.com upon identification of employee/s who are confirmed positive for the virus, exhibiting symptoms of the virus or on self-quarantine and provide updates at least weekly. These numbers also to be reported to your Local Resilience Coordinator (LRC) to allow Resilience Teams (RT) to assess appropriate responses in accordance with the Disruptive Event Response Instruction - AECOM Global. Each state/country has specific resilience reporting contacts located on the Global Resilience Team contact list.

b. Inform fellow employees if a co-worker possibly exposed them to a flu-like illness, while maintaining strict confidentially regarding the identity of the co-worker, so that employees can self-monitor for symptoms and stay home if they become sick. (Sample notification: We have been notified that there has been a potential exposure to the coronavirus in this office/building. As a precaution, it is recommended that all employees potentially affected begin self-monitoring for symptoms and to stay home if you become ill. Ensure that you follow the office procedure for notification of management of unexpected absences). For additional information, refer to the AECOM Global update through the Ecosystem

c. A medical release of a clearance to return to work (following an extended absence) may not be available because of a busy health care system. Requiring a physician's release to return to work should be considered in cases of hospitalization or medical leave of absence in line with local HR protocols.

d. Address staff rumours immediately through investigation and follow-up, then inform management of communication with employee and onward reporting to the Local Resilience Coordinator.

3.2.5 HR Representative

a. Advise employees and supervisors regarding sick time or paid time off options.

b. Discuss with supervisors if telecommuting is an option for the employee.

3.2.6 Managers/SH&E Representative

a. Provide information to staff regarding good hygiene, including cough and sneeze etiquette and proper hand washing. Hold periodic meetings to refresh awareness of prevention measures.

b. Remind employees to check with their health care provider to determine if flu inoculations are recommended.

c. Follow-up with facilities and office managers to provide tissues, disinfectant wipes, hand sanitizers and no-touch receptacles for disposal.

d. Coordinate with facilities managers to arrange for commonly touched surfaces such as doorknobs and countertops to be cleaned frequently in accordance with AECOM's Infectious Disease and Pandemic Cleaning Instruction - AECOM Global.

3.3 Travel Worldwide to Areas Affected by a Pandemic

AECOM's Global Security & Resilience (GSR) shall be consulted to obtain advice, approvals or restrictions, and support, for employees traveling worldwide to and returning from areas affected by a pandemic or potential pandemic. Travel to high risk locations as defined by the Country Risk Score Index will also require approval. AECOM's Corporate guidance can be found on the Ecosystem and is updated weekly.

Persons visiting areas with reports of outbreaks of concern can reduce their risk of infection by observing the following measures:

3.3.1 Before Traveling to an Affected Area

a. Educate yourself and others who may be traveling with you through consultation with AECOM's GSR Travel Security Portal (Drum Cussac) and AECOM's policies and procedures located on the AECOM Integrated Management Systems (IMS) platform.

b. Confirm applicable and routine vaccinations are current. See your doctor or health-care provider, or (for employees) follow the international business and travel requirements on the International Travel Procedure. When traveling from the US, contact our travel resource, WorkCare Travel Consultant directly at 800-455-6155 and outside the US, contact iSOS (International SOS) at +1 215 942 8226 (Membership # 11BMMS000147), ideally 4-6 weeks before travel, to get any additional vaccination medications or information you may need. In many cases, a medical examination may be required prior to travel.

c. Assemble a travel health kit containing basic first aid and medical supplies. Be sure to include a thermometer and alcohol-based hand gel or wipes for hand hygiene. See the AECOM Travel Health- Pack Smart Checklist.

d. Identify in-country health-care resources in advance of your trip. Employees may contact iSOS, HR or WorkCare for assistance in identifying available resources.

3.3.2 During Travel to an Affected Area

a. As with other infectious illnesses, one of the most important preventive practices is careful and frequent hand washing for at least 20 seconds. Cleaning hands often with soap and water removes potentially infectious material from skin and helps prevent disease transmission. Waterless alcohol-based hand gels or wipes may be used when soap is not available, and hands are not visibly soiled.

b. If an employee becomes sick with symptoms such as a fever accompanied by cough and sore throat, or difficulty breathing or if they develop any illness that requires prompt medical attention, a consular officer (refer to the country's representatives on the GSR Travel Portal-Drum Cussac) or iSOS can assist you in locating approved medical services and informing your family or friends. The employee should defer any further travel until they are free of symptoms, unless traveling locally for medical care or instructed to evacuate by your project management, security, or upon advice of occupational health nurses. AECOM employees on foreign travel should notify their HR representative of any serious illness. Local employees should contact their supervisor according to their specified reporting policy.

c. In the event of a flu outbreak, avoid all direct contact with birds or swine and avoid farms and markets. There is the possibility that other animal groups may become reservoirs of the infection in the future so current information from WHO/CDC should be checked for updated guidance.

3.3.3 After Return from Travel

a. Monitor your health for 14 days after return for any fever or breathing difficulties.

b. If you become ill with a fever plus a cough and sore throat, or trouble breathing during this 14-day period, consult your primary care physician. Do not come into work until advised by your primary care physician that it is safe to do so. Communicate the following:

   i. your symptoms;

   ii. where you travelled; and

   iii. if you have had direct contact with animals, birds, or severely ill persons.

c. Do not travel while ill, unless you are seeking medical care. Limiting close physical contact (<3ft/1 meter) with others as much as possible can help prevent the spread of an infectious illness.

4. Help & Training

The following resources provide an overview of AECOM's Organizational Resilience framework and process (titles also available at AECOM University).

a. Global Resilience Team Framework

b. Organizational Resilience: Redefining What's Possible

c. Powering Organizational Resilience through Functional Readiness

d. Resilience Coordinator Overview

e. Resilience Readiness: Disruptive Event Guidance

5. Terms and Definitions

a.	Local Resilience Coordinator	A manager designated as the Office or Worksite lead for local level organizational resilience who may or may not be the emergency response coordinator. The LRC is the point of contact with the Region Resilience Team in determining further action, including notifications, following an initial emergency response.
b.	Pandemic	An epidemic occurring worldwide, or over a very wide area, crossing international boundaries and usually affecting a large number of people as declared by the World Health Organization

c.	Resilience Team (RT)	Interdependent networks of necessary and essential business functions collaborating at the enterprise, region and/or local levels to achieve organizational resiliency. Functions include but are not limited to communications, facilities, finance, human resources (HR), information technology, legal, procurement, safety, health, and environment, and security. Refer to the Organizational Resilience Standard - AECOM Global

6. References

This procedure forms a sub-set of AECOM's overall Organizational Resilience framework and should be read and executed as such. This procedure is to be applied in conjunction with the following Procedures and Instructions.

a. Organizational Resilience Standard - AECOM Global – SR1-003-PR1

b. Disruptive Event Response Instruction - AECOM Global – SR1-003-WI2

c. Infectious Disease and Pandemic Cleaning Instruction – AECOM Global - SR1-003-WI4

7. Appendices

The following appendices are designed to assist business leads, people managers, HR partners, SH&E representatives and Resilience Coordinators assess processes to follow when presented with potentially symptomatic employees, visitors, locations and provide useful resources for communicating prevention methods in the workplace.

a. Appendix 1 – Manager Resilience Checklist.

b. Appendix 2 – Virus Prevention Posters and Flyers

8. Change Log

Rev #	Change Date	Description of Change	Location of Change
0	March 11, 2020	Initial Release as SR1-003-PR2	

Appendix 1 – Manager Resilience Checklist

AECOM Managers Guideline on 2019-nCoV Scenarios						
	CASE	**SUB-CASE**	**What Business Leader should ask the "Case" Employee to do**	**What Business Leader should ask other employees potentially affected by "Case" Employee**	**What Admin should do to the Office**	**Notice and Announcement (To ensure privacy, any notifications/announcements regarding specific cases must be approved by AECOM Legal)**
1	Employee confirmed to have contracted COVID-19.		Employee to stay away from the office and seek medical treatment. Employee may not return to work without medical clearance.	Without disclosing the identity of the infected employee, persons with workstations within 1m/ 3 ft of the "Case" Employee are to observe 14-day quarantine or as recommended by the governing health agency.	Sanitization of whole floor.	• Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions. • Use the Tracking Form to communicate information to Corporate Occupational Injury Management Team by submitting to nurse@aecom.com. • Business Leaders to inform stakeholders who may have employees in contact with a confirmed case.
2A	Employee having close contacts (2) with a person of a clinically diagnosed/confirmed case.	Not feeling well/ Exhibiting Sign/symptoms (5).	Employee to not attend work and seek medical attention and observe any quarantine as instructed by governing health agency.	Persons with workstations within 1m/ 3 ft of the "Case" Employee to observe 14-day quarantine in accordance with governing health agency recommendations or provide medical clearance to return to work prior to the end of the quarantine period.	Sanitization of the whole floor.	• Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions. • Use the Tracking Form to communicate information to Corporate Occupational Injury Management Team by submitting to nurse@aecom.com. • Business Leaders to inform stakeholders who may have employees in contact with a confirmed case.
2B		Feeling Well/ not exhibiting any signs/symptoms.	Employee to observe 14-day quarantine or as instructed by governing health agency.	Persons with close contact with the "Case" employee to self-monitor. If begin having any symptoms see 2A.	Sanitization over an area of 6m (18 ft) radius from the workstation of the "Case" Employee.	• Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions. • Use the Tracking Form to communicate information to Corporate Occupational Injury Management Team by submitting to nurse@aecom.com. • Business Leaders to inform stakeholders who may have employees in contact with a confirmed case.

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AECOM Managers Guideline on 2019-nCoV Scenarios

	CASE	SUB-CASE	What Business Leader should ask the "Case" Employee to do	What Business Leader should ask other employees potentially affected by "Case" Employee	What Admin should do to the Office	Notice and Announcement (To ensure privacy, any notifications/announcements regarding specific cases must be approved by AECOM Legal)
3	Employee being a suspected case (1).		Employee to seek medical attention and observe 14-day quarantine. If at work they should obtain a suitable face-mask as available, notify their supervisor and leave straight away.	Persons with close contact with the "Case" Employee are to observe 14-day quarantine in accordance with governing health agency recommendations or provide medical clearance to return to work prior to the end of the quarantine period.	Sanitization over an area of 6m (18 ft) radius from the workstation of the "Case" Employee.	• Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions. • Use the Tracking Form to communicate information to Corporate Occupational Injury Management Team by submitting to nurse@aecom.com. • Business Leaders to inform stakeholders who may have employees in contact with a confirmed case.
4A	Employee visited a location (3) of a confirmed case but had no contact with the confirmed person.	Not feeling well/ Exhibiting Sign/symptoms (5).	Employee to seek medical attention and observe 14-day quarantine or provide medical clearance to return to work prior to end of the quarantine period.	Persons in close contact with the "Case" Employee put under observation – self-observe for COVID-19 Symptoms (6).	Sanitization of the work stations of the "Case" Employee and of persons with close contact.	• Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions. • Use the Tracking Form to communicate information to Corporate Occupational Injury Management Team by submitting to nurse@aecom.com. • Business Leaders to inform stakeholders who may have employees in contact with a confirmed case.
4B		Feeling Well/ not exhibiting any signs/symptoms.	Employee put under observation – self-observe for COVID-19 Symptoms.	Persons in close contact with the "Case" Employee put under observation – self-observe for COVID-19 Symptoms.	Sanitization of the work stations of the "Case" Employee and of persons with close contact.	• Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions.

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AECOM Managers Guideline on 2019-nCoV Scenarios

	CASE	SUB-CASE	What Business Leader should ask the "Case" Employee to do	What Business Leader should ask other employees potentially affected by "Case" Employee	What Admin should do to the Office	Notice and Announcement (To ensure privacy, any notifications/announcements regarding specific cases must be approved by AECOM Legal)
5A	Employee having close contact with a suspected case, i.e. with a person having symptoms of COVID-19.	Not feeling well/ Exhibiting Sign/symptoms (5).	Employee to seek medical attention and observe self-quarantine until outcome of the suspected case is confirmed and symptoms resolved.	Persons in close contact with the "Case" Employee put under observation – self-observe for COVID-19 Symptoms.	Sanitization of the work station of the "Case" Employee, and of those persons in close contact with the "Case" Employee.	• Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions. • Use the Tracking Form to communicate information to Corporate Occupational Injury Management Team by submitting to nurse@aecom.com. • Business Leaders to inform stakeholders who may have employees in contact with a confirmed case.
5B		Feeling Well/ not exhibiting any signs/symptoms.	Employee observes self-quarantine until outcome of the suspected case is confirmed.	Persons in close contact with the "Case" Employee put under observation – self-observe for COVID-19 Symptoms.	Sanitization of the work station of the "Case" Employee.	• Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions.
6A	Employee having visited a location of a suspected case.	Not feeling well/ Exhibiting Sign/symptoms (5).	Employee to seek medical attention and stay home until symptoms resolved.	Persons in close contact with the "Case" Employee put under observation – self-observe for COVID-19 Symptoms or until outcome of the suspected case is confirmed as negative. If "Case" employee confirmed positive, refer to 5A.	Sanitization of the work station of the "Case" Employee.	• *Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions. • Use the Tracking Form to communicate information to Corporate Occupational Injury Management Team by submitting to nurse@aecom.com. • Business Leaders to inform stakeholders who may have employees in contact with a confirmed case.
6B		Feeling Well/ not exhibiting any signs/symptoms.	Employee put under observation – self-observe for COVID-19 Symptoms.	Observe general hygiene.		If condition changes, see above.
7	Employee not of the above cases having fever or feeling unwell but without symptoms of COVID-19.		Employee to stay home until symptoms resolved. Seek medical attention if necessary.	Observe general hygiene.		

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Note:

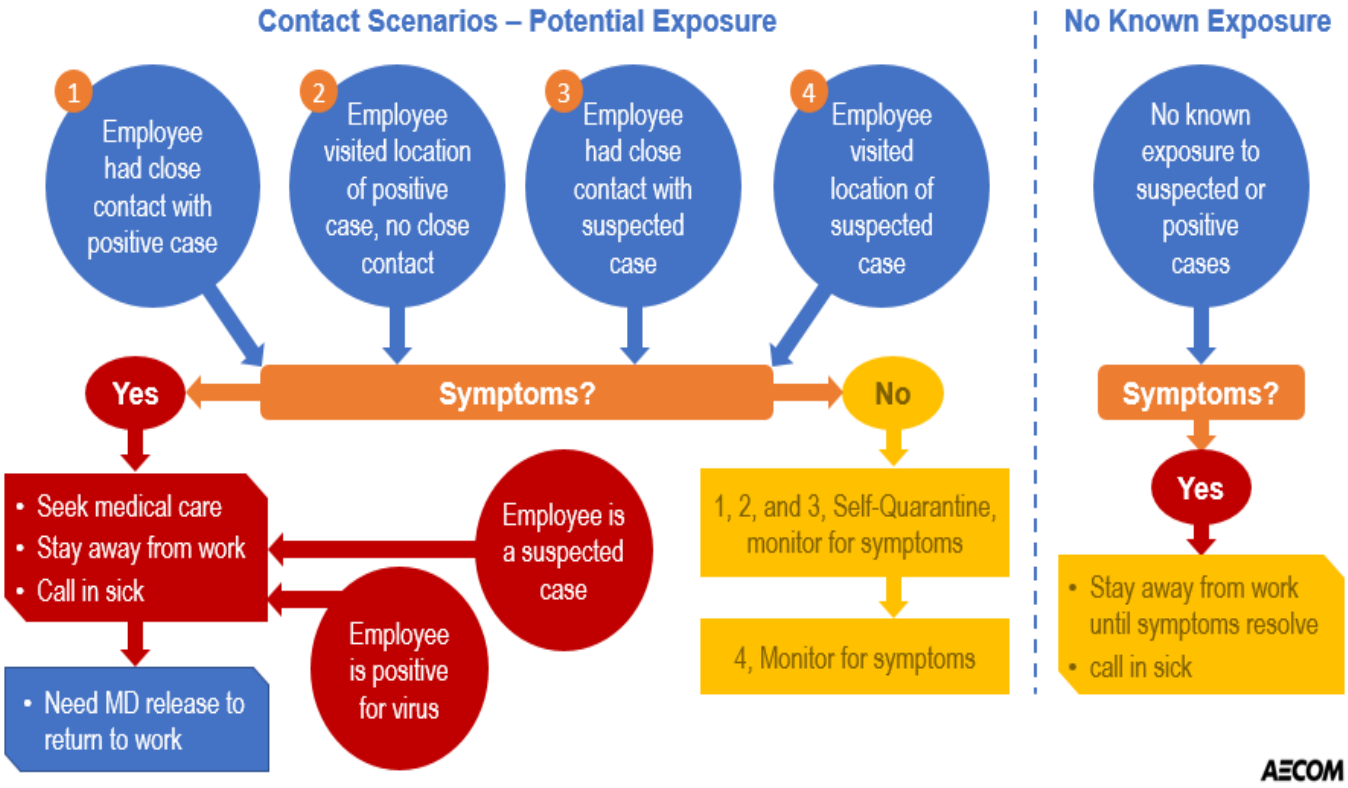
For Cases 1-6, the Employee shall report to the People Manager, HR and Business Unit Leader. The Business Unit Leader shall report to the Regional Resilience Coordinator.

For Case 7, the Employee should report to the People Manager. The People Manager should report to the Business Unit Leader.

1. Definition of Suspected Case: an individual fulfilling the following should report to a local medical facility for further investigation:
    a. Presented with fever OR acute respiratory illness OR pneumonia; AND
    b. any one of the following conditions within 14 days BEFORE ONSET OF SYMPTOMS:
        i. With travel history to Hubei Province* (irrespective of any exposure to a wet market or seafood market); OR other location where COVID-19 is active.
        ii. Visited a medical hospital in an area that has elevated numbers of the virus as identified by the World Health Organization.
        iii. Had close contact with a confirmed case of novel coronavirus infection while that patient was symptomatic.
2. Close contact refers to contact within 1meters (3 ft) for a period ≥ 30 min; or having meeting ≥ 30 min within a confined meeting room regardless of distance.
3. Location refers to, places other than the AECOM Office, the same meeting room or the same confined common area where our Employee and the concerned person (of confirmed or suspected case) have visited during the concerned time and stayed for > 30 min.
4. For all notices and announcements, Business Unit Leader shall give the facts (details of the Case and Sub-case, date, place) to Comms Partner. Resilience Administrator, to inform Comms Partner what action is being taken, or has been planned, on the same date the case is known. Comms Partner will prepare the draft for the Regional Resilience Coordinator. Formal notice and updates to Organizational Resilience Executive via Disruptive Event Briefing Agenda Template - AECOM Global will be issued by the Regional Resilience Coordinator. Business Leaders may forward the announcement to stakeholders (e.g. Client and authorities) as a response to their queries on an as needed basis.
5. Staff feeling unwell or experiencing symptoms who stay home shall apply for leave/PTO. Staff being required to observe quarantine in the above cases will be considered as working from home. Business Leaders to report the status of quarantine and work from home cases to HR and to assess the impact on work progress and efficiency.
6. This guideline provides the minimum requirements to be observed. Business Leaders may exercise discretion to adopt more cautious measures if they consider the case is of a higher risk (e.g. for other staff affected by the concerned employees where close contact is regular/frequent).
7. To ensure privacy, any notifications/announcements regarding specific cases must be approved by AECOM Legal.

This document constitutes internal guidelines compiled based upon general external advice and publications to assist management and staff in dealing with and making management decisions in relation to the Coronavirus (COVID-19). The document should not be construed as providing medical or legal advice and should not be shared outside of AECOM. To the extent that you require any further clarification or have any queries in relation to the content set out therein, please seek further guidance from Legal or the Resilience Team.

AECOM Pandemic Flow Chart



Appendix 2 - Virus Prevention Posters & Flyers

World Health Organization | Patient Safety — A World Alliance for Safer Health Care | SAVE LIVES — Clean Your Hands

How to Handwash?

WASH HANDS WHEN VISIBLY SOILED! OTHERWISE, USE HANDRUB

Duration of the entire procedure: 40-60 seconds

0



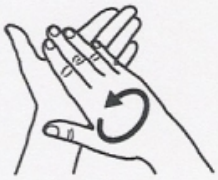
Wet hands with water;

1



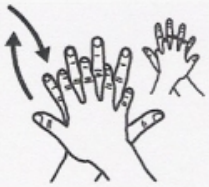
Apply enough soap to cover all hand surfaces;

2



Rub hands palm to palm;

3



Right palm over left dorsum with interlaced fingers and vice versa;

4



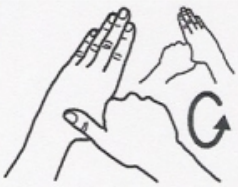
Palm to palm with fingers interlaced;

5



Backs of fingers to opposing palms with fingers interlocked;

6



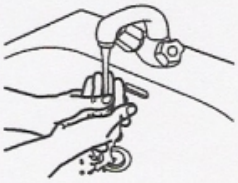
Rotational rubbing of left thumb clasped in right palm and vice versa;

7



Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa;

8



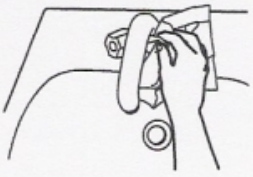
Rinse hands with water;

9



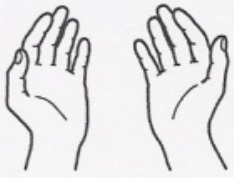
Dry hands thoroughly with a single use towel;

10



Use towel to turn off faucet;

11



Your hands are now safe.

Wash your hands

Wash your hands with soap and running water when hands are visibly dirty



If your hands are not visibly dirty, frequently clean them by using alcohol-based hand rub or soap and water



World Health Organization

Protect yourself and others from getting sick

Wash your hands



- after coughing or sneezing
- when caring for the sick
- before, during and after you prepare food
- before eating
- after toilet use
- when hands are visibly dirty
- after handling animals or animal waste

World Health Organization

STAY HEALTHY WHILE TRAVELLING

If you become sick while travelling, inform crew and seek medical care early





If you seek medical attention, share travel history with your health care provider

World Health Organization

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STAY HEALTHY
WHILE TRAVELLING
Avoid travel if you have a fever and cough
If you have a fever, cough and difficulty breathing seek medical care early and share previous travel history with your health care provider
World Health Organization

Americas

Bloodborne Pathogens

S3AM-111-PR1

1.0 Purpose and Scope

1.1 Define the AECOM procedures for eliminating and/or controlling occupational exposure to Bloodborne Pathogens on AECOM projects and activities.

1.2 A written Exposure Control Plan shall be developed and implemented during all AECOM operations where there is a reasonable potential for occupational exposure of AECOM employees and/or subcontractors to bloodborne pathogens as a regulated waste.

1.3 This procedure's requirements apply to all AECOM Americas employees and operations and any other entity and its personnel contractually required to comply with this document's content. Any jurisdictional requirements exceeding those identified in this procedure shall be met when conduction work in the given jurisdiction.

2.0 Terms and Definitions

2.1 **Blood** – Human whole blood; human blood components such as plasma or platelets; and human blood products such as clotting factors.

2.2 **Bloodborne Pathogens (BBP)** – Pathogenic microorganisms that are present in human blood and that can infect and cause disease in persons who are exposed to blood containing these pathogens including but not limited to hepatitis B virus (HBV), human immunodeficiency virus (HIV), hepatitis C, malaria, syphilis, babesiosis, brucellosis, leptospirosis, arboviral infections, relapsing fever, human T-lymphotropic virus Type I, and viral haemorrhagic fever (Ebola).

2.3 **Exposure Control Plan** *(S3AM-111-ATT1)* – A plan that addresses the requirements applicable to specific AECOM projects and activities designed to eliminate or minimize employee exposure. The Exposure Control Plan shall be incorporated into the location specific SH&E Plan and shall be accessible to all employees. The Exposure Control Plan shall include:

- Exposure determination.
- The schedule and method of implementation for:
  - Methods of compliance;
  - Hepatitis B Vaccination;
  - Post exposure Evaluation;
  - Communications of Hazards to employees; and
  - Record Keeping.
- Documentation methods for exposure incidents, to include:
  - Routes of exposure; and
  - The circumstances for which and exposure incident occurred.

Note: In the State of California this plan shall also address exposures to airborne pathogens.

2.4 **SH&E Plan** – A document prepared for a specific project or program that details the hazards, precautions, emergency planning, medical, and training requirements for that project or program.

2.5 **Occupational Exposure (Exposed) –** Reasonably anticipated skin, eye mucous membrane, or parenteral contact with blood or other potentially infectious materials that may result from the performance of an employee's duties. Employees will be considered to be potentially exposed, even though they are using the universal precautions specified for the project or program.

2.6 **Other Potentially Infectious Materials (OPIM)** – Body fluids and tissues including: semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid, amniotic fluid, saliva, and any other body fluid that is visibly contaminated with blood. When it is difficult or impossible to differentiate between body fluids, all body fluids should be treated as if they are potentially infectious.

Note: In the State of California airborne pathogens are also considered infectious materials.

2.7 **Regulated Waste** – (1) liquid or semi-liquid blood or other potentially infectious materials; (2) contaminated items that would release blood or other potentially infectious materials in a liquid or semi-liquid state if compressed; (3) items that are caked with dried blood or other potentially infectious materials and are capable of being released during handling; (4) objects contaminated with blood that can pierce the skin; and (5) pathological and microbiological wastes containing blood or other potentially infectious materials.

2.8 **Source Individual** – An individual, typically one who has been injured, whose blood or saliva has come in contact with another individual, typically one who has rendered first aid or Cardio Pulmonary Resuscitation (CPR) to the injured party.

2.9 **Universal Precautions** – All body fluids and materials potentially contaminated by body fluids will be considered to be infectious unless the fluids were from the person performing the clean up or decontamination activities. All employees coming in contact with another person's body fluids shall assume that the fluids are infectious and shall wear prescribed Personal Protective Equipment.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-004-PR1 Incident Reporting, Notifications & Investigation

3.3 S3AM-017-PR1 Injury & Illness Recordkeeping

3.4 S3AM-128-PR1 Medical Screening & Surveillance

3.5 S3AM-208-PR1 Personal Protective Equipment

3.6 S3AM-209-PR1 Risk Assessment & Management

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Occupational Health Manager**

- Will review and maintain all medical records generated as a result of post-exposure follow-up and maintain all medical records related to the follow-up.
- Will, where appropriate, consult with AECOM's local medical providers about follow-up recommendations.

4.1.2 **SH&E Manager**

- Will review project / program-specific Exposure Control Plans (normally part of the SH&E Plan) prior to the initial mobilization, at least annually for continuing projects or programs, and whenever necessary to reflect modified tasks or procedures that affect occupational exposure to bloodborne pathogens.
- Will consult with the Occupational Health Manager regarding all bloodborne pathogens exposure incidents.
- Will maintain training records and post-exposure follow-up information.
- Will confirm that site-specific training is conducted for all employees working at sites where regulated wastes were disposed or for employees who may be occupationally exposed while working at a facility that handles regulated wastes.

- Will confirm the Hepatitis B vaccine is made available to all employees with a potential occupational exposure (e.g. paramedic, medical laboratory employee, etc.).
- Will review all incident reports and arrange for post-exposure follow-up with AECOM's local medical provider.
- Will offer recommendations on how to prevent an incident from recurring.

4.1.3 **Manager**

- See that all recommendations made by the SH&E Manager are implemented.
- Support the SH&E Manager in their efforts to prevent occupational and non-occupational exposures to bloodborne pathogens.

4.1.4 **Employee**

- Use all PPE and universal precautions required to prevent exposure to infectious materials.
- Follow the exposure control methods outlined in their Exposure Control Plan.
- Report potential exposure incidents to their Supervisor or Manager immediately.

4.2 Potential Exposure Situations

4.2.1 There are a few activities within AECOM where potential occupational exposures to blood or other potentially infectious materials are of concern. These activities may include:

- Investigations of properties that received regulated wastes.
- Site visits or audits at Treatment Storage and Disposal facilities where medical waste is handled.
- Site visits or audits at medical or health care facilities.
- The provision of first-aid or cardiopulmonary resuscitation (CPR) to AECOM, subcontractor, or client personnel (if the action is part of the employee's occupations duties [e.g. paramedic] and not provided as a voluntary action).

4.2.2 Although AECOM does offer first-aid and CPR training to its employees on a regular basis, providing such aid is often on a voluntary basis and not directed by AECOM. As such, potential exposures may not be considered occupational exposures within the context of the OSHA Bloodborne Pathogens Standard. Site-specific Exposure Control Plans shall differentiate voluntary first-aid duties from occupational exposures as a component of the exposure determination. Refer to *S3AM-209-PR1 Risk Assessment & Management.*

4.3 Unforeseen Exposure Situations

4.3.1 Occasionally, potentially infectious material is encountered during a activity where none was expected; when this happens, the work shall be stopped, employee training conducted, and an exposure control plan prepared prior to resuming activities with potential exposures.

4.4 Employee Training

4.4.1 All personnel who will work on projects or programs which involve potential contact with regulated wastes will be required to attend a training class prior to the start of the project or program and annually for continuing projects or programs. Refer to *S3AM-003-PR1 SH&E Training.* The specific requirements and provisions of the written Exposure Control Plan shall be provided to each AECOM Employee and subcontractor assigned to work at the program / project.

4.4.2 Either of the following two sources of employee training will be used by AECOM to educate Employees on the hazards of exposure to bloodborne pathogens:

- The local chapter of the American Red Cross or other recognized training provider.
- AECOM's in-house training program.

4.4.3 Training sessions will review the following:

- Requirements of OSHA's Bloodborne Pathogens Standard or equivalent, applicable jurisdictional requirements.
- Review of AECOM's Bloodborne Pathogen Procedure (this document).
- Situations within AECOM that may involve exposure to bloodborne pathogens.
- Bloodborne diseases and symptoms of disease.
- Means of transmission.
- Work practice controls to reduce risk.
- Use of personal protective equipment to reduce risk.
- Incident reporting.
- AECOM's Post-Exposure Medical Follow-Up Procedures:

4.4.4 When contracting for CPR and first-aid training sessions, AECOM will request that each session include a section on the hazards associated with exposure to bloodborne pathogens and protective measures that shall be followed when administering first aid, CPR, or other emergency medical care. At the end of the session, Employees will be provided with a copy of this procedure. This procedure will be reviewed and a question-and-answer session will be conducted at the end of the presentation.

4.4.5 If the training provider cannot provide such training, AECOM will conduct a Blood Borne Pathogen training session prior to the start of the first aid or CPR class.

4.4.6 AECOM has and will have little control over employees who have not received AECOM provided first aid or CPR training, but who choose to perform Good Samaritan acts. Any Employee who does perform a Good Samaritan act that results in exposure to blood or other potentially infectious materials will, however, be provided with post-exposure medical follow-up as described in this procedure.

4.5 Personal Protective Equipment

4.5.1 All body fluids and materials potentially contaminated by body fluids will be considered to be infectious. All Employees coming in contact with another person’s body fluids shall assume that the fluids are infectious and shall wear prescribed personal protective equipment (PPE), refer to *S3AM-208-PR1 Personal Protective Equipment*.

4.5.2 The use of PPE to prevent exposure is more appropriate for the types of occupational and non-occupational exposures Employees might encounter than is the use of engineering or work practice controls that are more effectively instituted in medical care or laboratory facilities where employees are actually handling blood and other potentially infectious materials.

4.5.3 PPE such as Tyvek coveralls, shoe covers, and gloves will be provided to all field team members involved in site activities where regulated wastes may be present. Site-specific PPE requirements will be identified in the written Exposure Control Plan. The same type of PPE will also be available, if it is deemed necessary, for Employees involved with activities at TSD facilities that handle regulated wastes.

4.5.4 PPE will be provided to affected Employees at no cost.

4.6 Universal Precautions Kits

4.6.1 In those work areas where there is the potential for exposure to infectious materials, a universal precaution kit shall be readily available. The kit shall permit the clean-up, neutralization, transportation, and disposal of up to 1 litre of blood or body fluids. The kit shall contain the following items at a minimum:

- Safety shield/mask combination
- Liquid proof apron
- Medical-grade vinyl/nitrile gloves
- Liquid solidifier/deodorizer
- Pickup scoop with scraper
- Red biohazard waste bag with tie
- Germicidal solution with dry wipe
- Antimicrobial hand wipe
- ID tag
- Instructions for use

4.7 Personal Hygiene

4.7.1 Special provisions will be made so that hand washing facilities are available on-site for sites that are known to be contaminated with regulated wastes. Alcohol wipes will be available in the event that hand washing facilities are not immediately available.

4.7.2 To reduce the potential for infection, if skin contact with blood or other potentially infectious materials occurs, the exposed area should be washed with non-abrasive soap and water as soon as possible. Hand washing will also help to prevent the transfer of contamination from the hands to other areas of the body or other surfaces that may be contacted later. Even when protective gloves are worn, hands should be washed with non-abrasive soap and running water as soon as possible after the gloves are removed.

4.7.3 The use of an alcohol wipes should not be relied upon as the primary means of personal hygiene. Hands should be thoroughly washed with soap and running water as soon as possible.

4.7.4 If mucous membranes, such as the eyes, come in direct contact with blood or other potentially infectious materials, the area should be washed or flushed with water as soon as possible and reported immediately.

4.8 Reporting Exposure Incidents

4.8.1 All incidents in which an employee has been exposed to blood or other potentially infectious materials shall be reported to the employee's Supervisor and to the SH&E Manager immediately. An IndustrySafe on-line report shall be completed in accordance with *S3AM-004-PR1 Incident Reporting, Notifications & Investigation*. After reviewing the report, the SH&E Manager will provide recommendations, when appropriate, for preventing recurrence of the incident.

4.9 Medical Follow-Up to Exposure Incidents

4.9.1 Once notified, the SH&E Manager will in turn discuss the incident with AECOM's Occupational Health Manager and/or medical provider and make arrangements for an evaluation, refer to *S3AM-128-PR1 Medical Screening & Surveillance*. Prompt medical attention is important in the event of an exposure incident. If the incident occurs in the field, the Employee will either be asked to visit the local hospital or, if he/she chooses, return immediately to the office to visit AECOM's local medical provider.

4.9.2 An attempt will be made to test the affected employee, and if applicable, the source individual's blood, for bloodborne pathogens. No testing will be performed without the written consent of the exposed Employee or the source individual. If initially, the exposed Employee or the source individual does not consent to HIV serological testing, but does consent to HBV serological testing, AECOM will make provisions with the local medical provider to preserve the blood sample for at least 90 days in the event that after counselling efforts, the Employee voluntarily consents to HIV testing.

4.9.3 AECOM will rely on the professional judgment of its Occupational Health Manager and/or local medical providers in the event of an exposure incident. Evaluations and follow-up procedures will be provided according to the recommendations of the United States Public Health Service (USPHS), World Health Organization, or other Public Health organization in Canada and other countries in the Americas current at the time these evaluations and procedures take place. Minimally, a post-exposure evaluation and follow-up will include the following elements:

- Documentation of the route(s) of exposure
- Circumstances under which the exposure incident occurred
- Identification and documentation of the source individual in the case of first aid or emergency medical treatments
- Collection and testing of source individuals and exposed employee's blood for HBV and HIV serological status as soon as feasible and upon consent
- Post-exposure vaccination when medically indicated, as recommended by the USPHS
- Counselling, if necessary
- Evaluation of reported illnesses

4.9.4 Any and all follow-up recommendations offered by the physician will be immediately instituted by the SH&E Manager with the guidance of the Occupational Health Manager and/or the local medical provider and at no cost to the affected Employee. Repeat testing, counselling, and follow-up, if recommended, will also be provided at no cost to the Employee. AECOM will rely on the Occupational Health Manager and/or the local medical provider to provide counselling to Employees concerning infection status, including results of and interpretation of medical tests and advising the Employee about the protection of personal contacts.

4.9.5 All medical providers shall submit to AECOM's Occupational Health Manager and the affected Employee a written opinion of the post-exposure evaluation within 15 days of the completion of the evaluation.

4.9.6 All medical records generated as a result of the post-exposure evaluation will be retained in the office of the Occupational Health Manager, and as applicable AECOM's medical services provider, under lock and key and will be maintained with the strictest confidentiality. Refer to *S3AM-017-PR1 Injury & Illness Recordkeeping.*

4.10 Hepatitis Vaccination

4.10.1 Prior to performing site visits or field investigations where regulated wastes are stored, processed, or known to have been disposed of, AECOM will consult with the Occupational Health Manager and/or the local medical providers to determine if a hepatitis A or B vaccination is appropriate given the site conditions and the proposed scope of work. Where possible the first Hepatitis B vaccinations will be given prior to working at sites with known, potential occupational exposures.

4.10.2 Although AECOM does offer first-aid and CPR training to its Employees on a regular basis, providing such aid is often voluntary and not as a specified job duty of an Employee. As such, potential exposures may not be considered occupational within the context of the government Bloodborne Pathogens Standard. Pre-exposure hepatitis vaccinations will not typically be offered for voluntary roles.

4.10.3 Post-exposure hepatitis vaccination will be offered to Employees involved in an exposure incident within 24 hours of possible exposure.

4.10.4 The vaccinations discussed above shall be provided to Employees at no cost if required by the exposure determination.

4.11 Housekeeping

4.11.1 Other than through the provision of first aid or CPR, there is no potential for occupational exposure to blood or other potentially infectious materials within any of the AECOM offices. Therefore, the housekeeping requirements and requirements for warning signs and labels contained in the OSHA Bloodborne Pathogens standard are not applicable to our office operations.

4.11.2 When working at a site where regulated wastes have been disposed of, the specific housekeeping and warning sign requirements will be prescribed by the client and/or in the site-specific HASP.

4.11.3 When working at a client's facility, AECOM will review the facilities plan for compliance with all the requirements of the Bloodborne Pathogens Standard and will observe all housekeeping requirements, wear required PPE, and acknowledge all warning signs and labels as specified in the client's plan. If the client does not have an effective plan, AECOM will prepare a plan as part of the written Exposure Control Plan.

4.12 Regulated Waste Generated by AECOM

4.12.1 Any regulated waste generated by AECOM as a result of first aid activities or clean-up of potentially infectious material will be collected in sealed, watertight containers and disposed of according to the Host Employer's BBP program or disposed of through a permitted regulated waste facility.

4.12.2 Disposal manifests shall be maintained in accordance with local or governmental regulations.

4.13 Material Decontamination

4.13.1 Any areas or equipment that are contaminated by potentially infectious material will be decontaminated using a 10% solution of household bleach. Utilize appropriate personal protective equipment to control exposure to the bleach (e.g. safety goggles, gloves, etc.). Refer to *S3AM-208-PR1 Personal Protective Equipment*.

4.14 Procedure and Plan Review

4.14.1 All Exposure Control Plans for projects or programs extending over one year shall be reviewed annually by the SH&E Manager and affected Employees.

5.0 Records

5.1 Each SH&E Manager will maintain records and provide copies of the records to the Occupational Health Manager, related to bloodborne pathogens in accordance with the provisions of the standard and *S3AM-017-PR1 Injury & Illness Recordkeeping.*

5.2 Records maintained in accordance will include bloodborne pathogens exposure incidents, post-exposure follow-up, vaccination status, and training for all Employees with potential occupational exposure.

5.3 Employee medical and training records required by this procedure shall be provided upon request for examination and copying to the Employee, to anyone having written consent of the subject employee, or to State, Province, or Federal Occupational Safety and Health regulatory agencies.

6.0 Attachments

6.1 S3AM-111-ATT1 Bloodborne Pathogens Exposure Control Plan

6.2 S3AM-111-FM1 Hepatitis B Vaccination Declination

Americas

Bloodborne Pathogens Exposure Control Plan

S3AM-111-ATT1

1.0 Introduction

Employees are at risk for exposure to and possible transmission of infectious diseases each time they are in contact with blood or body fluids. Bloodborne pathogens are microorganisms present in human blood and other body fluids that can cause serious disease in humans and include, but are not limited to Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), and Human Immunodeficiency Virus (HIV). Therefore, this exposure control plan (ECP) has been established to ensure that employees are effectively informed concerning potential workplace health hazards, and that protective measures necessary to eliminate or minimize bloodborne exposure incidents are used whenever possible.

2.0 Exposure Determination

2.1 The Medical Screening Evaluation form will be used to evaluate which employees may incur occupational exposure to blood or other potentially infectious materials when performing routine tasks and procedures. Refer to *S3AM- 128-PR1 Medical Screening & Surveillance*. These exposure determinations will be made without regard to the use of personal protective equipment, and regardless of exposure frequency.

2.1.1 The employees in the following job classifications may have occupational exposure to bloodborne pathogens, and are covered by this program:

- Occupational health nurse
- Paramedics
- Registered nurses
- Designated first aid providers (providing first aid identified as part of the employee's occupational duties and not a voluntary action)
- Medical laboratory employees
- Janitorial workers in medical facilities and clinics.

2.1.2 Tasks and procedures that may expose the above employees to bloodborne pathogens include:

- Treating cuts, abrasions, and burns
- Cleaning contaminated environmental surfaces
- Administering cardiopulmonary resuscitation (CPR).

3.0 Exposure Control

3.1 "Universal precautions" are a required method of control to prevent exposure to blood and body fluids. This term refers to the concept that all human blood and certain human body fluids are treated as if known to be infectious for HIV, HBV, HCV, and other bloodborne pathogens, regardless of the perceived risk status of another individual. Universal precautions apply to blood, other body fluids containing visible blood, semen, and vaginal fluids. Universal precautions do not apply to feces, nasal secretions, saliva, sweat, tears, sputum, urine, and vomitus unless they contain visible blood. Although these fluids have an extremely low or nonexistent risk for bloodborne pathogens, they are a potential source for other infectious diseases, and precautions shall also be followed when these body fluids are present.

3.2 Engineering and Work Practice Controls

3.2.1 The following engineering controls will be in place in all areas of occupational exposure:

- Containers for disposable contaminated sharps shall be puncture-resistant, labeled a biohazard, leak-proof, and have a closable top.

- Containers for storage, transport, or shipment of blood or other potentially infectious materials, regulated waste, and contaminated laundry will be labeled with the biohazard symbol and site address, and have a securely closing lid.
- Engineering controls will be reviewed and maintained on a regular basis to ensure effectiveness.

3.2.2 The following work practice controls (administrative and personal protective equipment) shall be strictly followed to minimize exposure, and isolate or remove bloodborne pathogens from the workplace:

- Accessible handwashing facilities. If soap and running water are not available, an antiseptic hand cleaner in conjunction with clean paper towels or antiseptic towelettes are acceptable temporary alternatives to running water. When this alternative method is used, employees shall wash their hands with soap and running water as soon as feasible.
- Personal protective equipment (PPE) will be provided at no cost to the employee, and will be chosen based on the anticipated exposure to blood. PPE is considered appropriate if it does not permit blood or other potentially infectious materials to reach or pass through clothes, skin, or mucous membranes of the eyes or mouth under normal conditions of use, and for the duration of time the equipment will be used. PPE shall be readily accessible and will be removed prior to leaving the work area.
- Disposable single-use gloves shall be used as a protective barrier in all situations in which contact with body fluids is anticipated. Gloves of the correct size will be provided. Disposable gloves will not be washed or disinfected for reuse, and will be replaced between employees, and if they become torn or punctured. Gloves are especially important if the employee has cuts, abraded skin, chapped hands, or dermatitis.
- Liquid-impermeable gowns, boots, and masks, in combination with eye-protective devices such as goggles and shatterproof glasses with solid-side shields or chin-length face shields, shall be worn whenever splashing, spraying, or spattering of blood droplets or body fluids can be reasonably anticipated.
- Disposable pocket mask ventilation devices shall be provided in all first aid kits and used to avoid mouth-to-mouth contact during emergency cardiopulmonary resuscitation.
- Examples of Recommended PPE (depending on task, more PPE may be needed).

Task	Gloves	Gown	Mask	Goggles
Bleeding control w/ minimal bleeding	Yes	No	No	No
Bleeding control w /spurting blood	Yes	Yes	Yes	Yes
Cardiopulmonary resuscitation	No	No	Yes	No
Decontamination/clean-up	Yes	No	No	No
Medical laboratory activities	Yes	Yes	Yes	Yes

3.2.3 Eating, drinking, smoking, applying cosmetics, and handling of contact lenses is prohibited in work areas where there is a reasonable likelihood of occupational exposure. Food and drink cannot be kept in refrigerators, freezers, shelves, cabinets, or on counter tops where blood or body fluids are present.

3.2.4 Contaminated needles and other sharps shall not be bent or recapped unless a one-handed technique is used. They shall be disposed of in an appropriate sharps container.

3.2.5 All regulated biohazardous waste will be placed in a waste receptacle that has designated red biohazard bags and a closable top controlled by a foot peddle. When full, the bags shall be removed with gloved hands, tied off, and placed in a biohazard shipping carton, to be held for pick-

up. If any biohazard bag appears to be leaking, it shall be double-bagged. The waste will be incinerated per federal, provincial/territorial/state regulations.

3.3 Housekeeping

3.3.1 Universal precautions shall be used when cleaning or decontaminating any surface or equipment that may be contaminated. Appropriate PPE shall be used for protection during decontamination.

3.3.2 All contaminated environmental work surfaces such as countertops or floors will be cleaned according to regulatory requirements or with a household bleach solution diluted 1:10 with water directly following contamination with blood or body fluids.

3.3.3 Instruments such as tweezers, bandage scissors, and thermometers shall be disposable rather than reusable equipment, and shall be disposed of in an appropriate manner.

3.3.4 Broken, contaminated glassware shall not be picked up directly with the hands. It shall be cleaned up using a mechanical means such as a brush and dustpan or tongs.

4.0 Hepatitis B Vaccination

4.1 Within 10 working days of placement, all employees assigned to tasks with potential occupational exposure to bloodborne pathogens shall be offered the Hepatitis B vaccination at no cost to the employee, unless the employee has had a previous Hepatitis B vaccination series, antibody testing reveals the employee is immune, or the vaccine is contraindicated for medical reasons. Further, this vaccination series shall be made immediately available to employees who have an occupational exposure, whether as a result of their assigned tasks, or occurring from an incidental contact.

4.2 The local occupational medical facility used for routine medical surveillance will administer the vaccinations.

4.3 Employees who decline the Hepatitis B vaccine shall sign a copy of the waiver form located at the end of this Work Instruction. The signed waiver will be stored in the employee's medical record with the Occupational Health Manager. Employees may initially decline the vaccination, but may decide to take them at a later date, while still covered under this plan. The vaccinations will be made available to the employee at that time.

4.4 Employees choosing to take the vaccination series will sign a consent form at the occupational clinic prior to receiving the injections, and are advised to read the package insert regarding the efficacy, safety, method of administration, and benefits of the vaccine. Employees may also ask questions directly of the Medical Service Provider or local occupational physician. Employees are not required to participate in a prescreening program (to determine immunity) before receiving the vaccinations. If a routine booster of Hepatitis B vaccine is recommended by the U.S. Public Health Service at a future date, such booster dose(s) will be made available to affected employees.

5.0 Post-Exposure Incident Evaluation And Follow-Up

5.1 All occupational bloodborne pathogen exposures shall be reported to the HSE representative and Occupational Health Manager immediately after initial decontamination first aid is accomplished. Following the report of an exposure incident, a confidential medical evaluation with an occupational physician will be arranged as soon as possible, ideally no later than 1 to 2 hours after the incident has occurred. In some jurisdictions, depending on applicable workers' compensation law, employees may choose treatment from their personal physician. A copy of the OSHA Bloodborne Pathogen Standard, if applicable to the jurisdiction, will be provided if the physician does not have a copy. A written incident report shall be completed as soon as possible, fully describing the incident.

5.2 First aid protocol for treatment immediately after an exposure incident:

5.2.1 Lacerations, punctures, and abrasions should be washed under cool running water for at least 5 minutes, allowing free bleeding. Cleanse area well with soap or iodine solution. Apply sterile dressing as needed. Give tetanus booster if indicated (7 to10 years since last booster).

5.2.2 Ocular exposure requires irrigation of the eye with water or sterile normal saline solution for 15 minutes.

5.2.3 Mucous membrane exposure requires rinsing mouth with ½ strength 3 percent hydrogen peroxide for 30 seconds, four separate and consecutive times.

5.3 Confidential Medical Evaluation

5.3.1 The treating occupational physician will receive documentation of the routes of exposure, the circumstances surrounding the incident, and identification of the source individual (the individual the employee was exposed to). The blood of the source individual will be tested if possible, and after consent is obtained. When legally permissible, results of the source individual's tests will be made available to the exposed employee, with the exposed employee informed about the applicable laws and regulations concerning the disclosure of the identity and infectivity of the source individual.

5.3.2 Testing of the exposed employee's blood, if consented to (the employee may consent to baseline blood collection, but may request that the sample not be tested for HIV for up to 90 days, if at all), is recommended.

5.3.3 Post-exposure medical treatment will be offered in accordance with the current recommendations of the U.S. Public Health Services. This may include, but is not limited to:

- A series of HIV post-exposure blood tests
- Hepatitis B vaccination and/or Hepatitis B immune globulin
- HIV post-exposure prophylactic medications
- Evaluation of acute febrile illnesses following exposure
- Employee counseling concerning precautions to take during the period after the exposure incident, and information on signs and symptoms of potential illnesses.

5.4 Healthcare Professional's Written Opinion

5.4.1 The Occupational Health Manager shall obtain and provide the employee with a copy of the evaluating physician's written opinion within 15 days of the completion of the medical evaluation. A copy will be maintained in the employee's confidential medical record. The written opinion shall be in accordance with the requirements of the OSHA Bloodborne Pathogens Standard indicating that the employee has been informed of any medical conditions resulting from exposure that require further evaluation or treatment. All other findings or diagnoses shall remain confidential and will not be included in the report.

6.0 Hazard Communication

6.1 Fluorescent red or orange-red warning labels bearing the universal biohazard symbol and the legend BIOHAZARD shall be firmly affixed to all containers (e.g., waste cans, sharps containers, and refrigerators) used for the storage or shipment of blood or other potentially infectious materials.

6.2 All employees designated to perform tasks involving occupational exposure shall receive bloodborne pathogens training at the time of initial assignment to the job. This training will be given during working hours and at no cost to employees. Refresher courses will be provided annually (within 1 year of previous training), and if new tasks or procedures are implemented. Material appropriate in content and vocabulary to education level, literacy, and language of the employees shall be used for all required training.

6.3 Training will include: making accessible a copy of the regulatory text of the standard and explanation of its contents, general discussion on bloodborne diseases and their transmission, exposure control plan, engineering and work practice controls, personal protective equipment, Hepatitis B vaccine, response to emergencies involving blood, how to handle exposure incidents, the post-exposure evaluation and follow-up program, signs/labels/color-coding, and question and answer time with the trainer.

7.0 Exposure Incident Investigation

7.1 The SH&E Manager will review the circumstances of any exposure incident to determine corrective actions. The incident report will include:

7.1.1 Engineering controls in use at the time

7.1.2 Work practices followed

7.1.3 A description of any equipment being used

7.1.4 A description of the work being performed

7.1.5 PPE that was used at the time of the incident

7.1.6 Date, time, and location of the incident

7.1.7 Employee's training.

7.2 An incident report shall be completed within four hours of the incident and entered into AECOM's on-line incident reporting system (e.g., IndustrySafe) in accordance with *S3AM-004-PR1 Incident Reporting, Notifications & Investigations*. A copy of this incident report will be forwarded to the Occupational Health Manager, who will evaluate what follow-up actions should be addressed, including if revisions need to be made to the Exposure Control Plan.

8.0 Recordkeeping

8.1 The Occupational Health Manager will be responsible for establishing and maintaining accurate, confidential workers' compensation medical records for each employee with occupational exposure for the duration of employment plus 30 years, in accordance with OSHA 29 CFR 1910.1020 – Access to Employee Exposure and Medical Records.

8.2 The SH&E Manager will be responsible for maintaining the bloodborne pathogens training class records for at least 3 years from the date of training. The records will include the date of the training class, a summary of the class contents, the names of the qualified instructors, and the names and job titles of personnel attending the training.

8.3 Employee medical records shall be made available to employees (or their designated representative) with written consent by the employee within 15 working days of request.

8.4 An exposure incident will be evaluated by the Occupational Health Manager and SH&E Manager to determine if the case meets OSHA's Recordkeeping Requirements (29 CFR 1904).

Americas

Hepatitis B Vaccination Declination

S3AM-111-FM1

I understand that due to my occupational exposure to blood or other potentially infectious materials, I may be at risk of acquiring Hepatitis B virus (HBV) infection.

I have been given the opportunity to be vaccinated with Hepatitis B vaccine, at no charge to myself; however, I decline Hepatitis B vaccination at this time. I understand that by declining this vaccine, I continue to be at risk of acquiring Hepatitis B, a serious disease.

If, in the future, I continue to have occupational exposure to blood or other potentially infectious materials and I want to be vaccinated with the Hepatitis B vaccine, I can receive the vaccine series at no cost to me.

Name: _____

Date: _____

Witness: _____

Date: _____

Americas

Cold Stress

S3AM-112-PR1

1.0 Purpose and Scope

1.1 To protect employees from the severest effects of cold stress (hypothermia) and cold injury and to identify exposures to cold working conditions under which it is believed nearly all employees can be repeatedly exposed without adverse health effects.

1.2 This procedure applies to all AECOM Americas based employees and operations, and any other entity and its personnel contractually required to comply with this document's content, working outdoors in damp and cool (below 50 degrees Fahrenheit [°F] or 10 degrees Celsius [°C]) conditions or anytime temperatures are below 32°F or 0°C.

2.0 Terms and Definitions

2.1 **Cold Stress** – The production of physiological effects due to cold temperatures and\or wind chill.

2.2 **Equivalent Chill Temperature (ECT)** – Also known as Wind Chill (see below).

2.3 **Frostnip** – Superficial cooling of tissues without cellular destruction.

2.4 **Frostbite –** Freezing of tissue, resulting in tissue destruction.

2.5 **Hypothermia –** Condition of reduced core body temperature to 95ºF (35ºC) resulting in loss of dexterity, loss of mental alertness, collapse, and possible death.

2.6 **Wind Chill –** The combined effect of air temperature and wind. Also expressed as "equivalent chill temperature" (ECT), wind chill is defined as heat loss resulting from the effects of air temperature and wind velocity upon exposed skin.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-128-PR1 Medical Screening & Surveillance Program

3.3 S3AM-208-PR1 Personal Protective Equipment

3.4 S3AM-314-PR1 Working Alone

3.5 S3AM-315-PR1 Working On or Near Water

3.6 S3AM-333-PR1 Marine Safety & Vessel Operations

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager**

- Ensuring the safety of employees on their project sites, consistent with regulatory standards.
- Implement cold stress prevention measures as applicable at each work site.
- Develop/coordinate a work-warning regimen, as applicable.
- Confirm cold stress hazard assessments/evaluations were completed for the planned activities.
- Assign employees physically capable of performing the assigned tasks. Consider acclimation to cold weather when evaluating employee capability.

- Confirm employees are properly trained to recognize the symptoms of cold stress.

4.1.2 **Safety, Health and Environment (SH&E) Manager**

- Conduct/support cold stress assessments/evaluations.
- Conduct/support incident investigations related to potential cold stress-related illnesses.
- Assist project teams develop appropriate work-warming regimens.
- Provide cold stress awareness training.

4.1.3 **Supervisor**

- Identify the tasks that may be most impacted by cold stress and communicate the hazard to the assigned employees.
- Confirm that employees have been trained on the recognition of cold stress-related illnesses.
- Confirm that adequate supplies of warm fluids/drinks are readily available to employees.
- Confirm that a warm/sheltered rest area is available, as applicable.
- Conduct cold stress monitoring, as applicable.
- Implement the work-warming regimen.
- Confirm that first aid measures are implemented once cold stress symptoms are identified.
- Confirm that employees are physically capable of performing the assigned tasks and are not in a physically compromised condition.

4.1.4 **Employee**

- Observe each other for the early symptoms of cold stress-related illnesses.
- Maintain an adequate intake of available fluids.
- Report to work in a properly rested condition.
- Report all suspected cold stress-related illnesses.

4.2 Requirements

4.2.1 Carefully plan work anticipated to be performed in cool or cold conditions. If possible, heavy work should be scheduled during the warmer parts of the day or when the wind is most calm. Include costs in project budgets for specialized equipment and supplies needed to complete the field activities.

4.2.2 Staff working in extreme cold (wind chill or ECT below 10ºF or -12ºC) shall not work alone. The Buddy System shall be utilized to keep an eye on each other and to watch for signs of cold stress. Refer to *S3AM-314-PR1 Working Alone*. Watch for symptoms and signs of hypothermia

4.2.3 Monitor weather forecasts and weather conditions such as ambient temperature, wind speed, and precipitation. Use observations prior to entering and while in the field to ensure appropriate protections are in place:

- If possible, move the work to a warm location.
- If possible and as applicable, erect shelters or screens around the work area.
- If possible, heat the work area.
- If possible, adjust schedule according to the cold conditions, work level and worker acclimatization.
- Implement a work-warming regimen by taking breaks out of the cold. As applicable, consult *S3AM-112 ATT1 Temperature Thresholds* to determine wind chill and work-warming schedule.
- Take frequent short breaks in warm dry shelters to allow your body to warm up. Limit time of exposure to the cold. If shelter is not readily available, consider supplying temporary shelters.

- Provide assistance to prevent body heat loss, such as:
    - Providing appropriate sources of heat (e.g. warm packs, portable heaters, etc.).
    - Use of insulating materials on equipment handles when temperatures drop below 30°F (-1°C).

4.2.4 All staff working in extreme cold or snow conditions should understand the following guidelines for preventing and detecting hypothermia and frostbite; refer to *S3AM-112-ATT2 Symptoms & Treatment*:

- Ensure appropriate PPE requirements are established and adhered to.
- Avoid exhaustion or fatigue because energy is needed to keep muscles warm.
- Because prolonged exposure to cold air or to immersion in cold water at temperatures even well above freezing can lead to dangerous hypothermia, whole-body protection shall be used.
- Eat high calorie snacks to help maintain body metabolism.
- Confirm extra blankets or sleeping bags are on-site.
- Drink plenty of warm liquids. It is easy to become dehydrated in cold weather.
- Avoid caffeine and alcohol, which can act as diuretics. Alcohol consumption, depending upon quantity, can dilate blood vessels enhancing body heat loss or constrict blood vessels decreasing heat delivery to extremities.
- NEVER IGNORE SHIVERING. Persistent or violent shivering is a clear warning that you are on the verge of hypothermia.
- If you experience frost bite or hypothermia, find shelter and warmth and contact a medical practitioner if symptoms persist, refer to *S3AM-128-PR1 Medical Screening & Surveillance*.

4.3 Training

Before they begin work in a cold environment, employees that might be exposed to cold stress will be informed of the potential for cold stress and how to prevent cold stress. Employees that have not had the training within the twelve prior months shall repeat the training before exposure to cold stress, refer to *S3AM-003-PR1 SH&E Training*. Employees potentially exposed to cold stress will receive training including, but not limited to:

4.3.1 Sources of cold stress, the influence of protective clothing, and the importance of acclimatization.

4.3.2 How the body loses heat.

4.3.3 Recognition of cold-related illness symptoms.

4.3.4 Cold stress preventative/corrective measures including, but not limited to:

- Weather monitoring.
- Proper eating and drinking practices.
- Work-warming schedules and proper re-warming techniques.
- Buddy system.
- Safe cold work practices appropriate to the work that is to be performed.
- Proper use of cold environment personal protective clothing.

4.3.5 The harmful effects of excessive alcohol consumption in a cold stress environment.

4.3.6 The hazards associated with unstable snow or ice build ups.

4.3.7 First aid procedures for symptoms related to cold stress.

4.4 Personal Protective Equipment (PPE)

Wearing the right clothing is crucial to avoiding cold stress. The type of fabric also makes a difference. Cotton loses its insulation value when it becomes wet. Wool, on the other hand, retains its insulation even when wet. Adequate insulating dry clothing will be required in air or wind chill temperatures below 40 °F (4.4°C)

All PPE will comply with the requirements of *S3AM-208-PR1 Personal Protective Equipment* and consider the following requirements:

4.4.1 Wear at least 3 layers of clothing to help prevent cold stress. It is important to preserve the air space between the body and the outer layer of clothing to retain body heat.

- Wear a middle layer of down, wool, or similar materials to provide insulation.
- Avoid cotton, especially blue jeans.
- Wear an outer layer to break the wind and allow some ventilation (e.g., Gortex® or nylon)
- Do not wear tight clothing. Loose clothing allows better ventilation.

4.4.2 Wear proper clothing, including head coverings and gloves or mittens for cold, wet, and windy conditions.

4.4.3 Wear a hat or hardhat liner. Up to 40 percent of body heat can be lost when the head is left exposed.

4.4.4 Use insulated footwear with adequate traction to prevent slips and falls.

4.4.5 Wear insulated boots or other insulated footwear, and insulated gloves to help reduce the chance of frostbite.

4.4.6 Keep a change of dry clothing available in case work clothes become wet.

4.4.7 Eye and face protection for employees employed outdoors in a snow and/or ice-covered terrain should be supplied.

- Sunglasses (with UVA and UVB protection) and sunscreen should be used when there is a persistent combination of snow and direct sun.
- Special safety goggles to protect against blowing ice crystals and ultraviolet light and glare (which can produce temporary conjunctivitis and/or temporary loss of vision) should be required when there is an expanse of snow coverage causing a potential eye exposure hazard.
- Ensure face guards are used to protect skin in cold, windy conditions, including riding on an unshielded vehicle.

4.5 General Cold Stress Prevention Measures

4.5.1 In order to prevent hypothermia:

- Wear appropriate clothing and PPE as determined by the weather conditions.
- When active, ventilate excess heat by opening or removing outer layers of clothing to avoid sweating.
    - Start with the mitten or gloves, unless protection from ice, snow, or cold metal surfaces is needed.
    - Next remove head gear and neck wrappings.
    - Then coats/parkas should be opened at the waist and sleeves.
    - Finally, layers of clothing should be taken off.
    - When resting or tired, or colder conditions are encountered, add additional layers of clothing/ close outer layers in the reverse of the above order, or get out of the cold. Have a sweet drink but do not indulge in heavy eating.

- Garments worn to keep out rain and spray should also allow water vapor to escape.
- Take advantage of heat from the sun and stay out of the wind as much as possible.
- Have available emergency shelter providing protection from wind and rain and insulation from the ground.
- Replace wet clothing. If wet clothing cannot be replaced, then cover it with a layer of non-breathing material to prevent evaporation. Place an insulation layer over this non-breathing material.
- Get adequate rest; conserve energy.
- Get adequate nutrition to replenish energy stores; rest after meals.
- Drink adequate fluids to avoid dehydration.
- If any project / location staff member shows signs of hypothermia, stop and treat him/her.

4.5.2 In order to prevent frost bite:

- Dress to prevent hypothermia and protect the feet and hands.
- Avoid obstruction of circulation by, for example, tight boots or tightly fitting clothing.
- Avoid nicotine (particularly cigarettes) and do not consume alcohol.
- Keep ears and nose covered and out of the wind.
- Frostbite of the corneas of the eyes can be prevented by protective goggles.
- Adopt a “buddy system” of constantly watching the faces of others in the party for white skin tissue, which is evidence of frostbite (frostnip).
- Practice constant personal vigilance for signs of trouble in one’s own fingers and toes; when in doubt, investigate thoroughly before it is too late.

4.5.3 Adequate, insulating dry clothing that will help maintain core temperatures above 96.8°F (37°C) shall be provided to employees if work is performed in air temperatures below 40°F (4.4°C). Wind chill cooling rate and the cooling power of air are critical factors. The higher the wind speed and the lower the temperature in the work area, the greater the insulation value of the protective clothing required.

4.5.4 An Equivalent Chill Temperature (ECT) chart relating the actual dry bulb air temperature and the wind velocity is presented in *S3AM-112-ATT1 Temperature Thresholds*. Unless unusual or extenuating circumstances exist, cold injury to other than hands, feet, and head is not likely to occur without the development of the initial signs of hypothermia. Superficial or deep local tissue freezing will occur only at temperatures below 32°F (0°C) regardless of wind speed. However, older employees, those with circulatory problems and those with previous cold injuries require special precautionary protection against cold injury. The use of extra insulating clothing and/or a reduction in the duration of the exposure period are among the special precautions that should be considered.

4.5.5 Continuous exposure of skin should not be permitted when the air speed and temperature results in an ECT of –25°F (-32°C) or below.

4.5.6 At air temperatures of 40°F (4.4°C) or less, it is imperative that employees who become immersed in water or whose clothing becomes wet be immediately removed from the cold environment, provided a change of clothing, and be treated for hypothermia.

4.5.7 If the air velocity at the job site is increased by wind, draft, or artificial ventilating equipment, the cooling effect of the wind should be reduced by shielding the work area or by wearing an easily removable windbreak garment.

4.5.8 Adequate protection, such as general ventilation, shall be incorporated into any warming shelter design to prevent carbon monoxide poisoning.

4.5.9 Operation of internal combustion or similar devices within warming shelters is prohibited.

4.5.10 If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work should be modified or suspended until adequate clothing is made available or until weather conditions improve.

4.5.11 Walking and working surfaces shall be cleared of ice and snow to prevent slips and falls.

4.5.12 Confirm that employees carry fire starter materials if working in remote areas.

4.5.13 Supplies such as PPE, fuels, enclosures, de-icing, traction aids, warm drinks, and batteries will be specified by the SH&E Manager and/or the Manager and made available. These supplies will be inspected at least weekly during cold weather projects and replaced when necessary.

4.6 Cold Stress Prevention Measures for the Hands

4.6.1 Special protection of the hands is required to maintain manual dexterity for the prevention of accidents including, but not limited to the following:

- If fine work is to be performed with bare hands for more than 10 to 20 minutes in an environment below 60ºF (15ºC), special provisions should be established for keeping the employees' hands warm. For this purpose, warm air jets, radiant heaters (fuel burner or electric radiator), or contact warm plates may be utilized. Metal handles of tools and control bars should be covered by thermal insulating material at temperatures below 30ºF (-1º C).
- If the air temperature falls below 60ºF (15ºC) for sedentary work, 40ºF (4.4º C) for light work, or 20ºF (-6ºC) for moderate work, and fine manual dexterity is not required, employees should use gloves.

4.6.2 To prevent contact frostbite, employees should wear anti-contact gloves:

- When cold surfaces below 20°F (-6°C) are within reach, each employee should be warned to prevent inadvertent contact by bare skin.
- If the air temperature is 0°F (-18°C) or less, employees should protect their hands with mittens or appropriate gloves. Machine controls and tools for use in cold conditions should be designed so that they can be handled without removing the mittens or gloves.
- Ensure an adequate supply of dry gloves is available to replace wet gloves.

4.6.3 Provisions for additional total body protection are required if work is performed in an environment at or below 40ºF (4.4ºC). The employees should wear cold protective clothing appropriate for the level of cold and physical activity.

4.6.4 Additional Cold Stress Prevention Measures:

For work practices at or below 10ºF (-12ºC) ECT, the following will apply:

- The employee should be under constant protective observation (buddy system or supervision).
- The work rate should not be so high as to cause heavy sweating that will result in wet clothing. If heavy work is being performed, rest periods should be taken in heated shelters and opportunities to change into dry clothing should be provided.
- New employees should not be required to work full time in the cold during the first days of employment until they become acclimated to the working conditions and required protective clothing. Refer to *S3AM-112-ATT1 Temperature Thresholds* for guidance.
- The weight and bulkiness of clothing should be included in estimating the required work performance and weights to be lifted by the employee.
- The work should be arranged in such a way that sitting still or standing still for long periods is minimized. Unprotected metal chair seats should not be used. The employee should be protected from drafts to the greatest extent possible.

4.6.5 Employees handling evaporative liquid (gasoline, alcohol, or cleaning fluids) at air temperatures below 40ºF should take special precautions to avoid soaking of clothing or gloves with the liquids because of the added danger of cold injury due to evaporative cooling. Special note should be taken of the particularly acute effects of splashes of “cryogenic fluids” or those liquids with a boiling point that is just above ambient temperature.

4.6.6 Trauma sustained in freezing or subzero conditions requires special attention, because an injured employee is predisposed to cold injury. Special provisions should be made to prevent hypothermia and freezing of damaged tissue in addition to providing for first aid treatment.

4.7 Hypothermia in Water

4.7.1 Loss of body heat heat to the water is a major cause of deaths in boating and working near water incidents. Often the cause of death is listed as drowning; however, the primary cause is often hypothermia. It should also be noted that alcohol lowers the body temperature around 2 to 3 degrees by dilating the blood vessels. Do not drink alcohol around cold water. The following table shows the effects of hypothermia in water:

WATER TEMPERATURE		EXHAUSTION	SURVIVAL TIME
32.5°F	(0°C)	Under 15 minutes	Under 15 to 45 minutes
32.5 to 40°F	(0 to 4°C)	15 to 30 minutes	30 to 90 minutes
40 to 50°F	(4 to 10°C)	30 to 60 minutes	1 to 3 hours
50 to 60°F	(10 to 16°C)	1 to 2 hours	1 to 6 hours
60 to 70°F	(16 to 21°C)	2 to 7 hours	2 to 40 hours
70 to 80°F	(21 to 27°C)	3 to 12 hours	3 hours to indefinite
Over 80°F	(27°C)	Indefinite	Indefinite

4.7.2 Some points to remember when water is a potential hazard:

- Wear a personal flotation device when drowning is a potential hazard. Refer to *S3AM-315-PR1 Working On or Near Water*, and *S3AM-333-PR1 Marine Safety & Vessel Operations*.
- If the water is less than 50°F (10°C), wear a wet suit or dry suit for work in water (e.g., wading, or if a significant potential to fall in water exists).
- While in the water, do not attempt to swim unless to reach nearby safety. Unnecessary swimming increases the rate of body heat loss. Keep the head out of the water. This will increase survival time.
- Keep a positive attitude about rescue. This will increase chances of survival.
- If there is more than one person in the water, huddling is recommended to conserve body heat.

4.7.3 If an employee or equipment is to work on ice and the water beneath the ice is or may be more than 3¼ feet (1m) deep at any point:

- Test the ice prior to commencing to ensure it will support the load to be placed on it. Ongoing testing may be necessary.
- If there is any risk of falling through the ice employees must wear personal protective equipment that will ensure buoyancy and protect against hypothermia at all times while on the ice.

4.8 Work-Warming Regimen

4.8.1 If work is performed continuously in the cold at an equivalent chill temperature (ECT) at or below 19ºF (–7ºC), heated warming shelters (tents, cabins, rest rooms, etc.) should be made available nearby. The employees should be encouraged to use these shelters at regular intervals; the frequency will depend on the severity of the environmental exposure. Refer to *S3AM-112-ATT1 Temperature Thresholds* for guidance.

4.8.2 The onset of heavy shivering, minor frostbite (frostnip), the feeling of excessive fatigue, drowsiness, irritability, or euphoria are indications for immediate return to the shelter.

4.8.3 When entering the heated shelter, the outer layer of clothing should be removed and the remainder of the clothing should be loosened to permit sweat evaporation or a change of dry work clothing provided.

4.8.4 A change of dry work clothing should be provided as necessary to prevent employees from returning to the cold environment with wet clothing.

5.0 Records

5.1 Exposure assessments will be documented in the location's files.

6.0 Attachments

6.1 S3AM-112-ATT1 Temperature Thresholds

6.2 S3AM-112-ATT2 Symptoms & Treatment

Americas

Temperature Thresholds

S3AM-112-ATT1

1.0 Purpose and Scope

1.1 The following Tables 1 and 2 give apparent temperatures (wind chill of equivalent chill temperature [ECT]) for various combinations of wind and air temperature, as well as guidelines to the danger of skin exposure.

Table 1. Wind Chill Chart (C)

Actual Temp (°C)	Wind Speed in km/hour									
	8	16	24	32	40	48	56	64	72	80
	Ambient Temperature (°C)									
0	-2	-8	-11	-14	-16	-17	-18	-19	-19	-20
-5	-7	-14	-18	-21	-23	-25	-26	-27	-28	-28
-10	-12	-20	-25	-28	-31	-33	-34	-35	-36	-36
-15	-18	-26	-32	-35	-38	-40	-42	-43	-43	-44
-20	-23	-32	-38	-43	-46	-48	-50	-51	-52	-52
-25	-28	-38	-45	-50	-53	-56	-57	-59	-59	-60
-30	-33	-45	-52	-57	-61	-63	-65	-67	-67	-68
-35	-39	-51	-59	-64	-68	-71	-73	-75	-75	-76
-40	-44	-57	-65	-71	-75	-79	-81	-83	-83	-84
-45	-49	-63	-72	-78	-83	-86	-89	-90	-91	-92
-50	-54	-69	-79	-85	-90	-94	-96	-98	-99	-100

Note: A. Little Danger: if less than one hour of exposure to dry skin.
B. Danger: Exposed flesh freezes within one minute.
C. Great Danger: Flesh may freeze within 30 seconds.

*Source: *2014 Threshold Limit Values (TLV™) and Biological Exposure Indices (BEI™) booklet; published by ACGIH, Cincinnati, Ohio.*

Table 2. Equivalent Chill Temperature Chart (F)

Estimated Wind Speed (mph)	Actual Temperature Reading (°F)									
	50	40	30	20	10	0	-10	-20	-30	-40
	Equivalent Chill Temperature (°F)									
Calm	50	40	30	20	10	0	-10	-20	-30	-20
5	48	37	27	16	6	-5	-15	-26	-36	-47
10	40	28	16	4	-9	-24	-33	-46	-58	-70
15	36	22	9	-5	18	-32	-45	-58	-72	-85
20	32	18	4	-10	-25	-39	-53	-67	-82	-96
25	30	16	0	-15	-29	-44	-59	-75	-88	-104
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109
35	27	11	-4	-20	35	-51	-67	-82	-98	-113
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116
Wind speeds >40 mph have little additional effect	LITTLE DANGER				INCREASING DANGER			GREAT DANGER		
	Trenchfoot and immersion foot may occur at any point on this chart.									

1.2 How fast a person's body cools in cold weather depends on: air temperature, wind speed, heat of the sun, and work being done.

1.2.1 The following Table 3 provides guidelines for establishing periods of work to warming break periods based on ambient temperature and wind speed for workers wearing dry clothing.

1.2.2 Notes following the Table take into account additional factor such as physical exertion, whether workers are acclimatized, etc.

Table 3. Work-Warming Schedule Guidelines

Air Temp. (Sunny Sky) °F	No Noticeable Wind		5 mph Wind (8 km/h)		10 mph Wind (16 km/h)		15 mph Wind (24 km/h)		20 mph Wind (32 km/h)		25 mph Wind (40 km/h)		Air Temp. (Sunny Sky) °C
	Max. Work Period	Breaks	Max. Work Period	Breaks	Max. Work Period	Breaks	Max. Work Period	Breaks	Max. Work Period	Breaks	Max. Work Period	Breaks	
above 5°	Normal Work Schedule		Normal Work Schedule		Normal Work Schedule		Normal Work Schedule		Normal Work Schedule		Normal Work Schedule		above -15°
5° to -1°											100 min	2	-15° to -17°
0° to -4°									100 min	2	75 min	2	-18° to -20°
-5° to -9°							100 min	2	75 min	2	55 min	3	-21° to -22°
-10° to -14°					100 min	2	75 min	2	55 min	3	40 min	4	-23° to -25°
-15° to -19°			100 min	2	75 min	2	55 min	3	40 min	4	30 min	5	-26° to -28°
-20° to -24°	100 min	2	75 min	2	55 min	3	40 min	4	30 min	5	Cease Work		-29° to -31°
-25° to -29°	75 min	2	55 min	3	40 min	4	30 min	5	Cease Work				-32° to -34°
-30° to -34°	55 min	3	40 min	4	30 min	5	Cease Work						-35° to -37°
-35° to -39°	40 min	4	30 min	5	Cease Work								-38° to -39°
-40° to -44°	30 min	5	Cease Work										-40° to -42°
-44° & below	Cease Work												-43° & below

Modified from ACGIH 2014 Threshold Limit Values for Chemical Substances and Physical Agents.

Note 1: Schedule describes the maximum continuous duration of work and number of 10-15 minute breaks to be observed during any 4-hour work period and assumes that period will be followed by an extended warm-up period (e.g., lunch). Allowed breaks should be taken in a warm environment.

Note 2: Schedule applies to moderate to heavy work performed by acclimated workers wearing appropriate layered clothing. For light to moderate work apply the schedule for conditions one step lower. For unacclimated workers apply the schedule for conditions two steps lower. These modifications are additive.

Note 3: For work under 25%–50% overcast/clouds, apply the schedule for conditions one step lower. For work at night or under greater than 50% overcast/clouds, apply the schedule for conditions two steps lower. These modifications are additive with any applicable modifications from Note 2.

Note 4: For wind speeds in excess of 25 mph (40 km/h), cease all nonemergency work when temperatures fall below 5°F (-21°C).

Note 5: When the work involves riding on an unshielded vehicle or some other activity that generates wind, the number of breaks should be increases appropriately.

Note 6: If effective protection against the wind can be provided by shields or screens, work modifications or measures, then the work warm-up schedule for “No Noticeable Wind” would apply.

Note 7: If reliable weather reports are not available, use the following as a guide to estimate wind velocity:

- A 5 mph (8 km/h) wind will move a light flag
- A 10 mph (16 km/h) wind will fully extend the flag
- A 15 mph (24 km/h) wind will raise a newspaper sheet
- A 20 mph (32 km/h) wind will produce blowing and drifting snow.

Symptoms & Treatment

1.0 Cold Stress-related Illnesses

1.1 Frostbite

1.1.1 Frostbite is a localized cold injury characterized by freezing of the tissues with ice crystal formation. There are several degrees of damage. Frostbite can be categorized into:

- **Frost Nip or Initial Frostbite**: (1st degree frostbite) Characterized by blanching or whitening of skin.
- **Superficial Frostbite**: (2nd degree frostbite) Skin has a waxy or white appearance and is firm to the touch, but tissue beneath is resilient. Blistering and peeling of the frozen skin will follow exposure.
- **Deep Frostbite**: (3rd degree frostbite) Tissues are cold, pale, and solid; extremely serious injury with possible amputation of affected area.

1.1.2 Frostbite injury is almost always limited to the upper and lower extremities (finger and toes) or to such appendages as the ears, nose or cheeks.

1.1.3 Conditions conducive to frostbite include sub-zero temperatures, hypothermia, dehydration, obstruction of the blood supply to the extremities (by constricting clothing, especially on the feet or at the wrists or ankles), contact with cold metal, contact with organic liquids (such as gasoline or solvents that have been left outdoors in sub-zero temperatures), use of substances that cause vasoconstriction (such as smoking tobacco), or other injury or shock.

1.1.4 Frostbite can occur without hypothermia when the extremities do not receive sufficient heat. Frostbite occurs when there is freezing of the fluids around the cells of the affected tissues.

1.1.5 Contact by the skin with tools or other metal objects below 20°F (-7°C) may result in contact frostbite.

1.1.6 The first symptom of frostbite is an uncomfortable sensation of coldness and pain, followed by numbness. There may be tingling, stinging, or cramping. Ongoing symptoms of frostbite include:

- Sudden and complete cessation of cold or discomfort in affected fingers or toes, often followed by a pleasant feeling of warmth;
- Subsequently the only symptom may be the absence of any sensation in the frozen part;
- Paleness in the affected tissues;
- Firm or hard tissues; and
- Purple tissue, if a large area, such as an entire hand or food, is frostbitten.

1.1.7 If exposure occurs in temperatures that are below freezing (32ºF or below), frostbite or trench foot (immersion foot) may accompany or complicate the symptoms of hypothermia. Frostbite is the freezing of living tissues with a resultant breakdown of cell structure. Symptoms due to frostbite may include, but is not limited to:

- Superficial redness of the skin;
- Slight numbness;
- Blisters;
- Obstruction of blood flow (ischemia);
- Blood clots (thrombosis); and
- Skin discoloration due to insufficient oxygen in the blood (cyanosis).

1.1.8 Frostbite may occur if the skin comes into contact with objects with a surface temperature below freezing, such as metal tool handles. Trench foot is caused by continuous exposure to cold combined with persistent dampness or immersion in water. Injuries in this case include permanent tissue damage due to oxygen deficiency, damage to capillary walls, severe pain, blistering, tissue death, and ulceration.

1.1.9 Additionally, cold exposures may either induce or intensify vascular abnormalities. These include chilblain (a swelling or sore), Raynaud's disease, acrocyanosis (blueness of hands and feet) and thromboangiitis (inflammation of the innermost walls of blood vessels with accompanying clot formation). Workers suffering from these ailments should take particular precautions to avoid chilling.

1.2 Hypothermia

1.2.1 Hypothermia is a lower than normal body temperature that occurs when outer cold cools the body faster than the body can produce heat to stay warm. When this situation first occurs, blood vessels in the skin constrict in an attempt to conserve vital internal heat. Hands and feet are the first affected.

- If the body continues to lose heat, involuntary shivers begin. This is the body's way of attempting to produce more heat, and it is usually the first real warning sign of hypothermia.
- Further heat loss produces speech difficulty, confusion, loss of manual dexterity, collapse, and finally death.

1.2.2 Hypothermia can be caused by exposure to wind, cold, and/or moisture. The combination of wind, cold, and moisture can be deadly. Wet clothes or immersion in cold water greatly increases the hypothermia risk. The progressive clinical presentation of hypothermia is described in the table below.

Condition	Core Body Temp.	Signs/Symptoms	Treatment
Mild Hypothermia	99 – 97 F 37 – 36 C	Normal, shivering may begin	Seek dry shelter; replace wet clothing, insulate whole body and head, avoid sweating, use external warmth (bath, fire) only if core above 95 degrees F, give warm sweet drinks and food.
	97 – 95 F 36 – 35 C	Cold sensation, goose bumps, unable to perform complex tasks with hands, shiver can be mild to severe, hands numb.	
Moderate Hypothermia	95 – 93 F 35 – 34 C	Intense shivering, muscle in-coordination becomes apparent, movements slow and labored, stumbling pace, mild confusion may appear alert.	Avoid exercise and external warmth, gently rest; give warm sweet drinks and calories, internal warming via warm moist air, monitor pulse and breathing.
	93 – 90 F 34 – 32 C	Violent shivering persist, difficulty speaking, sluggish thinking, amnesia starts to appear, gross muscle movements sluggish, unable to use hands, stumbles frequently, signs of depression, withdrawn.	
Severe Hypothermia	90 – 86 F 32 – 30 C	Shivering stops, exposed skin blue or puffy, muscle coordination very poor, inability to walk, confusion, incoherent/irrational behavior, but may be able to maintain posture and appearance of awareness.	Medical emergency, give nothing by mouth, wrap in an insulated blanket, avoid rapid rewarming, transfer to hospital immediately.
	86 – 82 F 30 – 28 C	Muscle rigidity, semiconscious, stupor, loss of awareness of others, pulse and respiration rate decrease, possible heart fibrillation.	
	82 – 78 F 28 – 25.5 C	Unconscious, heart beat and respiration erratic, pulse may not be palpable.	
	78 – 75 F 25.5 – 24 C	Pulmonary edema, cardiac and respiratory failure, death. Death may occur before this temperature is reached.	

1.2.3 Early warning signs of hypothermia:

- Feeling of being cold and tired;
- Heavier breathing and increased pulse rate;
- Tendency to keep moving (e.g., stamping feet, rubbing hands, continued walking/pacing);
- Goose bumps, holding arms tightly wrapped around the body, hunching of shoulders, and
- Shivering.

1.2.4 Hypothermia damages both the body's internal temperature mechanisms (hypothalamus) and the peripheral mechanisms to prevent heat loss (vasoconstriction and perspiration.) These effects may last up to three years after the initial hypothermia episode. Symptoms of hypothermia may include, but are not limited to:

- Pain in the extremities;
- Severe shivering and numbness;
- Low core body temperature;
- Drowsiness and muscular weakness;
- Apathy;
- Mental confusion;
- Loss of consciousness;
- Shock, and
- Decreasing pulse and breathing rate.

2.0 Recommended Treatment for Cold Stress-related Illnesses

2.1 Frostbite

2.1.1 Wrap the victim in woollen blanket and keep dry until he or she can be brought inside.

2.1.2 Remove the victim from the cold environment.

2.1.3 Do not rub, chafe, or manipulate frozen parts.

2.1.4 Place the victim in warm water (102ºF to 105ºF) and make sure the water remains warm. Test the water by pouring it on the inner surface of your forearm. Never thaw affected body parts if the victim has to go back out into the cold; refreezing can cause significant tissue damage.

2.1.5 Do not use hot water bottles or a heat lamp, and do not place the victim near a hot stove.

2.1.6 Do not allow the victim to walk if his or her feet are affected.

2.1.7 Have the victim gently exercise the affected parts once they are thawed.

2.1.8 Seek immediate medical attention for thawing of serious frostbite.

2.2 Hypothermia

2.2.1 Bring the victim into a warm room or shelter as quickly as possible.

2.2.2 Give artificial respiration and stop any bleeding, if necessary.

2.2.3 If the victim cannot be moved (spinal injury, etc.), carefully place newspapers, blankets, or some other insulation between the victim and the ground.

2.2.4 Remove all wet clothing.

2.2.5 Provide an external heat source, because the body cannot generate its own heat. Wrap the victim in prewarmed blankets, place him or her in the liner of a portable hypothermia treatment unit, put the torso (not the extremities) into a tub of warm water, or use body-to-body contact to rewarm the body core. These measures will slowly reopen the peripheral circulation, minimizing the possibility

of after-shock or after-drop (the flowing of cooled, stagnated blood from the limbs to the heart), which may cause ventricular fibrillation, cardiac arrest, or death.

2.2.6 Do not allow the victim to sleep.

2.2.7 Give warm, sweet drinks. Do not give alcohol or pain relievers.

2.2.8 Keep the victim still. Do not try to walk.

2.2.9 Do not rub numb skin.

2.2.10 Get medical attention as soon as possible.

Americas

Compressed Gases

S3AM-114-PR1

1.0 Purpose and Scope

1.1 This procedure provides the requirements for using, handling, storing, transporting, disposition and/or decommissioning compressed gas cylinders.

1.2 This procedure applies to all AECOM Americas based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 **Compressed Air (Non-Breathable)** – Air that is at a pressure greater than that of the atmosphere. Compressed air shall not be used for cleaning purposes except where reduced to less than 30 psi and then only with effective chip guarding and personal protective equipment. Utilized for tools, equipment, and mechanical machinery and cleaning purposes as described in this procedure.

2.2 **Compressed Gas** – Any material or mixture in a pressure vessel having:

- An absolute pressure exceeding 40 pounds per square inch (PSI) at 70°F (25 pounds per square inch gauge); or
- An absolute pressure exceeding 104 Psia at 130°F, regardless of the pressure at 70°F.

2.3 **Cylinder –** Pressure vessel designed for pressures higher than 40 Psia and having a circular cross section.

2.4 **Decommission** – The removal of a compressed gas cylinder from service by rendering it permanently unusable.

2.5 **Disposition** – Recycling, treatment, or disposal of a compressed gas cylinder and/or its contents.

2.6 **Pneumatics –** The use of pressurized air to affect mechanical motion for machinery, equipment and tools.

2.7 **Psi** – Pounds per square inch.

2.8 **Psia –** Pounds per square inch absolute (i.e., pressure in a container that would appear on an ordinary gauge plus the local atmospheric pressure [14.696 psi at sea level]), psig- pounds per square inch gauge.

2.9 **Psig** – Pounds per square inch gauge. The pressure in a vessel or container as registered on a gauge attached to the container. This reading does not include the pressure of the atmosphere outside the container.

2.10 **Pressure Relief Valve** – A device installed on most cylinders to prevent the rupture of a normally pressurized cylinder when it is inadvertently exposed to fire or high temperatures.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-116-PR1 Hazardous Materials Shipping

3.3 S3AM-127-PR1 Exposure Monitoring

3.4 S3AM-208-PR1 Personal Protective Equipment

3.5 S3AM-209-PR1 Risk Assessment & Management

3.6 S3AM-332-PR1 Hot Work

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager**

- Ensuring the safety of employees on their project sites.
- Implement these procedures during all activities involving compressed gases.
- Seek consultation with the SH&E Manager when unknown compressed gas cylinders are encountered.
- Confirm employees have received the appropriate training as it relates to compressed gases/compressed gas cylinders.
- Confirm a hazard assessment/evaluation of the activities involving compressed gases has been completed.
- Contact the SH&E Manager prior to any compressed gas cylinder operation.
- Immediately report any leaking/suspected leaking compressed gas cylinder(s) to the SH&E Manager and implement the appropriate emergency action(s).
- Immediately report the discovery of any unknown compressed gas cylinder(s) to the SH&E Manager and cordon off the area in all directions a minimum of 50 feet (15.24 meters).
- Confirm that all compressed gas cylinders are properly inspected, stored, and, secured.
- Confirm that all compressed gas cylinders are handled in a safe manner, protecting both the person and cylinder.
- Confirm that all compressed gas cylinder manifolds and connections are properly made and inspected.
- Confirm an appropriate emergency response plan is established prior to the start of any compressed gas cylinder operation.

4.1.2 **SH&E Manager**

- Review and authorize all compressed gas cylinder operations.
- Conduct/support compressed gas hazard assessments/evaluations.
- Provide awareness training to project teams regarding hazards of encountered compressed gases.
- Support the identification/disposition of unknown compressed gas cylinders.
- Support the development of a site-specific cylinder plan.

4.1.3 **Employee**

- Immediately report any leaking/suspected leaking compressed gas cylinder(s) to a Manager.
- Immediately report the discovery of any unknown compressed gas cylinders to Project Manager.
- Properly handle all compressed gas cylinders.
- Shall be supervised by employees experienced in the operation of compressed gas tools and equipment.

4.2 Training

4.2.1 On-site orientation to the hazards of the equipment and the proper use, handling, and storage shall be completed for all employees handling or coming into contact with compressed air tools and equipment or compressed gas cylinders. Refer to *S3AM-003-PR1 SH&E Training* and *S3AM-114-ATT1 Compressor Safety*.

4.2.2 Employees shall be instructed on the PPE requirements for the applicable tasks. Refer to *S3AM-208-PR1 Personal Protective Equipment*.

4.3 General Use of Compressed Air or Gas

4.3.1 Compressed air or other compressed gases are not to be used to blow dirt, chips, or dust from clothing while it is being worn. Compressed air used for other types of cleaning (other than clothing/persons) is to be limited to 30 psig.

4.3.2 The use of blown compressed air is to be controlled, and proper personal protective equipment or safeguards utilized, to protect against the possibility of eye injury to the operator or other persons.

4.3.3 Compressed air or gases are not to be used to empty containers of liquids.

4.3.4 Compressed gases are not to be used to elevate or otherwise transfer any hazardous substance from one container to another unless the containers are designed to withstand the operating gas pressure with a safety factor of at least four.

4.3.5 Compressed cylinders of unknown content will not be opened, but will be returned to the supplier, manufacturer or equivalent.

4.4 Air Compressor Operations

4.4.1 Air compressor equipment should be operated only by authorized and trained employees.

4.4.2 The air intake should be from a clean, outside, fresh air source. Screens or filters can be used to clean the air.

4.4.3 Air compressors should never be operated at speeds faster than the manufacturer's recommendation.

4.4.4 Equipment should not become overheated.

4.4.5 Moving parts, such as compressor flywheels, pulleys, and belts that could be hazardous should be effectively guarded.

4.4.6 Keep the air supplied tools clean and dry. Dust, moisture, and corrosive fumes can damage tools.

4.4.7 Keep tools clean, lubricated, and maintained according to manufacturer's instructions.

4.4.8 Only use attachments and accessories recommended by the manufacturer.

4.4.9 Review the manufacturer's instruction before using a tool.

4.4.10 Post warning signs where pneumatic tools are used.

4.4.11 Set up screens or shields in areas where nearby workers may be exposed to flying fragments, chips, dust, and excessive noise.

4.4.12 Be aware of proper handling and ergonomics while using the tool.

4.4.13 Reduce physical fatigue by supporting heavy tools with a counter-balance wherever possible

4.4.14 Refer to *S3AM-114-ATT1 Compressor Safety* for additional information.

4.5 Air Hoses

4.5.1 Use the proper hose and fittings of the correct diameter.

4.5.2 Use hoses specifically designed to resist abrasion, cutting, crushing and failure from continuous flexing.

4.5.3 Choose air-supply hoses that have a minimum working pressure rating of 1035 kPa (150 psig) or 150% of the maximum pressure produced in the system, whichever is higher.

4.5.4 Check hoses regularly for cuts, bulges and abrasions. Tag and replace, if defective.

4.5.5 Blow out the air line before connecting a tool. Hold hose firmly and blow away from yourself and others.

4.5.6 Make sure that hose connections fit properly and are equipped with a mechanical means of securing the connection (e.g., chain, wire, or positive locking device).

4.5.7 Install quick disconnects of a pressure-release type rather than a disengagement type. Attach the male end of the connector to the tool, NOT the hose.

4.5.8 Do not operate the tool at a pressure above the manufacturer's rating.

4.5.9 Turn off the air pressure to hose when not in use or when changing power tools.

4.5.10 Do not carry a pneumatic tool by its hose.

4.5.11 Do not use compressed air to blow debris or to clean dirt from clothes.

4.5.12 All pipes, hoses, and fittings shall have a rating of the maximum pressure of the compressor. Compressed air pipelines should be identified (psi) as to maximum working pressure.

4.5.13 Air supply shutoff valves should be located (as near as possible) at the point-of-operation.

4.5.14 Air hoses should be kept free of grease and oil to reduce the possibility of deterioration.

4.5.15 Avoid trip hazards. Hoses should not be strung across floors or aisles where they are liable to cause employees to trip and fall. When possible, air supply hoses should be suspended overhead, or otherwise located to afford efficient access and protection against damage.

4.5.16 Hose ends shall be secured to prevent whipping if an accidental cut or break occurs.

4.5.17 Pneumatic impact tools, such as riveting guns, should never be pointed at a person.

4.5.18 Before a pneumatic tool is disconnected (unless it has quick disconnect plugs), the air supply shall be turned off at the control valve and the tool bled.

4.5.19 Shop air used for cleaning should be regulated to15 psi unless equipped with diffuser nozzles to provide lesser pressure.

4.5.20 Goggles, face shields or other eye protection shall be worn by employees using compressed air for cleaning equipment.

4.5.21 Static electricity can be generated through the use of pneumatic tools. This type of equipment shall be grounded or bonded if it is used where fuel, flammable vapors or explosive atmospheres are present.

4.5.22 The following are hazards associated with the use of compressed air tools and equipment:

- Poorly designed tool (wrist strain);
- Vibration (vibration-induced white finger);
- Noise (hearing loss); and
- Dust (respiratory problems).

4.5.23 The following hazards have the potential to cause serious bodily injury when working with compressed air:

- Incorrect tool selection;
- Use of damaged tool;
- Improper, inadequate, or no guards;
- Rotating shaft (entanglement);
- Wheel breakage (grinder);
- Flying chips;
- Whipping of the hose;
- Accidental start up;

- Air embolism (compressed air injected into the body);
- Dropped tool; and
- Tripping over hose.

4.6 Compressed Air Equipment Maintenance

4.6.1 Only authorized and trained employees should service and maintain air compressor equipment.

4.6.2 Exposed, non-current-carrying, metal parts of compressor should be effectively grounded.

4.6.3 Low Flash Point lubricants should not be used on compressors because of its high operating temperatures that could cause a fire or explosion.

4.6.4 Equipment should not be over lubricated.

4.6.5 Gasoline or diesel fuel powered compressors shall not be used indoors.

4.6.6 Equipment placed outside but near buildings should have the exhausts directed away from doors, windows and fresh air intakes.

4.6.7 Soapy water of lye solutions can be used to clean compressor parts of carbon deposits, but kerosene or other flammable substances should not be used. Frequent cleaning is necessary to keep compressors in good working condition.

4.6.8 The air systems should be completely purged after each cleaning.

4.6.9 During maintenance work, the switches of electrically operated compressors should be locked open and tagged to prevent accidental starting.

4.6.10 Portable electric compressors should be disconnected from the power supply before performing maintenance.

4.7 Compressed Gas Cylinder Requirements

4.7.1 Cylinders are not to be used unless they bear Department of Transportation (DOT) or Transportation of Dangerous Goods (TDG) markings showing that they have been tested as required by DOT or TDG regulations.

4.7.2 Cylinders shall never be dropped, struck, or permitted to strike each other violently. Cylinders may be moved by tilting and rolling them on their bottom edges.

4.7.3 Valve protection caps shall always be kept on cylinders when they are being moved or stored, and until ready for use. Caution should be exercised as insects such as spiders, wasps, and bees may be encountered in cylinder caps.

4.7.4 Do not lift cylinders by the valve protection cap.

4.7.5 Cylinder valves are to be kept closed except when gas is being used or when connected to a permanent manifold. Valves of empty cylinders shall be closed.

4.7.6 Cylinders shall never be used as rollers or supports, or for any purpose other than carrying gas.

4.7.7 Valves and regulators shall be inspected for foreign materials such as oil or dirt and deficiencies such as damaged threads or broken gauges. Deficient valves or regulators shall be removed from service and replaced.

4.7.8 Threads on regulator connections or other auxiliary equipment shall be the same as those on the cylinder valve outlet.

4.7.9 Regulators shall be specific to the gas being used and no adapters may be used to connect regulators to cylinders.

4.7.10 When withdrawing cylinder content, open the cylinder valve slowly using the appropriate tool (e.g., manufacturer supplied, non-sparking, etc.). Point the valve opening away from yourself and other persons.

4.7.11 Before a regulator is removed from a cylinder, close the cylinder valve and release all pressure from the regulator. This procedure also serves as a check to confirm that the main cylinder valve is completely closed.

4.7.12 Never hammer the valve wheel in attempting to open or close the valve.

4.7.13 No person, except the owner of the cylinder or person authorized by the owner, shall refill a cylinder (Exceptions to this includes the filling of self-contained breathing apparatus cylinders with Grade D breathing air, or the filling of the [Foxboro] Organic Vapor Analyzer (OVA) hydrogen cylinders). Disposable cylinders shall not be refilled with any material after use of the original contents.

4.7.14 Cylinders of compressed gas shall be stored in areas where they are protected from external heat sources such as flame impingement, intense radiant heat, electric arc, or high-temperature steam lines.

4.7.15 Cylinders are to be stored in an assigned, well-ventilated area, with full and empty cylinders stored separately. Empty cylinders shall be marked ‘empty’.

4.7.16 Stored fuel gases and oxygen cylinders are to be separated by at least 20 feet, or by a fire wall at least 5 feet high that has a fire-resistance rating of at least ½ hour.

4.7.17 Oxygen, nitrogen, helium, or freon cylinders shall only be stored or transported in an upright or horizontal position. Acetylene cylinders shall always be kept in an upright position. All horizontally-placed cylinders are to be secured by chocks or ties to prevent rolling.

4.7.18 Cylinders are to be secured to a fixed object by chain or equivalent fastening device whenever they are placed in an upright position. The protective cap is not to be removed or the cylinder valve opened until the cylinder is secured.

4.7.19 Repair of leaks shall never be attempted on a pressurized system. System pressure should be reduced to atmospheric pressure as rapidly as possible, and the Manager notified immediately.

4.7.20 Compressed gas cylinders shall be legibly marked for the purpose of identifying the gas content with either the chemical or the trade name of the gas. Such marking is to be done by means of stenciling, stamping or labelling, and shall not be readily removable. Whenever practical, the marking is to be located on the shoulder of the cylinder. Positive identification of the gas in any cylinder is required before connecting cylinders for use.

4.7.21 Gas cylinders moved by hoist shall be handled in suitable cradles or job-made “skip” (materials) boxes. Any slings used for this purpose shall be specifically designed for that cylinder handling.

4.7.22 Cylinders shall not be placed where they might form part of an electrical circuit.

4.7.23 Transfer of compressed gases (including acetylene) from one cylinder to another, or mixing of gases in a cylinder, is prohibited.

4.7.24 Oxygen cylinders are never to be stored near:

- Highly combustible materials, especially oil and grease;
- Reserve stocks of acetylene or other fuel gas cylinders; and
- Any other substance likely to cause or accelerate fire.

4.7.25 Compressed oxygen is never to be used:

- As breathing air;
- To purge pipelines, tanks, or any confined area;
- To supply a head-pressure tank;
- In pneumatic tools;
- In oil preheating burners;

- To start internal combustion engines;
- For ventilation;
- For cleaning clothing; and
- In any other way as a substitute for compressed air.

4.7.26 Use of a cylinder's contents for purposes other than those intended by the supplier is prohibited.

4.7.27 Cylinders of compressed natural gas or propane equipped with a pressure relief device shall always be positioned in a manner that this device remains above the liquid level (e.g., if stored or installed horizontally on a forklift, relief device is positioned at the top).

4.7.28 Storage of liquefied petroleum gas (LPG) within buildings is prohibited, and outdoor storage or LPG shall meet applicable building and fire codes.

4.8 Special Precautions for Compressed Gas Cylinders Containing Hydrogen

4.8.1 Inside buildings, cylinders of hydrogen should be separated from oxygen cylinders by a minimum distance of 20 feet (6.1 meters) or by a barrier of non-combustible material at least 5 feet (1.5 meters) high having a fire resistance rating of at least one half hour.

4.8.2 Conspicuous signs should be posted in hydrogen storage areas forbidding smoking, open flames or the use of lights or lighting not approved for use in flammable areas.

4.8.3 Hydrogen storage areas shall be labeled, "Hydrogen-Flammable Gas-No Smoking-No Open Flame" or equivalent.

4.9 Inspection of Compressed Gas Cylinders

4.9.1 Prior to formally accepting any delivered compressed gas cylinders, a visual inspection of each cylinder will be documented as specified below. In addition, all compressed gas cylinders stored at an AECOM facility will be inspected monthly.

- Visually inspect cylinders, refer to *S3AM-114-FM1 Compressed Gas Cylinder Inspection.*
- Verify that all the required markings are on the cylinders.
- If required, determine when the cylinder was last hydrostatically-tested.
- Inspect the safety relief devices, if required.
- If any defects are noted during the inspection, the cylinder should be refused on delivery and a new delivery requested (notify the Manager).

4.9.2 Where compressed gas cylinders are stored at an AECOM facility, a qualified person will be designated to confirm cylinder activities comply with the requirements in this procedure. Inspection entails the evaluation of the integrity of the cylinder as well as the serviceability of any attached manifold and valve fittings. Inspection activities of cylinders beyond visual inspection are recommended to be conducted in isolation or a remote location for worker and public safety. The inspection of any cylinder will be conducted by a qualified person, refer to *S3AM-114-FM1 Compressed Gas Cylinder Inspection*.

4.10 Cylinder Inspection Procedures

4.10.1 All cylinder inspection procedures will adhere to the applicable regulatory requirement. At a minimum, the inspection process will include the following procedures:

- Observe the cylinder from a safe distance to identify any visual markings or other information.
- Inspect the cylinder size, shape, and general condition (if visible, include the valve system/stem in the inspection process).
- If the cylinder or valve system appears to be in poor condition or has lost structural integrity, do not approach the cylinder. Observations indicating a cylinder is in poor condition may include:

- Leaking,
- Hissing sound,
- Odor in vicinity of the cylinder,
- Rusty components,
- Bulging side wall or end, and/or
- Corroded valve system.

4.10.2 If the cylinder is determined to be in poor condition, cordon the area off and limit access to necessary employees only.

4.10.3 Wear applicable PPE and approach the cylinder with the appropriate direct reading air monitoring instrument (do not approach from the ends of the cylinder), then determine the airborne contaminant concentrations in the immediate area.

4.10.4 Document cylinder information (e.g., visible markings, labels, placards, etc.).

4.10.5 Cylinders presenting potential deficiencies (e.g., dent, missing labels, valve protection cap cannot be removed by hand, corrosion, etc.) shall be tagged 'Do Not Use', removed from use, and returned to the supplier.

4.11 Ground Transport of Compressed Gas Cylinders

4.11.1 AECOM will transport (drive/haul) quantities of compressed gases which do not exceed Materials of Trade (MOT) quantities, whereas the transport of placardable quantities is prohibited without the proper DOT / TDG licenses/credentials and consultation with the SH&E Manager.

4.11.2 Compressed gas cylinders in portable service are to be conveyed by suitable trucks, to which they are securely fastened. All gas cylinders in service shall be securely held in substantial racks or secured to other rigid structures so that they will not fall or be knocked over.

4.12 Air/Common Carrier Transport

4.12.1 All shipping of compressed gases via air/common carrier including instrument gases, regardless of quantity, shall be conducted by a qualified and trained HazMat Shipper (Level 1-2 Shipper) or jurisdictional equivalent, and shall conducted under the oversight of a designated DOT/International Air Transport Association (IATA) shipping specialist, or jurisdictional equivalent. Refer to *S3AM-116-PR1 Hazardous Materials Shipping.*

4.12.2 No compressed gas cylinder, regardless of contents or quantity, will be shipped via an external carrier vendor (i.e., UPS, FedEx, etc.) without the authorization of:

- SH&E Manager, and
- DOT/IATA shipping specialist.

4.12.3

4.13 Cylinder Color Coding Determination

4.13.1 The color coding of compressed gas cylinders is established by the Compressed Gas Association, which has assigned specific colors to categories or classes of chemicals/substances. It is important to note there is currently not requirement to adhere to this color coding scheme.

4.13.2 While recently manufactured cylinders reflect the color coding guidance established by the CGA, older cylinders may not reflect this nomenclature. It is also possible for cylinders to have been repainted a different color from their original.

4.13.3 Cylinder contents should <u>never</u> be determined by the color of the cylinder alone. Colors are not uniform throughout the compressed gas industry.

4.13.4 Cylinder contents shall be identified by a decal, label, tag, or stenciling. If an identifying label is lacking or not legible, return the container to the supplier, unused.

4.14 Air Monitoring Requirements

4.14.1 Air monitoring requirements are dependent upon the specific substances contained within the cylinders and will be specified within the site-specific safety plan prepared prior to commencement of field activities. Air monitoring parameters, refer to *S3AM-127-PR1 Exposure Monitoring*, may include, but are not limited to:

- Explosivity (i.e., lower explosive limit [LEL]), and
- Chemical-specific substance (e.g., chlorine, ammonia, arsine, etc.).

4.14.2 Action levels will be identified in the site-specific safety plan.

4.15 Cylinder Staging

4.15.1 Staging involves the organization, and sometimes consolidation, of cylinders that have similar contents or characteristics.

4.15.2 The staging of cylinders will occur in a remote location at the site in order to minimize the potential injury or property damage from an accidental release or emergency decompression (if the integrity of the cylinder is in question, it should not be moved).

4.15.3 Safe distances will be based on the evacuation distances provided in DOT's Emergency Response Guidebook (most current edition).

4.15.4 When multiple cylinders containing different substances are present, the distance should be based on the greatest evacuation distance required by the substances present.

4.16 Cylinder Disposition & Decommissioning Activities

4.16.1 Disposition refers to the recycling, treatment, or disposal of a compressed gas cylinder and/or its contents.

4.16.2 Recovery and recycling of materials are preferred over any other method of disposition. Cylinder disposition activities shall be approved by the SH&E Manager.

4.16.3 An effort should be made to recover and recycle the contents of a cylinder; however, if recovering or recycling the contents is not possible, then other options include:

- Venting to the Atmosphere,
- Flaring,
- Neutralization, and
- Detonation.

4.16.4 Under no circumstances will poisonous, toxic, or ozone-depleting substances be vented to the atmosphere. Only cylinders containing flammable gases should be detonated, as the flammable contents will be consumed in the subsequent explosion.

4.16.5 If the cylinder valve has been determined to be inoperable, then the available options for disposition are limited to having an outside vendor perform the remote opening and sampling of the cylinder, or detonation of the cylinder where the cylinder contents are consumed in the subsequent explosion (flammable gases only).

4.16.6 All cylinders shall be inventoried, staged, and inspected.

4.16.7 Prior to the commencement of cylinder disposition and decommissioning activities, local emergency response agencies (i.e., Fire Department, Medical, and Emergency Response, if separate) shall be confirmed and, as applicable, activities coordinated with the local agencies.

4.16.8 Air monitoring is mandatory during cylinder disposition and decommissioning operations.

4.16.9 A SH&E Manager shall be contacted during the planning stages of a cylinder disposition and decommissioning effort in order to determine whether a site-specific cylinder plan is required.

4.17 Venting to the Atmosphere

4.17.1 Cylinders that contain non-flammable, non-toxic materials can be vented to the atmosphere. All venting activities will be performed in accordance with the following procedures:

- Atmospheric venting will be accomplished at a remote location and in compliance with all applicable environmental air regulatory requirements.
- Atmospheric venting activities will be completed in a Level B Ensemble (unless otherwise specified in the site-specific safety plan and cylinder plan).
- Venting activities will be dependent upon a wind direction that does not carry the outgas plume in the direction of an adjacent public structure.
- The cylinder will be properly grounded to confirm a static charge is not generated, potentially resulting in ignition of a flammable gas.
- All tools used on the cylinder will be non-sparking.
- Low-pressure discharging will not exceed 15 pounds per square inch gauge (psig).
- Once discharging has started, all workers will retreat to the exclusion zone (minimum 100 feet) around the remote location until the discharging process is complete.

4.18 Flaring

4.18.1 Flaring activities involve the combustion of the cylinder contents through the discharge of a low-intensity flame. Flaring activities will be performed in accordance with the following procedures:

- Flaring will be accomplished at a remote location and in compliance with all applicable environmental air regulatory requirements.
- All personnel involved with flaring activities shall be appropriately trained and wear PPE appropriate to the hazards (e.g. Nomex fire-retardant forearm-length gloves, other fire-retardant clothing, self-contained breathing apparatus, etc.).
- Flaring activities will be dependent upon a wind direction that does not carry the combustion plume in the direction of any offsite structure or activity, or into uncontrolled (public access) areas.
- The cylinder will be properly grounded to confirm a static charge is not generated, potentially resulting in ignition of a flammable gas.
- All tools used on the cylinder will be non-sparking.
- Low-pressure discharging will not exceed 15 pounds per square inch gauge (psig).
- A hot work permit shall be completed prior to the start of flaring activities, refer to *S3AM-332-PR1 Hot Work*.
- No other cylinders will be within 50 feet (15.24 meters) of the cylinder being flared.
- Flaring activities will use a low-pressure discharge and maintain a small, low-intensity flame.
- A firewatch will be established, with a worker stationed outside the exclusion zone with a fire extinguisher (20A:100B:C) during flaring activities (i.e., fire watch). During the work the worker assigned to the firewatch will have no other duties.
- The flare will be positioned so that it is not pointing toward any flammable materials, persons, or equipment in the immediate area.

4.19 Neutralization

4.19.1 Neutralization refers to the on-site neutralization of the cylinder contents through a controlled chemical reaction process. Specialized equipment may be necessary based on the chemical involved, as well as reaction by-products, catalysts, or physical conditions (i.e., temperature, acidic, basic, etc.). Neutralization activities will be performed in accordance with the following procedures:

- Neutralization is the required disposition method for cylinders containing acid gases, as well as many alkaline gases.
- The neutralization process shall be approved by a professional engineer (e.g., chemical) or based on a published chemical-specific neutralization methodology.
- Liquid levels in the reaction vessels will be maintained at least 12 inches (30.5 centimeters) below the top of the vessel.
- Based on the specific chemical reaction, the temperature of the reaction vessel and its contents will be monitored continuously and controlled accordingly.
- Pressure levels will be maintained within acceptable limits to prevent the reaction from accelerating, unwanted by-product formation, or the break-through of the chemical intended to be neutralized.
- Employees involved in neutralization activities shall be appropriately trained and wear the PPE identified within the site-specific safety plan and cylinder plan.

4.20 Detonation

4.20.1 Detonation refers to the use of explosives to open and subsequently consume the contents of the cylinder by the heat generated during the explosion. Detonation activities will be performed in accordance with the following procedures:

- All personnel involved with detonation activities shall be appropriately trained and wear PPE appropriate to the hazards (e.g. Nomex fire-retardant forearm-length gloves, other fire-retardant clothing, self-contained breathing apparatus, etc.).
- A detonation plan shall be submitted to and approved by the SH&E Manager prior to the commencement of cylinder detonation activities.
- The detonation of compressed gas cylinders will be completed under the guidance of experienced ordnance and explosives (OE) professional who is licensed in the use of explosives.
- A sufficient amount of explosives will be used to consume the entire contents of the cylinder (flammable gases only).
- A blast pit will be excavated where all detonations will take place.
- The OE professional will determine the blast hazard zone/potential debris impact zone, and this area will be evacuated prior to the detonation.
- The OE professional will sound a warning signal (e.g., horn or equivalent) three times to indicate that a detonation is imminent and confirm all persons have evacuated the blast hazard zone prior to detonation.
- Employees will be on standby outside the blast hazard zone with fire extinguishers (minimum rating of 20A:100B:C).

4.21 Cylinder Decommissioning Operations

4.21.1 Decommissioning refers to the removal of a compressed gas cylinder from service by rendering it permanently unusable.

4.21.2 Prior to decommissioning, cylinder contents will be verified, removed from the cylinder, and the cylinder purged with an inert gas (e.g., nitrogen, carbon dioxide, etc.).

4.21.3 All identifying marks or decals will be removed from the cylinder.

4.21.4 The SH&E Manager shall be contacted prior to the decommissioning of compressed gas cylinders that contain or previously contained:

- Ethylene oxide,

- Arsine,
- Diborane,
- Hydrogen selenide,
- Cyanogen chloride,
- Amines,
- Hydrogen sulfide,
- Acetylene, or
- Methyl mercaptan.

4.21.5 Additional safety precautions may be necessary due to highly reactive residues left behind by these substances.

4.21.6 The recommended methods of decommissioning include:

- Burning/torch-cutting an elongated hole into the side of the cylinder, refer to *S3AM-332-PR1 Hot Work;*
- Torch-cutting the cylinder in half; and
- Crushing the cylinder.

5.0 Records

5.1 None

6.0 Attachments

6.1 S3AM-114-ATT1 Compressor Safety

6.2 S3AM-114-FM1 Compressed Gas Cylinder Inspection

Americas

Compressor Safety

S3AM-114-ATT1

1.0 Objective / Overview

1.1 Compressors should be used with extreme caution in order to prevent personal injury.

1.2 When using a compressor it's important to follow the manufacturer's instructions to avoid injuring someone or damaging your compressor.

1.3 Allow only trained, authorized personnel to operate the compressor. Along with training, other safety measures include: proper maintenance of equipment and personal protective equipment.

2.0 Safe Operating Guidelines

2.1 Follow manufactures recommended operating instructions, every compressor is not the same. Maintain adequate ventilation.

2.2 Gas and diesel powered generators emit carbon monoxide (CO). Never operate a fuel-powered compressor in an enclosed building without proper ventilation.

2.3 Turn the compressor off to refuel. Gasoline and its vapors may ignite if they come into contact with hot components or an electrical spark, store fuel in a properly designed container in a secure location.

2.4 Operators shall perform a pre-operational check of all air hoses, couplings, and connections to determine if leakage or other damage exists. Tag unsafe equipment and take out of service immediately.

2.5 Decompress air from the compressor prior to removing any caps or air equipment attachments such as jackhammers, drills, etc.

2.6 Keep oil and flammable material clear of air fittings and joints.

2.7 Make sure connections are secure to avoid a hose coming loose during use.

2.8 To avoid a shock, make sure that your hands are dry and you're standing in a dry place whenever you operate an electrically powered compressor.

2.9 Use only UL-listed, three-prong extension cords. Be sure the extension cord is the proper size (wire-gauge) to handle the electric load that will be plugged into it.

2.10 Have a Class A:B:C fire extinguisher readily available at all times.

3.0 Potential Hazards

3.1 Burns from contact with the hot muffler or engine

3.2 Shocks/electrocution

3.3 Noise exposure

3.4 Inhaling exhaust gases, CO

3.5 Contact with pressurized air

4.0 Training Requirements

4.1 Review of applicable procedures.

4.2 Demonstrated knowledge on the use of the compressor.

4.3 Review of manufacturers operating guidelines.

5.0 Personal Protective Equipment

5.1 Leather Gloves

5.2 Hearing Protection

5.3 Long Sleeve Shirt (e.g., to shield from burns, etc.)

5.4 Refer to *S3AM-208-PR1 Personal Protective Equipment*

Americas

Compressed Gas Cylinder Inspection

S3AM-114-FM1

Location Inspected: _____ **Job No.:** _____

Date Inspected: _____ **Name of Inspector:** _____

1.	DOT / TDG container specification number present on cylinders.	☐ Yes	☐ No	☐ NA
2.	Proper DOT / TDG shipping name, ID # and hazard class on cylinders.	☐ Yes	☐ No	☐ NA
3.	Manufacturer's name and appropriate hazard warnings present.	☐ Yes	☐ No	☐ NA
4.	Serial number of cylinders and inspectors official mark present.	☐ Yes	☐ No	☐ NA
5.	Most recent hydrostatic test date marked and within 5 years.	☐ Yes	☐ No	☐ NA
6.	Cylinder valve and neck ring free of oil, grease or other foreign matter.	☐ Yes	☐ No	☐ NA
7.	Valve threads clean and in good condition.	☐ Yes	☐ No	☐ NA
8.	Pressure rating of cylinder not exceeded.	☐ Yes	☐ No	☐ NA
9.	Cylinder surface is free of cracks, and dents, gouges, weld defects, etc.	☐ Yes	☐ No	☐ NA
10.	Cylinder surface is free of arc burns and fire burns.	☐ Yes	☐ No	☐ NA
11.	Cylinder cap is present and threaded in place.	☐ Yes	☐ No	☐ NA
12.	Cylinder surface, particularly bottom, is free of excessive corrosion, and pitting.	☐ Yes	☐ No	☐ NA
13.	Cylinders must be capped when regulators are removed.	☐ Yes	☐ No	☐ NA
14.	Oxygen and fuel cylinders are stowed in designated well-ventilated areas.	☐ Yes	☐ No	☐ NA
15.	Storage areas have temperatures less than 125º F (52º C).	☐ Yes	☐ No	☐ NA
16.	Cylinders are stored upright and secured from falling over.	☐ Yes	☐ No	☐ NA
17.	Cylinders are in segregated groups by gas type and not intermingled with other cylinders.	☐ Yes	☐ No	☐ NA
18.	Oxygen cylinders are stored at least 20 feet (6.1 meters) away from flammables. (A fire-resistive partition of at least 1-hour fire-resistance rating of at least 5-foot (1.52 meters) height may be used in lieu of 20 foot [6.1 meter] separation.)	☐ Yes	☐ No	☐ NA
19.	Flammable or combustible materials are kept at least 20 feet (6.1 meters) away from stored cylinders.	☐ Yes	☐ No	☐ NA
20.	Gas cylinder valves are protected from snow and ice during winter months.	☐ Yes	☐ No	☐ NA
21.	Oxygen cylinders are kept free from oil and grease.	☐ Yes	☐ No	☐ NA
22.	Welding cylinders are securely fastened to ready-use racks.	☐ Yes	☐ No	☐ NA
23.	Smoking or open flames are not permitted in areas where cylinders are stored.	☐ Yes	☐ No	☐ NA
24.	Cylinder storage areas are posted with the following sign: “DANGER – NO SMOKING OR OPEN FLAME”.	☐ Yes	☐ No	☐ NA
25.	Cylinders are labeled with gas contents and warning statement.	☐ Yes	☐ No	☐ NA
26.	Empty cylinders are segregated from full cylinders.	☐ Yes	☐ No	☐ NA

Americas

Corrosive & Reactive Materials

S3AM-125-PR1

1.0 Purpose and Scope

1.1 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content where corrosive and/or reactive materials are used or stored.

1.2 The purpose of this procedure is to protect employees from the hazards of corrosive and reactive materials. This procedure considers a corrosive material as one that has a pH less than 2.0 (acid), or greater than 12.5 (base). A reactive material is a chemical that may be sensitive to shock, or may react with air or water depending upon its makeup.

2.0 Terms and Definitions

2.1 None

3.0 References

3.1 S3AM-115-PR1 Hazardous Materials Communication

3.2 S3AM-116-PR1 Hazardous Materials Shipping

3.3 S3AM-123-PR1 Respiratory Protection

3.4 S3AM-208-PR1 Personal Protective Equipment

4.0 Procedure

4.1 Implementation of this procedure is the responsibility of the Manager directing activities of the facility, site, or project location.

4.2 Appoint a responsible person who will:

4.2.1 Inspect storage areas periodically.

4.2.2 Monitor the quantity of corrosive and reactive materials on site, as well as that of incoming materials.

4.2.3 Review work practices that involve corrosive and reactive materials.

4.3 Require that all employees working with corrosive or reactive materials, or who may be exposed to such materials, are trained in accordance with *S3AM-115-PR1 – Hazardous Materials Communication*.

4.4 Control the use of corrosive and reactive materials by AECOM personnel.

4.4.1 Order only those materials and quantities that are needed to complete a job.

4.4.2 Check incoming corrosive and reactive materials for proper labeling in accordance with *S3AM-115-PR1 Hazardous Materials Communication*.

- Label materials, if needed, as they arrive on site.
- Mark reactive materials containers with the date of receipt of the chemical.

4.4.3 Check incoming corrosive and reactive materials for safety data sheets (SDS). If SDSs are not provided or are already on file, order them from the manufacturer, distributor, or vendor.

4.4.4 Add incoming corrosive and reactive chemicals to the hazardous materials inventory, if not already present, following procedures set forth in *S3AM-115-PR1 Hazardous Materials Communication.*

4.4.5 Do not store any quantity of corrosive or reactive materials in an office (with the exception of limited quantities of consumer products). These materials are to be stored off site, or at an on-site laboratory or storage area.

4.5 Store corrosive and reactive materials as indicted in the MSDS:

4.5.1 In a cool, dry environment, free from extremes of temperature and humidity.

4.5.2 In a manner that separates them from other materials (including flammables and oxidizers) and from each other.

- Separate acids and bases.
- Separate reactive materials from acids and bases, and protect from contact with water.

4.5.3 On materials that are acid-resistant (Teflon-coated, plastic, etc.) for small containers.

4.5.4 Covered, not stacked on one another, on acid-resistant material for carboys (approximately 5 gallons/22 liters).

4.5.5 On individual racks or securely blocked on skids, with closure (plug) facing upward to prevent leakage from drums.

4.6 Require that labeling and signage are in place.

4.6.1 Label containers with the appropriate warning word to indicate the hazard, such as: DANGER; WARNING; CAUTION; CORROSIVE; OXIDIZER.

4.7 Use corrosive and reactive materials appropriately.

4.7.1 Prior to use and in accordance with MSDS, safe-handling procedures shall be developed for each operation, and type and concentration of the chemical. In all cases, review the MSDS and product information before use.

4.7.2 Follow *S3AM-208-PR1 Personal Protective Equipment* when working with or around corrosive and reactive materials. Review the MSDS for the chemical used to determine the specific type of PPE needed, to include at a minimum:

- Chemical-splash goggles
- Chemical-resistant gloves
- Chemical-resistant apron

4.7.3 Obtain medical care immediately in the event of:

- Skin or eye exposure (e.g., splash) to corrosive liquids
- Inhalation of vapors of corrosive liquids that cause respiratory discomfort.

4.7.4 Require an eyewash station to be located in all areas where acids or bases are used. Safety showers shall be nearby if significant acid or base quantities are involved.

- Place emergency eyewashes and showers in accessible locations that require no more than 10 seconds to reach, and are in a travel distance no greater than 25 feet (7.5 meters) from the hazard.
- Keep the areas surrounding eyewashes and safety showers free of stored materials or debris at all times.
- Mark emergency eyewashes and showers with a highly visible sign.
- Require the area around emergency eyewashes and showers to be well lighted and visible.
- Where portable eyewash units are used, a process shall be in place to change the water and clean the unit, as required by the manufacturer's instructions.
- Require emergency showers and shower/eyewash combinations connected to a self-contained water supply to deliver a minimum 20 gallons (85 liters) per minute for 15 minutes.

- Require emergency showers and shower/eyewash combinations permanently connected to a potable water supply to deliver at least 30 gallons (127.5 liters) per minute continuously.
- Require emergency eyewashes to be capable of delivering to the eyes not less than 0.4 gallon (1.5 liters) per minute for 15 minutes.

4.8 Be prepared to clean up spills of corrosive and reactive materials.

4.8.1 Have a written spill response plan in place before materials are stored on site.

4.8.2 Have commercial spill kits available for cleanup of small quantities of materials. At a minimum, kits should contain appropriate protective clothing (including full-body suits, gloves, and boots) and spill control equipment (including absorbents, pillows, shovels, containers, etc.).

4.8.3 Where necessary, confirm that appropriate respiratory protection equipment is provided to spill responders. For additional information, see *S3AM-123-PR1 Respiratory Protection*.

4.8.4 Clean up or respond to spills promptly.

4.8.5 Confirm that personnel responding to a spill have been trained in the hazards associated with the spilled material, as well as use of the spill control equipment, including PPE required for the task.

4.8.6 Do not use combustible organic materials such as sawdust, excelsior, wood chips and shavings, paper, rags, or burlap bags to absorb or clean up spills.

4.9 Develop a waste management plan and procedures, including procedures for collection, storage, labeling, pick-up and transport, and final disposal.

4.10 Dispose of corrosive and reactive materials appropriately.

4.10.1 Segregate organic acids, inorganic acids, and basic wastes.

4.10.2 Contract hazardous waste disposal services should be obtained, as necessary, to dispose of waste materials. All waste shall be appropriately packaged for off-site transportation, if applicable.

4.10.3 Wastes shall be marked, labeled, and shipped in accordance with regulatory requirements. For additional information, see *S3AM-116-PR1 Hazardous Materials Shipping*.

4.11 Inspect corrosive and reactive storage and use areas periodically.

4.11.1 Inspect office, laboratory, and project settings quarterly.

4.11.2 Use the inspection sheet provided as *S3AM-125-FM1 Corrosive & Reactive Materials Inspection* or equivalent, to inspect sites.

5.0 Records

The following information will be maintained in the location or project file:

5.1 Completed Corrosive and Reactive Material Inspection Sheets.

5.2 Worker Right-to-Know training documentation.

5.3 Written Spill Response Plan.

5.4 Waste Management Plan.

5.5 Documentation of training for spill response personnel.

5.6 Documentation of hazard communication training for personnel exposed to corrosive and/or reactive materials.

6.0 Attachments

6.1 S3AM-125-FM1 Corrosive & Reactive Materials Inspection

Americas

Corrosive & Reactive Materials Inspection

S3NA-125-FM1

Location: _____

Name of Inspector: _____ **Date Inspected:** _____

Labeling

1.	Original containers are labeled with: • Name of chemical • Signal word (e.g., DANGER; WARNING; CAUTION, etc.) • Manufacturer	☐ Yes	☐ No	☐ NA

Pre-Job Activities

2.	Corrosives and reactives are stored in a cool, dry environment, free from temperature extremes	☐ Yes	☐ No	☐ NA
3.	Corrosives and reactives are stored in their properly labeled original containers, cushioned against shock, and stored to prevent leaks	☐ Yes	☐ No	☐ NA
4.	Corrosives are not stored in the vicinity of oxidizers	☐ Yes	☐ No	☐ NA
5.	Hydrofluoric acid is stored only in acid-proof polyethylene- or ceresin-lined containers	☐ Yes	☐ No	☐ NA
6.	Corrosives are stored on acid-resistant material	☐ Yes	☐ No	☐ NA
7.	Chromic acid, nitric acid, perchloric acid, and potassium permanganate (all oxidizers) are stored separately from other corrosives and flammables	☐ Yes	☐ No	☐ NA

Handling

8.	The following minimum required PPE is used when working with corrosives: • Chemical splash goggles • Chemical resistant gloves • Chemical resistant apron	☐ Yes	☐ No	☐ NA
9.	Bottles or carboys are opened slowly to guard from splashes.	☐ Yes	☐ No	☐ NA
10.	The outside of the container is washed off with water after use to clean off any droplets of material.	☐ Yes	☐ No	☐ NA
11.	An eyewash is located in all areas where corrosives are used.	☐ Yes	☐ No	☐ NA
12.	An eyewash is:			
	• Within 25 feet (7.62 meters) or 10 seconds of travel	☐ Yes	☐ No	☐ NA
	• Marked with a highly visible sign	☐ Yes	☐ No	☐ NA
	• Well lit and visible	☐ Yes	☐ No	☐ NA
	• Working and delivering a minimum of 1.5 liters of water per minute for 15 minutes	☐ Yes	☐ No	☐ NA
13.	Where substantial quantities of corrosives and/or reactives are stored, access to an emergency shower is available.	☐ Yes	☐ No	☐ NA
14.	Spill control materials compatible with chemicals are available for emergency use.	☐ Yes	☐ No	☐ NA

Waste Disposal

15.	Organic acid, inorganic acid, and basic waste are kept segregated.	☐ Yes	☐ No	☐ NA
16.	Corrosive waste is disposed in accordance with regulatory and client requirements.	☐ Yes	☐ No	☐ NA
17.	A waste management plan or procedure is in place.	☐ Yes	☐ No	☐ NA
18.	Arrangements for waste collection, transport, and disposal are in place.	☐ Yes	☐ No	☐ NA

Comments:

Americas

Drilling, Boring & Direct Push Probing

S3AM-321-PR1

1.0 Purpose and Scope

1.1 This document provides procedures designed to help prevent injuries to personnel working on the project and pedestrians, property damage, and adverse environmental impact as a result of potential hazards associated with drilling, boring and direct-push probing. These hazards include, but are not limited to, encountering underground utilities, subsurface installations, rotating equipment and potential overhead hazards.

1.2 This procedure provides the minimum requirements to be followed when drilling, boring, and probing work are performed.

1.3 This procedure applies to all Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

1.4 The Manager is responsible for meeting all the requirements in this procedure.

1.5 AECOM's clients may have specific procedures which shall be followed to identify and map utility and subsurface structures on their properties or facilities. Provided the client's procedures meet or exceed those of AECOM, approval shall be obtained from the Manager and the SH&E Manager to follow the client's procedures.

2.0 Terms and Definitions

2.1 **Underground Utilities –** All utility systems located beneath grade level, including, but not limited to, gas, electrical, water, compressed air, sewage, signaling, and communications, etc.

2.2 **Ground Disturbance (GD) –** Any indentation, interruption, intrusion, excavation, construction, or other activity in the earth's surface as a result of work that results in the penetration of the ground.

2.3 **Intrusive Activities –** Examples: Excavation of soil borings, installations of monitoring wells, installation of soil gas sampling probes, excavation of test pits / trenches or other man-made cuts, cavity, trench, or depression in an earth surface formed by earth removal.

2.4 **Subsurface Installations –** Examples: Subterranean tunnels, underground parking garages, and other structures beneath the surface.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-118-PR1 Hearing Conservation

3.3 S3AM-208-PR1 Personal Protection Equipment

3.4 S3AM-209-PR1 Risk Assessment & Management

3.5 S3AM-213-PR1 Subcontractor Management

3.6 S3AM-305-PR1 Hand & Power Tools

3.7 S3AM-306-PR1 Highway and Road Work

3.8 S3AM-322-PR1 Overhead Lines

3.9 S3AM-322-FM1 Overhead Electrical Lines Acknowledgement

3.10 S3AM-325-PR1 Lockout Tagout

3.11 S3AM-326-PR1 Machine Guarding

3.12 S3AM-331-PR1 Underground Utilities

3.13 S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager**

- Confirm the development of the project SH&E Plan and compliance with this procedure.
- Confirm the appropriate equipment and materials are available to conduct the drilling, boring or direct-push operations.
- Confirm compliance with *S3AM-331-PR1 Underground Utilities.*
- Review the *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist* prior to authorizing work to proceed.
- Confirm that employees conducting drilling, boring or direct-push probing possess any required training, registrations or certifications.
- Confirm all employees involved and affected by the task review the SH&E Plan, *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist* and Task Hazard Assessment (THA) prior to work commencing.
- Confirm an equipment maintenance inventory is maintained, schedules adhered to and appropriate inspections of equipment are conducted.
- Provide authorization (with the concurrence of the Site Supervisor and SH&E Manager) for work to resume if interrupted due to unexpected conditions or events.

4.1.2 **Safety, Health & Environment (SH&E) Manager**

- Assist AECOM management as needed by providing guidance and clarification as to issues that may arise.
- Review the project SH&E Plan to confirm compliance with jurisdictional regulations**.** Provide technical guidance as needed when a variance is pursued related to this procedure. Confirm variance process meets requirements identified in *S2-001-SM1 Global SH&E Management System Manual*.

4.1.3 **Employees**

- Maintain training as appropriate to the work to be completed (e.g., ground disturbance, lockout tagout, equipment operation, etc.). Refer to *S3AM-003-PR1 SH&E Training.*
- Review the SH&E Plan, *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist* and Task Hazard Assessment (THA) prior to work commencing.
- As appropriate to the anticipated or encountered hazards and as addressed in the applicable planning documentation, utilize appropriate personal protective equipment (PPE) and applicable training, practices and operating procedures.
- Immediately notify the Manager of any unanticipated conditions or events. If assigned equipment, perform appropriate inspections and confirmations of maintenance and / or repairs.

4.2 Training

4.2.1 All on-site employees involved with drilling, boring, and direct-push probing shall be trained, at a minimum, in these procedures and in the procedures of *S3AM-331-PR1 Underground Utilities*.

4.2.2 All operators and assistants shall have the appropriate safety training based on the SH&E Training Matrix and any additional training assessments developed at the business group**,** and be versed in the equipment to be utilized.

- Refer to *S3AM-003-PR1 SH&E Training.*

- This training may include, but is not limited to, Excavation / Trenching (Ground Disturbance), HAZWOPER, Petroleum Safety Training (or Construction Safety Training), and H2S Alive as appropriate.
- Only qualified personnel shall operate and inspect equipment.

4.2.3 All on-site Employees involved with drilling, boring, and direct-push probing activities shall be provided with on-site orientation of the drill rig and its operation.

4.2.4 All Employees involved with drilling, boring and direct-push probing activities at a client site shall receive the applicable client-required training**.**

4.3 Planning

4.3.1 SH&E Plan – At a minimum, a SH&E plan that includes a pre-job hazard assessment shall be prepared and communicated to all involved personnel prior to any drilling, boring, and direct-push probing activities. Refer to *S3AM-209-PR1 Risk Assessment & Management*.

- Assessment shall include both overhead and subsurface utilities and installations. Refer to *S3AM-322-PR1 Overhead Lines* and *S3AM-331-PR1 Underground Utilities*.
- The SH&E Plan will address any required environmental monitoring including gas monitoring, dust, noise, metals, radiation or other monitoring as may be appropriate for site conditions.
- All SH&E Plan requirements will be followed by the project team.
- The location specific emergency response plan shall be in place, contain procedures applicable to the potential emergencies presented by the operations, and be reviewed with all personnel potentially affected.

4.3.2 A Task Hazard Assessment (THA) shall be completed before every assigned task at the work location. The focus of the analysis shall be on the specific assigned task and the evaluation of risks and assignment of control measures based on actual work conditions.

4.3.3 *S3AM-321- ATT2 Pre-Drilling, Boring & Direct-Push Probing Flow Chart* summarizes the key Pre-Drilling, Boring, and Direct-push probing requirements addressed in this procedure.

4.3.4 Procedures and documentation as detailed in *S3AM-322-PR1 Overhead Lines* and *S3AM-331-PR1 Underground Utilities* shall be completed prior to any intrusive subsurface work.

- The locations of subsurface and overhead utilities and subsurface installations will be investigated, documented, mapped on a site plan and evidenced with appropriate surface markings.
- A site walk shall be conducted by the project team / site Manager and any other appropriate personnel, with the objectives of reviewing all planned intrusive activity locations, the locations of subsurface and overhead utilities and the potential for subsurface installations, to determine the appropriate utility clearance activities, and to observe other physical hazards.
- All proposed subsurface activities will be reviewed in comparison to subsurface and overhead utilities and subsurface installations and adjustments made as necessary.
- Appropriate clearance activities shall confirm location(s) of identified underground utilities and subsurface structures. Review the applicable completed *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist.*
- Site Walks should be repeated as necessary following the clearance of subsurface utilities and installations to confirm hazards are clearly identified.

4.3.5 Confirm drilling location(s) and / or bore entry and bore exit points are adequately identified on the worksite to enable appropriate equipment positioning.

4.4 Permits, Notifications and Access Agreements

4.4.1 Any required notifications shall be provided within the appropriate timeframe to the applicable organization (e.g. owner, agency, governing body, etc.).

4.4.2 All applicable permits (e.g. client, government, working near rail road, etc.) will be identified, obtained, and adhered to.

4.4.3 Access agreements will be obtained and adhered to as necessary.

4.5 Pre-Qualifying and Re-Qualifying Drilling Subcontractors

4.5.1 All drilling subcontractors will be properly pre-qualified in accordance with *S3AM-213-PR1 Subcontractor Management*.

4.5.2 The qualifications of the drilling crew performing the work will be evaluated prior to each mobilization and each day by AECOM's on-site representative to assure that their safety performance, training, qualifications, equipment, processes, and approaches reflect AECOM standards for excellence.

4.5.3 All drilling subcontractor equipment will be properly maintained and properly equipped, and the drilling subcontractor will verify their equipment is fully functional as a normal part of their daily and pre-work routine. Refer to *S3AM-321-FM1 Daily Drilling, Boring & Direct Push Equipment Inspection.*

4.6 General Health and Safety

4.6.1 Personal Protective Equipment – Refer to the *S3AM-208-PR1 Personal Protection Equipment* for best practices. These requirements may be modified or expanded in the SH&E Plan. Clothing shall be close fitting and comfortable without loose ends, straps, draw strings, belts, or otherwise unfastened parts that might catch on some rotating or translating component of the rig.

- Depending upon the hazards present, additional PPE may be required such as fire retardant clothing, specific hearing protection, respiratory protective equipment and chemical protective clothing.
- If the location has potential for underground electrical utilities to be present, workers shall ensure footwear has additional protection of shock resistant soles required (white rectangle with omega symbol).

4.6.2 Hearing Conservation – Hearing conservation program requirements may apply when working around operating equipment. Refer to *S3AM-118-PR1 Hearing Conservation*.

- Each worker shall wear noise-reducing ear protectors around operating equipment or during elevated noise levels. Distance from the elevated noise level is the primary measure of control for non-essential drilling personnel.

4.7 Drilling, Boring and Direct Push Equipment Maintenance and Inspections

4.7.1 All equipment will be inspected prior to the initiation of operations and daily during operations using the *S3AM-321-FM1 Daily Drilling, Boring & Direct-Push Equipment Inspection*. This inspection is the responsibility of the operator who will provide written documentation of the inspection prior to the start of drilling each day.

- Equipment that is deemed defective will immediately be repaired by a qualified person, or, if repair is not practicable, tagged "Out of Service" and sent for repairs or discarded.

4.7.2 Managers shall confirm an accurate inventory of the equipment within their operation requiring scheduled maintenance is developed. Using applicable regulations, industry standards, best practices, and manufacturer's recommendations, a maintenance schedule shall be developed with defined responsibility, required actions, and frequency. Refer to *S3AM-321-FM2 Drilling, Boring, & Direct-Push Equipment Maintenance Inventory.*

4.7.3 The maintenance program for equipment shall:

- Adhere to applicable regulations, standards, and manufacturers' specifications;
- Provide for service by appropriately qualified maintenance personnel; and,
- Require maintenance schedules and records of maintenance.

4.7.4 Employees or operators who are assigned equipment are required to review maintenance schedules for that equipment and will confirm that required maintenance has occurred or see that it is undertaken.

4.8 General Requirements

4.8.1 Excluding geoprobe activities, set up any sample tables and general work areas for employees at a safe distance from the rig.

- The recommended safe distance is the height of the fully extended mast plus 5 feet (1.5 meters), and no less than 30 feet (9.1 meters) from the rig.
- An increase to this distance may be required due to noise exposure hazards. Refer to *S3AM-118-PR1Hearing Conservation.*

4.8.2 Operation of the drilling, boring or direct-push equipment shall be restricted to the designated operator except to activate the emergency shut-off as required.

- All rotary drilling equipment shall have an emergency shut off / kill switch. The location of the switch and operation should be reviewed with all involved Employees.

4.8.3 Sit-on direct push rigs are not permitted on AECOM worksites unless the rig has been modified (in accordance with manufacturer's requirements) to be operated by remote control or the rig has been manufactured with a rollover protection system and seat belt.

4.8.4 Consult jurisdictional regulations as use of J-hooks and cat-heads may be prohibited. Examples:

- 29 CFR 1926 requires derricks and cranes to use hooks with self-closing latches and permits the use of J-hooks only for a task unrelated to this procedure (setting trusses).
- British Columbia and Saskatchewan prohibit the use of friction cat-heads**.**

4.9 Identifying the Work Area

4.9.1 Ensure the work area is adequately identified:

- Including zone around the drilling, boring, or direct push equipment, as well as fluid equipment, entry point, exit point and any excavated areas.
- Utilize barricades, signage, pylons, snow fence, etc. as appropriate.
- Implement traffic control as necessary.
- Coordinate with concurrent operations to identify their associated hazards and controls, and communicate those associated with AECOM tasks.

4.9.2 When operating near public vehicular and pedestrian traffic, the on-site personnel shall take every precaution necessary to see that the work zone is properly established, identified, and isolated from both moving traffic and passer-by pedestrians (refer to *S3AM-306-PR1 Highway and Road Work*).

4.9.3 All traffic control devices shall be installed, placed, and maintained in accordance with a Traffic Control Plan, client specifications, and / or the Manual of Uniform Traffic Control Devices and Manual of Uniform Traffic Control Devices for Canada in Canada. Traffic control devices shall consist of and not be limited to

- Directional and informational signage;
- High visibility barricades, cones, or barrels;
- Lighting; and
- Other equipment and devices as required.

4.10 Clearing Work Areas

4.10.1 In addition to any minimum requirements the drilling subcontractor may have, prior to set up, adequate site clearing and leveling shall be performed to accommodate the rig and supplies and provide a safe working area.

4.10.2 Clearing the site includes clearing the intended drilling area obstacles and of underground utilities in accordance with *S3AM-331-PR1 Underground Utilities*.

4.10.3 Drilling or probing shall not commence when tree limbs, unstable ground, or site obstructions cause unsafe tool handling conditions.

- The cleared / levelled area should be large enough to accommodate the rig and supplies.
- If the rig is positioned on a steep grade and levelling of the ground is impossible or impractical, the wheel of the transport vehicle shall be blocked and other means employed of preventing the rig from moving or toppling over.

4.11 Drilling Activities

4.11.1 Federal / State / Provincial / Territorial regulations that govern drill rig operations and exposed moving parts shall be adhered to.

4.11.2 All applicable client on-site safety procedures shall be understood and adhered to.

4.11.3 Minimum approach distances (MAD) from subsurface and overhead utilities and subsurface installations will be established including 5 feet (1.5 meters) from any subsurface utility, 7 feet (2.1 meters) from the pad surrounding any underground storage tanks, and 10 feet (3 meters) from any overhead energized electrical line (or further depending on line voltage). These approach distances are a minimum; government regulations and utility requirements may dictate a greater set back distance and should be confirmed.

4.11.4 Verify that equipment / energy is isolated when lockout is required:

- Refer to operator's manual and *S3AM-325-PR1 Lockout Tagout*.
- Ensure stop switch is activated.
- Driller is out of the seat.
- Test controls to ensure they do not engage.

4.11.5 In addition to any identified minimum requirements (as applicable, client, drilling subcontractor), the following safety measures shall be taken during drilling, boring or probing operations on site:

- The operator and helper shall be present during all active rig operations.
- Site personnel shall remain within visual contact of the rig operator.
- Hard hats, approved safety boots, safety glasses, and hearing protection shall be worn in the work zone (minimum, the radius around the rig equal to the height of the drill rig mast) of a rig.
- Gas monitoring shall be conducted as appropriate.
- Hands, feet and other body parts shall be kept away from moving parts, (e.g. hoisted, rotating, pushing, etc.) including augers, drill rods and reamers.
- When observing drilling, stand upwind of the drill rig to prevent potential exposure to vapors that may be emitted from the borehole.
- The emergency shut-off switch on the rig shall be identified to site personnel and tested on a daily basis by the operator.
- Unauthorized personnel shall be kept outside of the established work zone.
- Rig crew and other worksite personnel shall not use a cell phone while operating the drill rig or other equipment or within the rig work zone.
- Do not drive the rig from hole to hole with the mast (derrick) in the raised position.
- Before raising the mast (derrick) look up to check for overhead obstructions. Refer to *S3AM-322-PR1 Overhead Lines*.

- Before raising the mast (derrick), all rig personnel (with the exception of the operator) and visitors should be cleared from the areas immediately to the rear and the sides of the mast. All rig personnel and visitors should be informed that the mast is being raised prior to raising it.
- Before the mast (derrick) of a drill rig is raised and drilling is commenced, the drill rig shall be first levelled and stabilized with levelling jacks and / or solid cribbing.
    - The drill rig shall be releveled if it settles after initial set up.
    - Lower the mast (derrick) only when the levelling jacks are down, and do not raise the levelling jack pads until the mast (derrick) is lowered completely.
- After the rig has been positioned to begin drilling, all brakes and / or locks shall be set before drilling begins.
- The operator of a rig shall only operate a drill rig from the position of the controls. The rig shall not be in operation if the operator of the rig leaves the area of the controls.
- Throwing or dropping tools shall not be permitted. All tools shall be carefully passed by hand between personnel or a hoist line should be used.
- If it is necessary to operate the rig within an enclosed area, make certain that exhaust fumes are conducted out of the area.
    - Exhaust fumes can be toxic and some cannot be detected by smell.
    - Air monitoring and, as necessary, noise monitoring shall be conducted.
- Clean mud and grease from boots before mounting a rig platform and use hand holds and railings. Watch for slippery ground when dismounting from the platform.
- During freezing weather, do not touch any metal parts of the rig with exposed flesh. Freezing of moist skin to metal can occur almost instantaneously.
- All unattended bore holes shall be adequately covered or otherwise protected to prevent rig personnel, site visitors, or animals from stepping or falling into the hole. All open bore holes shall be covered, protected, or backfilled adequately and according to Federal / State / Provincial / Territorial or local regulations on completion of the drilling project.
- When using a ladder on a rig, face the ladder and grasp either the side rails or the rungs with both hands while ascending and descending. Always use adequate fall protection and a full body harness when climbing above 6 feet (1.8 meters) of the ground. Do not attempt to use one or both hands to carry a tool while on a ladder. Use a hoist line and a tool “bucket” or a safety hook to raise or lower hand tools.

4.12 Drilling Fluid

4.12.1 Ensure drilling fluid is appropriate to the soil type and conditions to be encountered to enable smooth drilling.

4.12.2 Drilling fluid used in the boring process shall be contained at the entry and, as applicable, exit locations until recycled or removed from the site.

4.12.3 Confirm drilling fluid does not enter roadways, streams, municipal storm or sanitary sewer lines, and / or any other drainage system or body of water.

4.12.4 Monitor drilling equipment and fluid equipment for any leakage or spills. Confirm appropriate containment is in place and adequate spill response supplies are available.

4.12.5 It is important to monitor fluid flow and pressure gauges when drilling with any tooling, but it is essential when drilling with a mud motor (pump placed in the drill string to provide additional power to the bit while drilling).

4.13 Unanticipated Concrete / Debris or Void

4.13.1 The presence of subsurface installations and utilities requires special care when obstructions / refusal and voids are encountered and when unexpected absence of soil recovery occurs during

drilling operations. Other indicators of subsurface installations and utilities are the presence of warning tape, pea gravel, sand, non-indigenous material, bentonite, red concrete (indicative of electrical duct banks) and any departure from native soil or backfill.

4.13.2 If unanticipated concrete / debris is encountered and / or if a void is encountered, drilling will be immediately discontinued and the Manager notified. Drilling may only proceed with Manager or SH&E Manager approval.

4.14 Use of Manual Slide Hammer

4.14.1 The following health and safety procedures should be followed when using a manual slide hammer to install shallow injection points, drive point piezometers, and drill tools:

- Only use a manual slide hammer that either attaches directly to the point / piezometer being driven or that incorporates a cap on the point / piezometer / drill tool that prevents the slide hammer from slipping off the point / piezometer / drill tool.
- Always grasp the manual slide hammer (handles if equipped with handles) with both hands while driving the point / piezometer / drill tool.
- Never allow hands or feet to get between the manual slide hammer and the drive plate or anvil.

4.15 Use of Augers

4.15.1 The following general health and safety procedures should be followed when supervising borings with continuous flight hollow-stem augers:

- Never place hands or fingers under the bottom of an auger section when it is being hoisted over the top of the auger section in the ground or other hard surfaces such as the drill rig platform.
- Never allow feet to get under the auger section that is being hoisted.
- When augers are rotating, stay clear of the rotating auger and other rotating components of the drill rig. Never reach behind or around a rotating auger for any reason.
- Use a long-handled shovel to move auger cuttings away from a rotating auger. Never use hands or feet to move cuttings away from a rotating auger.
- Do not attempt to remove earth from rotating augers. Augers should be cleaned only when the drill rig is in neutral and the augers are stopped from rotating.
- Loud noises may occur while driving split spoons. At minimum hearing protection shall be worn when driving split spoons.
- When pulling / lifting augers, a clevis pin or other closed device shall be used. Use of J-hooks is prohibited.

4.16 Attaching and Breaking Rods

4.16.1 Do not use manual tools (e.g., pipe wrenches) in combination with rotation of the drill stem. Manual tools are not designed for the load, and may break.

- The use of such tools creates a significant impact hazard for those in the work area, because they rotate with the drill stem. Manual tool use in combination with a rotating drill stem to attach or break rods is therefore prohibited.
- Manual tools may be used if the drill stem is isolated / positively disengaged.
- Mechanical means of rod separation that are permitted include:
  - Opposing hydraulic controls.
  - Rod locking devices or machine's power vice.
  - Hydraulic breakout tools.
  - Hydraulic foot clamps.

4.16.2 Rod box changes present severe crushing hazards. Operators shall ensure all crew members are clear of the machine and hoisting equipment while they are changing rod boxes.

4.17 Rotary, Sonic and Core Drilling

4.17.1 In addition to the health and safety procedures identified above, the following general health and safety procedures should be followed when supervising borings with rotary, sonic and core drilling:

- Drill rods should not be braked during lowering into the hole with drill rod chuck jaws. Drill rods should not be held or lowered into the hole with pipe wrenches.
- If a string of drill rods are accidentally or inadvertently released into the hole, do not attempt to grab the falling rods with your hands or a wrench.
- When drill rods are hoisted from the hole, they should be cleaned for safe handling with a rubber or other suitable rod wiper. Do not use hands to clean drilling fluids from drill rods.
- When drill rods are rotating, stay clear of the rotating components of the drill rig. Never reach behind or around a rotating drill rod for any reason.
- Use a long-handled shovel to move cuttings away from the top of the borehole. Never use hands or feet to move cuttings away from the borehole.
- If work shall progress over a portable drilling fluid (mud) pit, do not attempt to stand on narrow sides or cross members. The mud pit should be equipped with rough-surfaced, fitted cover panels of adequate strength to hold drill rig personnel.
- Keep away from area where drill rods are being moved or raised to the rig. Do not stand in the area where a drill rod will fall or slide if it should be dropped.
- Loud noises may occur during drilling. Hearing protection shall be worn.

4.18 Direct-push

4.18.1 The following general health and safety procedures should be followed when supervising drilling borings with direct-push drilling:

- Loud noise may occur during direct-push drilling. Appropriate hearing protection shall be worn.
- When drill rods are hoisted from the hole, they should be cleaned for safe handling with a suitable rod wiper. Do not use hands to clean drilling fluids from drill rods.
- If work shall progress over a portable drilling fluid (mud) pit, do not attempt to stand on narrow sides or cross members. The mud pit should be equipped with rough-surfaced, fitted cover panels of adequate strength to hold drill rig personnel.
- Drill rods should not be lifted and leaned unsecured against the mast. Either provide some method of securing the upper ends of the drill rod sections for safe vertical storage or lay the rods down.

4.19 Horizontal Directional Drilling

4.19.1 During surface to surface operations a 16.4’ (5 meters) safe zone shall be established and identified at both the entry and exit locations; no personnel are permitted to be within this zone unless the drill is locked out and the operator is out of the seat.

4.19.2 Machine shall be locked out before entering an excavation, changing tools, adding or removing drill stem or doing any other work on tools or the drill stem at the exit end of the bore.

4.19.3 A tracking head shall be installed on the drill stem:

4.19.4 Assemble drill head using components appropriate to the soil conditions to be encountered (e.g. nozzle, bit, beacon housing, etc.).

4.19.5 Ensure all personnel are clear of the bore entry point (outside of identified work zone).

4.19.6 At all times two way communication will be maintained at entrance and exit points using two way radios or equally effective communication means. If at any time communication is lost, all work will be stopped until communication is re-established

4.19.7 Locate drill head with tracking device at least every half-length of pipe. Adjust direction as necessary to follow the intended bore path.

4.19.8 Any drilling fluid returning to the surface shall be cleaned up promptly.

4.19.9 Drill pipe should exit the bore at an angle of 5 to 10° from the ground surface.

4.19.10 Turn off fluid flow as soon as drill head emerges.

4.19.11 Lockout machine and remove drill head using appropriate breakout tools.

4.19.12 Select and attach a reamer that allows the return of drilling fluids and cuttings, to reduce frictional pullback forces, and to allow for bend radius of the pipe. Reamer shall be:

- The smaller of 1.5 times the outside diameter (O.D.) or 12 inches (300mm) larger than the diameter of the product pipe.
- A diameter less than 1.5 times the diameter of the product may be necessary in collapsing soil formations.
- Reamed diameter may need to be increased by up to 25% if substantial swelling of the soil is expected to occur.

4.19.13 All personnel shall clear the trench or the designated surface zone (16.4 feet [5 meters]) once the reamer is attached. Operator shall only reverse lockout and commence pullback when communication is received from personnel on exit hole side and operator has confirmed the message.

4.19.14 Personnel on exit hole side shall ensure reamer is pulled the entire way back to the exit hole.

- If rotation is started when drill rod and reamer are away from the exit hole, very fast sideways movement of the rod and reamer can occur.
- Larger reamers and longer lengths of exposed drill rod increase the speed and distance of this movement.

4.19.15 If working with trailing drill stem, swivels shall be verified as lubricated and rotating freely by hand prior to use:

- A freely moving swivel prevents trailing drill stem or product from rotating / whipping.
- If the swivel does not move freely by hand it shall be removed from service and repaired or replaced.
- Only use swivels with limited articulation to prevent whipping or cranking action between the reamer and trailing drill pipe or product.

4.19.16 It is important to clean and lubricate the tool and drill stem joint threads before each use.

4.19.17 Any individual drill pipes that are bent or damaged shall be immediately taken out of service.

4.19.18 Occasionally change the order of the lead drill pipe (i.e. move the lead pipe to the end of the stem, or other pipe rotation procedures) to extend drill stem life.

4.19.19 Operator should avoid stalling the pipe rotation to avoid stress damage from shock loading.

4.20 Drilling at Potential MEC / UXO Sites

4.20.1 If the project site is suspected of containing munitions and explosives of concern (MEC) or unexploded ordnance (UXO), the UXO team will conduct a reconnaissance and MEC / UXO avoidance to provide clear access routes to each site before drilling crews enter the area. The following procedures will be implemented:

- Drilling operations on an MEC / UXO site will not be conducted until a complete plan for the site is prepared and approved by the AECOM UXO Safety Officer. MEC / UXO avoidance shall be conducted during drilling operations on known or suspect MEC / UXO sites.
- The UXO team will identify and distinctly mark the boundaries of a clear approach path for the drilling crews, vehicles, and equipment to enter the site. This path will be, at a minimum, twice the width of the widest vehicle. No personnel will be allowed outside any marked boundary.
- If MEC / UXO is encountered on the ground surface, the UXO team will clearly mark the area where it is found, report it to the proper authorities, and divert the approach path around it.
- The UXO team will conduct an access survey using the appropriate geophysical instrument over the approach path for avoidance of MEC / UXO that may be in the subsurface. If a magnetic anomaly is encountered, it will be assumed to be MEC / UXO, and the approach path will be diverted around the anomaly. UXO personnel only will operate the appropriate geophysical instrument and identify MEC / UXO.
- An incremental geophysical survey of the drill-hole location(s) will be initially accomplished by the UXO team using a hand auger to install a pilot hole. If MEC / UXO is encountered or an anomaly cannot be positively identified as inert material, Hazardous, Toxic, and Radioactive Waste (HTRW) sampling personnel will select a new drill-hole location.
- Once the surface of a drilling site has been cleared and a pilot hole established as described above, the drilling contractor will be notified that the site is available for subsurface drilling.

4.21 Movement and Transport of Drilling, Boring or Direct-Push Equipment

4.21.1 Personnel transporting equipment shall be properly licensed and shall operate the vehicle according to Federal / State / Provincial / Territorial, and local regulations. Refer to *S3AM-005-PR1 Driving* and *S3AM-320-PR1 Commercial Motor Vehicles*.

4.21.2 Confirm the traveling height (overhead clearance), width, length and weight of the equipment with the carrier. Identify highway and bridge load, width and overhead limits, to confirm these limits are not exceeded and with adequate margin.

4.21.3 Allow for overhang of any drilling, boring or direct-push equipment when cornering or approaching other vehicles or structures.

4.21.4 Be aware that the canopies of service stations and motels are often too low for equipment loaded on a trailer to clear

4.21.5 Watch for low hanging electrical lines, particularly at the entrances to drilling sites or restaurants, motels, other commercial sites.

4.21.6 Never travel on a street, road, or highway with any part of the drilling, boring or direct-push equipment in a raised or partially raised position.

4.21.7 Remove all ignition keys if rig is left unattended unless client requirements specify that the keys remain in the ignition switch at all times.

4.21.8 Before moving a rig on location, the operator shall do the following:

- To the extent practical, walk the planned route of travel and inspect it for depressions, gullies, ruts, and other obstacles.
- Check the brakes of the truck / carrier, especially if the terrain along the route of travel is rough or sloped.
- Discharge all passengers before moving on rough or steep terrain.

4.21.9 Engage the front axle (on 4x4, 6x6, etc., vehicles) before traversing rough or steep terrain

4.21.10 Driving drill rigs along the sides of hills or embankments should be avoided; however, if side-hill travel becomes necessary, the operator shall conservatively evaluate the ability of the rig to remain upright while on the hill or embankment. The possibility shall be considered that the presence of

drilling tools on the rig may reduce the ability of the rig to remain upright (raises the center of mass of the rig).

4.21.11 Logs, ditches, road curbs, and other long and horizontal obstacles should be approached and driven over squarely, not at an angle.

4.21.12 When close lateral or overhead clearance is encountered, or when backing up, the driver of the rig shall be guided by another person on the ground.

4.21.13 Loads on the drill rig and truck shall be properly stored while the truck is moving, and the mast shall be in the fully lowered position.

4.22 Loading and Unloading

4.22.1 Consult applicable manufacturer's recommendations for loading and unloading of the equipment.

4.22.2 Use ramps of adequate design that are solid and substantial enough to bear the weight of the rig with carrier, including tools.

4.22.3 Load and unload on level ground.

4.22.4 Use the assistance of someone on the ground as a guide.

4.22.5 Check the brakes on the rig carrier before approaching loading ramps.

4.22.6 Distribute the weight of the rig, carrier, and tools on the trailer so that the center of weight is approximately on the centerline of the trailer and so that some of the trailer load is transferred to the height of the pulling vehicle. Refer to the trailer manufacturer's weight distribution recommendations.

4.22.7 The rig and tools should be secured to the hauling vehicle with ties, chains, and / or load binders of adequate capacity.

5.0 Records

5.1 All employee training files shall be maintained in accordance with *S3AM-003PR1 SH&E Training*.

5.2 Completed inspections and maintenance inventories shall be maintained the site or project files.

6.0 Attachments

6.1 S3AM-321-ATT1 Core Drilling Machine

6.2 S3AM-321-ATT2 Pre-Drilling, Boring, & Direct-Push Probing Flow Chart

6.3 S3AM-321-FM1 Daily Drilling, Boring & Direct-Push Equipment Inspection

6.4 S3AM-321-FM2 Drilling, Boring & Direct-Push Equipment Maintenance Inventory

Americas

Core Drilling Machine

S3AM-321-ATT1

1.0 Objective / Overview

1.1 Core drilling machines are used on all types of jobs. They can be electrical or gas powered and come with a stand or can be hand held. Caution should be used when operating such a machine. It may look harmless and easy to run, but drilling machines have many hazards.

1.2 Prior to coring activities the location should be checked for buried utilities in accordance with *S3AM-331-PR1 Underground Utilities*.

2.0 Safe Operating Guidelines

2.1 Clean the flanges before mounting the blade.

2.2 Make sure the blade is correct for the material being cut and that the arrow on the blade corresponds with the direction of rotation of the machine spindle.

2.3 Use built-in vacuum or bolt-down anchors depending on the type of surface to be cored. Do not bypass anchoring system.

2.4 Properly manage power cable for electric units to prevent slips, trips or falls by the operator or those nearby.

2.5 Avoid tilting the blade when cutting.

2.6 Use only the machines that have an approved safety guard.

2.7 Remove the diamond blade from the machine during transit to prevent accidental damage.

2.8 Inspect the blades frequently to detect cracks or undercutting of the steel center.

2.9 Do not let excessive heat be generated at the cutting edge of the blade.

2.10 Use adequate water supply to both sides of the blade.

2.11 Follow the manufacturers recommended pulley sizes and operating speeds for specific blade diameters.

2.12 Make sure to tighten drive belts to ensure full available power.

2.13 Don't force the blade on the blade shaft or mount blade on an undersized spindle.



3.0 Potential Hazards

3.1 Utilities

3.2 Electricity

3.3 Flying debris

3.4 Noise exposure

3.5 Inadequate housekeeping

3.6 Fumes or dust

3.7 Pinch points

3.8 Binding/biting – torque control

4.0 Training Requirements

4.1 Review of applicable SOPs (e.g., *S3AM-305-PR1 Hand & Power Tools*; *S3AM-302-PR1 Electrical Safety*).

4.2 Demonstrated knowledge on the use of a coring machine.

4.3 Review and follow manufacturers' operating guidelines.

5.0 Personal Protective Equipment (Level D PPE)

5.1 Hard hat

5.2 Safety Vest

5.3 Leather gloves

5.4 Face shield

5.5 Steel-toed/composite-toed boots

5.6 Hearing protection

5.7 Respirator or dust mask (as applicable to the respiratory hazards)

6.0 Other Safety Tips

6.1 Keep fingers and hands away from the cutting edge.

6.2 Hold handle firmly when operating.

6.3 A subsurface utility clearance shall be performed prior to initiating drilling operations.

6.4 Stand firmly and apply body weight at anchored side of guarded platform.

Americas

Pre-Drilling, Boring & Direct Push Probing Flow Chart

S3AM-321-ATT2

Before Any Drilling, Boring and Direct Push Probing Activities

PERMITS and ACCESS AGREEMENTS

- **Government and Utility/Infrastructure Permits**
- **Client Permits and Procedures**
- **Access Agreements**

KEY POINT: Obtain all permits and sign Access Agreement (if required).

GENERAL HEALTH and SAFETY

KEY POINT: Prepare SH&E Plan, as well as Task Hazard Assessments (THA).

IDENTIFICATION and MAPPING OF UTILITY and SUBSURFACE STRUCTURES

KEY POINT: Generate a comprehensive site map illustrating known locations of overhead/subsurface utilities, subsurface structures, and proposed boring locations.
Review completed *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist*.

SITE WALK

KEY POINT: Perform a site walk utilizing site map and 360 degree view to verify known conditions, including overhead obstructions or hazards, and identify potential issues. Add discovered items/issues to map for use in location confirmation.

PROPOSED SUBSURFACE INVESTIGATION LOCATIONS

KEY POINT: Confirm that locations meet the minimum required set-back distances.

UTILITY CLEARANCE INVESTIGATION LOCATION CONFIRMATION

KEY POINT: Visually verify hand clearance. Review completed *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist*.

DRILL RIG INSPECTIONS

KEY POINT: Drill rig inspected and documented daily by operator prior to drilling.

BEGIN DRILLING, BORING OR DIRECT PUSH PROBING

KEY POINT: Prior to commencing any intrusive subsurface work, *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist* shall be completed.
Upon commencing the work, if unanticipated conditions or events are encountered (e.g. concrete/debris, void encountered, etc.) stop work and notify the Manager. Authorization to proceed shall have the concurrence of the Manager, Site Supervisor and SH&E Manager.

Americas

Daily Drilling, Boring & Direct-Push Equipment Inspection

S3AM-321-FM1

Site / Project Name _____ Rig Inspector (Name/Company) _____

RIG INFORMATION:

Rig Type Rotary/Auger Drilling Rig ☐ Direct Push Type (DPT) ☐

Owner _____ VIN# _____

Year/Make _____ Mileage _____

Model _____ Drill Hrs _____

INSTRUCTIONS: Each shift shall inspect all applicable items. If an unsatisfactory condition (fail) is observed, suspend operation of the equipment and report the condition to the site supervisor immediately.

Emergency Equipment / Devices / Switches	
Kill switches are located and accessible to workers on both sides of the rotating stem. NOTE: Location and number of switches depend on the rig manufacturer; please refer to owner's manual (DPT typically has one switch on control panel).	☐ Pass ☐ Fail ☐ N/A
Kill switches installed by the manufacturer, alarms and other devices (e.g. positive air shut-off valve) tested and in operable condition. All workers familiar with location and operation of devices. **NEVER BYPASS, DISABLE, OR REMOVE KILL DEVICES.**	☐ Pass ☐ Fail ☐ N/A
First aid kit adequate and on equipment / readily available.	☐ Pass ☐ Fail ☐ N/A
Absorbent materials on equipment / readily available (spill response).	☐ Pass ☐ Fail ☐ N/A
A fire extinguisher of appropriate size is located on drill rig and readily available/accessible for drilling crew (recommended 20 lbs.).	☐ Pass ☐ Fail ☐ N/A
Protective Guards	
Drive shafts, belts, chain drives, and universal joints are guarded to prevent accidental insertion of hands, fingers, or tools.	☐ Pass ☐ Fail ☐ N/A
Cables	
Cables on drill rig free of kinks, frayed wires, birdcages, flat spots, grease, and worn or missing sections.	☐ Pass ☐ Fail ☐ N/A
Cables are terminated at the working end with a proper eye splice; either swaged, coupled, or using cable clamps.	☐ Pass ☐ Fail ☐ N/A
Cable clamps are installed with the saddle on the live or load side. Clamps are not alternated and are of the correct size and number for the cable size.	☐ Pass ☐ Fail ☐ N/A
Wire ropes are not allowed to bend around sharp edges without cushion material.	☐ Pass ☐ Fail ☐ N/A
Pulleys and Cable Winches	
Pulleys are not bent, cracked, or broken.	☐ Pass ☐ Fail ☐ N/A
Pulleys operate smoothly and freely, without resistance.	☐ Pass ☐ Fail ☐ N/A
Motor is mounted in correct location and tightly secured to drill rig.	☐ Pass ☐ Fail ☐ N/A
Winch capable of being placed in the free spool (unwind smoothly) and locked position correctly, demonstrating that the cable is suitable for lifting during drilling operations.	☐ Pass ☐ Fail ☐ N/A
Safety Latches	
Hooks installed on hoist cables are the safety type with a functional latch to prevent accidental separation.	☐ Pass ☐ Fail ☐ N/A
Safety latches are functional and completely span the entire throat of the hook and have positive action to close the throat except when manually displaced for connecting or disconnecting a load.	☐ Pass ☐ Fail ☐ N/A
Flights / Augers / Reamers	
Flights / Augers / Reamers are not bent, cracked, or broken. NOTE: Flights / Augers / Reamers failing inspection must be removed from jobsite.	☐ Pass ☐ Fail ☐ N/A

Flights are blunt to prevent the risks of cuts.	☐ Pass ☐ Fail ☐ N/A
Auger keys are not bent, cracked/fractured, excessively worn, or otherwise damaged.	☐ Pass ☐ Fail ☐ N/A
Auger bolt holes and threads are not damaged.	☐ Pass ☐ Fail ☐ N/A
Inspect flights/augers for metal burns. NOTE: Burrs must be filed to flat surface.	☐ Pass ☐ Fail ☐ N/A
Augers / Reamers lying flat on the ground (avoid stacking).	☐ Pass ☐ Fail ☐ N/A
Augers / Reamers over 50lbs (22.7kg) moved mechanically. (Avoid manual lifting).	☐ Pass ☐ Fail ☐ N/A
Drill String	
Appropriate break out tool(s) available.	☐ Pass ☐ Fail ☐ N/A
Rod box and power vice operating smoothly and freely.	
Drill string are not bent and do not have any cracks/fractures.	☐ Pass ☐ Fail ☐ N/A
Drill string connections (e.g. pins, threads, couplers) are of the proper type, are not bent, have no cracks/fractures, and are not excessively worn.	☐ Pass ☐ Fail ☐ N/A
Swivel connectors (for trailing horizontal drill stem) lubricated and freely rotating.	☐ Pass ☐ Fail ☐ N/A
Mast	
Mast is free of bends, cracks, or broken sections.	☐ Pass ☐ Fail ☐ N/A
All mounting hardware (pins, bolts, etc.) in place.	☐ Pass ☐ Fail ☐ N/A
No moving of drill rig or maintenance/repairs while mast is in vertical position.	☐ Pass ☐ Fail ☐ N/A
Hammering Device	
Hammer free of cracks, fatigue, or other signs of excessive wear.	☐ Pass ☐ Fail ☐ N/A
Hammer connections are secure.	☐ Pass ☐ Fail ☐ N/A
Leveling Devices	
Outriggers move in/out and up/down smoothly and freely while using controls on drill rig, with no hydraulics leaks.	☐ Pass ☐ Fail ☐ N/A
Outriggers are extended prior to and whenever the mast is raised off its cradle. Outriggers must maintain pressure to continuously support and stabilize the drill rig (even while unattended).	☐ Pass ☐ Fail ☐ N/A
Outriggers are properly supported on the ground surface to prevent setting into the soil (use of outrigger support pads).	☐ Pass ☐ Fail ☐ N/A
Controls	
Controls are intact, properly labeled, have freedom of movement, and have no loose wiring or connections.	☐ Pass ☐ Fail ☐ N/A
Controls are not blocked or locked into an operating position.	☐ Pass ☐ Fail ☐ N/A
Installed lights, signals, gauges, and alarms operate properly.	☐ Pass ☐ Fail ☐ N/A
Lifting Devices	
Slings, chokers, and lifting devices (straps, not chains) inspected before using and are in proper working order. NOTE: Damaged units are labeled and removed from jobsite.	☐ Pass ☐ Fail ☐ N/A
Shackles/Clevises are in proper working order with pins/screws in place that is to be used while lifting.	☐ Pass ☐ Fail ☐ N/A
Cables and lifting devices are not operated erratically or with a jerking action to overcome resistance.	☐ Pass ☐ Fail ☐ N/A
Hydraulic System	
Hydraulic lines are secure, in good condition with no signs of excessive wear, and not leaking. NOTE: Check while pressurized.	☐ Pass ☐ Fail ☐ N/A
Hydraulic lines are not in a bent or pinched position causing additional fluid restrictions/pressures.	☐ Pass ☐ Fail ☐ N/A
Hydraulic oil reservoir has appropriate amount of oil and not leaking.	☐ Pass ☐ Fail ☐ N/A
Documentation available to confirm that pressure relief valve was checked during shop maintenance activity and noted on maintenance log.	☐ Pass ☐ Fail ☐ N/A
Pump Lines (water, grout, etc)	
Suction/Discharge hoses, pipes, valves, and fittings are secured and not leaking.	☐ Pass ☐ Fail ☐ N/A
High pressure hoses have a safety chain, cable, or strap at each end to prevent whipping in the event of a failure.	☐ Pass ☐ Fail ☐ N/A

Ladders	
Drill rig has a permanently attached or proper portable ladder to be used for access to drilling platform.	☐ Pass ☐ Fail ☐ N/A
Ladders and platforms not to be used for tool storage- keep ladders and operator platforms clear during drilling.	☐ Pass ☐ Fail ☐ N/A
Tires / Tracks	
Tires / Tracks on rig are not excessively worn and free of any debris or foreign material.	☐ Pass ☐ Fail ☐ N/A
General	
General condition – exterior (no structural damage, no loose bolts, platform tidy, etc.)	
General condition – interior (cab clean, tidy)	
Drill rig meets regulations for transport on state/federal highways (inspection sticker, license plate, etc.).	☐ Pass ☐ Fail ☐ N/A
Rig is of appropriate size to meet job requirements.	☐ Pass ☐ Fail ☐ N/A
Maintenance log available for previous 3 months to confirm proper maintenance/inspection.	☐ Pass ☐ Fail ☐ N/A
Exhaust	
Exhaust system is free from defect and routes engine exhaust away from drill rig workers.	☐ Pass ☐ Fail ☐ N/A
Fuels	
Fuel stored in an approved and properly labeled container.	☐ Pass ☐ Fail ☐ N/A
Fuel transfer lines free from signs of excessive wear and not leaking.	☐ Pass ☐ Fail ☐ N/A
Refueling and transferring of fuel is performed in an approved area with sufficient containment to prevent spillage.	☐ Pass ☐ Fail ☐ N/A
Exclusion/Work Zones	
The exclusion/work zone is centered over the borehole (and if applicable, bore exit point) and the radius equal to or greater than the height of the mast (measured from ground level).	☐ Pass ☐ Fail ☐ N/A
The exclusion/work zone is clear of tripping hazards or the hazards are documented with appropriate controls on the Task Hazard Assessment.	☐ Pass ☐ Fail ☐ N/A
The exclusion/work zone communicated to concurrent/adjacent operations to prevent overlap of work zones or line of fire.	☐ Pass ☐ Fail ☐ N/A
Subsurface Utilities / Installations and Overhead Obstructions	
Subsurface utilities / installations have been confirmed as identified and cleared through site observation and review of the completed *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist.*	☐ Pass ☐ Fail ☐ N/A
Except where electrical distribution and transmission lines have been de-energized and visibly grounded, drill rigs will be operated proximate to under, by, or near power lines in accordance with the Minimum Approach Distance (MAD).	☐ Pass ☐ Fail ☐ N/A
Rig Repairs	
Repairs, when possible, are conducted offsite to reduce the risk of any onsite incidents.	☐ Pass ☐ Fail ☐ N/A
Specialized PPE	
When working at elevated heights, workers are to wear a fall restraining device attached in a manner to restrict falls to less than six feet (1.83 meters).	☐ Pass ☐ Fail ☐ N/A
When working in wet/slippery conditions, all workers have a lug-type sole or similar slip resistant sole, on their safety footwear to prevent slipping.	☐ Pass ☐ Fail ☐ N/A

Comments:

Signature of Inspector: _____ Date: _____

Americas

Drilling, Boring & Direct-Push Equipment Maintenance Inventory

S3AM-321-FM2

Equipment (*Make, Model, Serial #*)	Equipment Owner	Equipment Status (*On Hire, Active, Decommissioned*)	Frequency of service	Service Type	Manufacturer's Standards	Industry Standards	Legislated Requirements	Location of Equipment

Americas

Electrical Safety

S3AM-302-PR1

1.0 Purpose and Scope

1.1 Outline the safe working requirements for working with and near electric equipment and installations to minimize and control electrical hazards such as electrical shock, arc flash, and electrical fires in the workplace.

1.2 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

1.3 As a general rule, AECOM employees shall not work on exposed, energized systems with a potential greater than 50 volts. This work should be performed by a qualified electrician.

2.0 Terms and Definitions

2.1 **Arc Flash –** A dangerous condition associated with the release of energy during an electrical arc.

2.2 **Arc Flash Analysis –** A mathematical determination of the energy released by an electric arc and the distance from the source that a flash hazard exists. The process for an Arc Flash Analysis is defined in National Fire Protection Act 70E of the National Electric Code and Canadian Standards Association Z462.

2.3 **Arc Rating** – The maximum incident energy resistance demonstrated by a material prior to breakdown or at the onset of a second-degree skin burn (expressed in cal/cm2).

2.4 **Circuit Protective Device –** A load-rated switch, circuit breaker, or other device specifically designed as a disconnecting means for opening, reversing, or closing of live circuits.

2.5 **Energized Electrical Equipment –** Electrically connected to or having a source of voltage.

2.6 **Flash Hazard –** A dangerous situation associated with the release of energy caused by an electric arc.

2.7 **Ground Fault Circuit Interrupter (GFCI) –** An electrical device that protects the users of all devices connected to it from electrical shock. The GFCI is part of the circuit or device in use and continuously measures the current in that circuit. If a leakage of current is detected, as in the case of an electrical short circuit, the circuit is opened at the GFCI and current cannot flow beyond the GFCI.

2.8 **Licensed Electrician –** A person who possesses the local licenses and certifications to work on electrical circuitry, panels or equipment if full compliance with local legislation.

2.9 **Portable Electric Equipment –** Cord- and plug-connected equipment and extension cords.

2.10 **Qualified Persons** – Individuals who have specific and documented training and has demonstrated skills and knowledge in the construction and operation of electric equipment and installations to avoid the hazards of working on or near energized electrical equipment. Qualified Persons shall have been specifically permitted to near exposed energized and parts. Even an experienced electrician is unqualified unless he or she knows the particular equipment and has received specific safety training on the potential hazards involved.

2.11 **Shock Hazard –** A dangerous situation associated with the possible release of energy caused by contact or approach to live parts**.**

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-202-PR1 Competent Person Designation

3.3 S3AM-208-PR1 Personal Protective Equipment

3.4 S3AM-209-PR1 Risk Asssessment & Management

3.5 S3AM-218-PR1 Permit to Work

3.6 S3AM-305-PR1 Hand & Power Tools

3.7 S3AM-322-PR1 Overhead Lines

3.8 S3AM-325-PR1 Lockout Tagout

3.9 S3AM-410-PR1 Hazardous Energy Control

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager / Supervisor**

- Approve all Energized Electrical Work Permits.
- Confirm that all projects under their direct control or authority have a written SH&E Plan prepared for the activity.
- Confirm communication with client / owner of hazards presented by the work conducted by AECOM and controls measures in place.
- Provide technical guidance in support of this procedure.
- Confirming employees are informed of and comply with the provisions of this procedure.
- Supporting employees in the reporting of incidents per *S3AM-004-PR1 Incident Reporting, Notifications & Investigations,* including the entry of the incident into the on-line incident management system (e.g. IndustrySafe).

4.1.2 **SH&E Manager**

- Provide technical guidance and support to the Manager or Supervisor.
- Assist the Manager or Supervisor in compliance with the requirements of this procedure.
- Assist in the incident investigation and review process

4.1.3 **Employees**

- Comply with requirements of this procedure.
- Stop work if workers, other than Qualified Persons, are exposed to live electrical systems at unknown voltages or potentials greater than 50 volts.
- Only open electrical panels only if they are a Qualified Person.
- Employees designated as a Qualified Person, conduct work on or near energized electrical equipment in accordance with applicable training and jurisdictional requirements.
- Employees designated as a competent person in relation to the Assured Equipment Grounding Conductor Program, administer testing and recording in accordance with jurisdictional requirements.
- Immediately report incidents per *S3AM-004-PR1 Incident Reporting, Notifications & Investigations*, including the entry of the incident into the on-line incident management system (e.g., IndustrySafe).

4.2 Training

4.2.1 Employees who have potential exposures to electrical hazards shall be trained in and be familiar with the electrical safety-related work practices required by the applicable regulations. Refer to the *S3AM-003-PR1 SH&E Training* for specific required training.

4.2.2 Employees shall have reviewed and acknowledged the applicable SH&E plan specific to the project or location.

4.2.3 Refer to *S3AM-302-ATT1 Live Electrical Work* for qualifications if working on or near exposed electric conductors or circuit parts that can be energized.

4.3 General Requirements

4.3.1 Electrical equipment installed to provide electric power and light at worksites (both temporary and permanent) shall contain markings durable to the expected environment to inform workers of the equipment's:

- Manufacturer, trademark, or party responsible for the equipment.
- Voltage, current, or wattage.
- Any other ratings as necessary.
- Equipment / installations not appropriately marked shall not be used.

4.3.2 Electrical outlets utilized to supply power for electrical equipment during field operations shall be of the three-wire grounding type. They should be tested for correct polarity and adequacy of the ground with a circuit analyzer. If it is determined that the outlet is incorrectly wired or inadequately grounded, it must not be used until serviced by a licensed electrician.

4.3.3 GFCI devices will be in place between the equipment and power source for all temporary circuits unless protected by an assured equipment grounding program as defined in this procedure (i.e., circuits that are not part of a permanently installed facility electrical system, such as on a construction site or temporary field installation).

4.3.4 Unqualified personnel are not permitted to work on electrical equipment unless it has been de-energized, verified as being free of hazardous energy and locked and tagged out in accordance with *S3AM-325-PR1 Lockout Tagout*.

- Electrical equipment that has been de-energized but not locked and tagged out shall be treated as energized.

4.3.5 After a circuit is de-energized by a circuit protective device, the circuit may not be repeatedly manually reenergized until it has been determined that the equipment and circuit can be safely energized.

4.3.6 Temporary or permanent light fixtures that present a shock or burn hazard shall be guarded.

4.3.7 Confirm power switches are properly labeled to identify what they control, unless this is clearly confirmed through switch proximity or location. Electric conductors shall be protected from damage.

4.4 Classified Locations

Electrical equipment and wiring may be installed in locations where any of the following may be present: flammable vapors, liquids, or gases; combustible dusts or fibers; or a concentration or quantity of flammable or combustible material. Below is a list of each type of location and the associated hazards.

4.4.1 Class I Locations

Class I locations are those in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures. Class I locations include the following:

A. Class I, Division 1 location is a location:

1. In which ignitable concentrations of flammable gases or vapors may exist under normal operating conditions; or
2. In which ignitable concentrations of such gases or vapors may exist frequently because of repair or maintenance operations or because of leakage; or

3. In which breakdown or faulty operation of equipment or processes might release ignitable concentrations of flammable gases or vapors, and might also cause simultaneous failure of electric equipment.

B. Class I, Division 2 location is a location:

1. In which volatile flammable liquids or flammable gases are handled, processed, or used, but in which the hazardous liquids, vapors, or gases will normally be confined within closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown of such containers or systems, or in case of abnormal operation of equipment; or

2. In which ignitable concentrations of gases or vapors are normally prevented by positive mechanical ventilation, and which might become hazardous through failure or abnormal operations of the ventilating equipment; or

3. That is adjacent to a Class I, Division 1 location, and to which ignitable concentrations of gases or vapors might occasionally be communicated unless such communication is prevented by adequate positive-pressure ventilation from a source of clean air, and effective safeguards against ventilation failure are provided.

4.4.2 Class II Locations

Class II locations are those that are hazardous because of the presence of combustible dust. Class II locations include the following:

A. Class II, Division 1 location is a location:

1. In which combustible dust is or may be in suspension in the air under normal operating conditions, in quantities sufficient to produce explosive or ignitable mixtures; or

2. There mechanical failure or abnormal operation of machinery or equipment might cause such explosive or ignitable mixtures to be produced, and might also provide a source of ignition through simultaneous failure of electric equipment, operation of protection devices, or from other causes, or

3. In which combustible dusts of an electrically conductive nature may be present.

B. B. Class II, Division 2 location is a location in which:

1. Combustible dust will not normally be in suspension in the air in quantities sufficient to produce explosive or ignitable mixtures, and dust accumulations are normally insufficient to interfere with the normal operation of electrical equipment or other apparatus; or

2. Dust may be in suspension in the air as a result of infrequent malfunction of handling or processing equipment, and dust accumulations resulting therefrom may be ignitable by abnormal operation or failure of electrical equipment or other apparatus.

4.4.3 Class III Locations

Class III locations are those that are hazardous because of the presence of easily ignitable fibers or flyings but in which such fibers or flyings are not likely to be in suspension in the air in quantities sufficient to produce ignitable mixtures. Class III locations include the following:

A. Class III, Division 1 location is a location in which easily ignitable fibers or materials producing combustible flyings are handled, manufactured, or used.

B. Class III, Division 2 location is a location in which easily ignitable fibers are stored or handled, except in process of manufacture.

4.5 Distribution System Setup

4.5.1 Under no circumstances shall electrical lines be routed through doorways, hatches, windows, or other openings.

4.5.2 Electric lines crossing work areas, personnel, or vehicular traffic areas shall be either fastened securely overhead (at a height that provides safe clearance for work operations), or protected by a cover capable of withstanding the imposed loads without creating a trip hazard.

4.5.3 Circuit breakers shall be labeled to indicate their use.

4.5.4 All circuit breaker panels shall have no openings or uncovered knockouts and shall be kept covered when not in use.

4.5.5 All live parts of electrical equipment operating at 50 volts or more shall be properly guarded against accidental contact.

4.5.6 Extension Cord Use

- Extension cords and electrical connections on handheld and other power tools will be inspected prior to use for cuts, kinks, frayed wires, etc. If any deficiency is noted, the equipment will be tagged “OUT OF SERVICE” and removed from service. Manufacturer-installed insulated electrical cords will not be repaired except by a licensed electrician.
- Extension cords are not to be placed across aisles, through doors, through holes in a wall, or in areas where the cord may be damaged or create a tripping hazard.
- Extension cord sets for use in field operations should be of the three-wire grounding type and will be rated for the intended load.
- Use of extension cords is allowed only for temporary installations not to exceed 90 days.
- “Daisy chaining” or connecting a series of extension cords together is not permitted.
- Extension cords shall be provided with a plug cap that is either molded to the cord or equipped with a cord clamp to prevent strain on the terminal screws.
- Extension cords shall not be fastened with staples or otherwise hung in a manner that could damage the outer jacket or insulation.
- Ground fault circuit interrupters shall be used or, if permitted by legislation, an “assured equipment grounding conductor program” is to be established for all nonpermanent wiring needed for construction purposes or when working outdoors, in wet or moist areas or elsewhere as required by legislation.

4.5.7 Temporary Lights/Task Lights

- A temporary light shall not be suspended by the cord unless the cord and light are designed for suspension.
- Temporary lights shall be equipped with bulb protectors unless they are installed at least 7 or more feet overhead.

4.6 Working on or Near Energized Parts

4.6.1 Working on or near energized parts covers either potential direct physical contact or contact by means of tools or equipment and working close enough to the energized part to draw an arc.

4.6.2 Any work on exposed, live electrical systems above 50 volts shall be conducted by a licensed electrician who is a Qualified Person.

4.6.3 Refer to *S3AM-302-ATT1 Live Electrical Work*.

4.6.4 Prior to performing any work near exposed, energized systems, the Qualified Person shall:

- Confirm with the Licensed Electrician that it is safe to do so.
- Perform a Shock Hazard Analysis.
- Perform an Arc Flash Analysis.
- Establish emergency contacts.

- Complete and have approved the Energized Electrical Work Permit. Refer also to *S3AM-218-PR1 Permit to Work* for additional guidance related to Safe Work Permits.
- Have all required personal protective equipment (PPE), insulated tools, and test equipment tested and ready to use.
- Know and understand the procedures to be followed.
- Ensure that adequate lighting and clearance space is available.
- Remove all conductive clothing and jewelry.

4.6.5 Working Near Overhead Power Lines

- Personnel working in the vicinity of overhead power lines, either on the ground or elevated, shall comply with *S3AM-322-PR1 Overhead Lines.*
- All workers and equipment including cranes and drill rigs shall maintain a clearance distance of at least 50 feet (15.24m meters) from overhead power lines unless a detailed assessment has been completed demonstrating that a smaller clearance distance provides protection.

4.7 Grounding

4.7.1 “Ground fault protection” is required on construction sites. To provide this protection, either “ground fault circuit interrupters” (GFCI) are to be used with temporary receptacles, or if permitted by legislation an “assured equipment grounding conductor program” is to be established in which plug-connected electrical equipment, extension cords, and temporary receptacles are tested on a periodic basis.

4.7.2 Ground Fault Circuit Interrupters

- A GFCI is an electrical device that is designed to prevent electrocution from electrical leakage. It is designed to measure the difference in amperage between the “hot” wire and the “neutral” wire in a circuit. Under ideal conditions, the amperage should be the same in both wires. If there is electrical leakage (a ground-fault), the amperages will be different. If the difference is more than a predetermined amount, the GFCI “trips” and stops the flow of electricity.
- GFCIs may trip from many causes including but not limited to:
    - Electrical leakage in the tool from internal defects, damaged insulation or from normal leakage in long runs of cords.
    - Moisture in the air or cords lying in water or on moist dirt.
    - Too many tools on one GFCI circuit.
    - Faulty wiring of the GFCI into the circuit.
    - Defective GFCI.
    - Any such tripping will require the problem to be corrected before the protected circuit can be re-set.

4.7.3 All 120-volt, single-phase, 15- and 20-ampere temporary receptacles shall be protected with “approved” GFCIs. “Approved” means listed by Underwriters Laboratories.

4.7.4 There are several types of GFCIs.

- A combination circuit breaker and GFCI that is installed in place of the ordinary circuit breaker.
- A receptacle containing a built-in GFCI.
- A portable GFCI that plugs into a receptacle and allows the extension cord or tool to be plugged into the GFCI.
- A portable unit containing several GFCI protected receptacles.

4.7.5 GFCIs contain a test button and a reset button. Each GFCI needs to be tested prior to use and on a periodic basis depending upon the manufacturer's recommendations (at a minimum monthly).

4.7.6 Assured Equipment Grounding Conductor Program

- If allowed by local legislation, assured equipment grounding conductor program is to be used instead of GFCIs to provide ground fault protection, the program shall be governed by the following requirements.
- Temporary receptacles shall be electrically grounded in accordance with the temporary wiring requirements of the National Electrical Code (United States)/Canadian Electrical Code.
- Extension cords shall be three-wire cords containing an equipment grounding conductor (ground wire).
- Electrical equipment that is plugged into a receptacle or extension cord (portable electrical tools, bench grinders, electric heaters, etc.) shall have a ground wire properly attached to the non-current-carrying metal parts of the equipment. (Double-insulated tools have no ground wire and are therefore exempt from these testing and recording requirements but still need to be inspected for defects.)
- The Manager or Supervisor is required to designate one or more competent persons to administer this testing and recording program. Refer to S3AM-202-PR1 Competent Person Designation.
- Periodic testing of all plug connected equipment, all extension cords, and all temporary receptacles is to be conducted at the following times:
    - Before a new item (equipment, cord, or receptacle) is put into use.
    - After any repairs to the item.
    - After any incident in which the item may have been damaged.
    - Within three months of the last test. (An exception is allowed in the Standard in which extension cords, and temporary receptacles, which are fixed in place and are not exposed to damage, may be tested every months months.)
- The purpose of the test is to determine the following:
    - Temporary receptacles—to be sure that the receptacle is grounded.
    - Extension Cords—to be sure that the ground wire is connected to the proper terminal at each end and that the ground wire is continuous throughout the length of the cord.
    - Plug Connected Equipment—to be sure that the ground wire is connected to the proper terminal and to the non-current carrying metal parts of the equipment and that the ground wire is continuous from the equipment to the plug.
- The tests may be conducted using the following instruments:
    - A receptacle tester may be used to test receptacles and to test extension cords when plugged into a receptacle.
    - A continuity tester, or a volt-ohm meter, may be used to test equipment and to test extension cords when not plugged into a receptacle.
- Records must be kept to show which items have passed the test and when the test was conducted. These records may be either written inspection logs, a color-coding system using colored tape attached to the item, or some other effective means.
- Color coding shall be used in the following manner:
    - After a plug-connected piece of equipment or an extension cord has been inspected and passed the test, colored tape is to be placed around the cord near the plug. After a temporary receptacle has passed the test, colored tape is to be placed on the cover plate.

- Any set of colors may be used, with the exception of white, black, or silver.
- If there has been no overall site requirements established by the general contractor, use the following colors for the test periods.

January, February, March	Red
April, May, June	Blue
July, August, September	Orange
October, November, December	Green

- The tests administered every three months are to begin on the first working day of each quarter. Testing and color coding are to be continued until all items covered by this program have been tested. The test administered every six months, for those receptacles and extension cords needing only semi-annual testing, are to be color coded using the quarterly color current at the time of the semi-annual test.
- A visual inspection of plug-connected equipment, extension cords, and temporary receptacles is to be made by the user before each use. The purpose of the visual inspection is to look for damage or defects that could affect the safe use of the item. (Exception: extension cords and temporary receptacles that are fixed in place and not exposed to damage are not required to be given a daily visual inspection, but it is a good idea to do the daily visual inspection anyway.)
- Equipment, cords, or receptacles showing damage or defects that could affect its safe operation are not to be used. This applies not only to the visual inspection before each use but also applies to any evidence of damage observed any time during use. Damaged items are to be taken out of service and are not to be used until properly repaired and retested.
- Equipment covered by this program is not to be used until the equipment has been tested and color coded according to the requirements of this program.
- A copy of this program is to be kept at the worksite.

4.8 PPE/Work Practices

4.8.1 PPE requirements shall be determined based on the results of each of the following: Task Hazard Analysis, Shock Hazard Analysis, and Arc Flash Analysis. Refer to the *S3AM-208-PR1 Personal Protective Equipment* and *S3AM-302-ATT1 Live Electrical Work*.

4.8.2 PPE

2 – Required PPE (range based on maximum voltage)	
50 to 240 volts	• **Eye/Face: Safety glasses with side shields or goggles and Arc-Flash Face Shield *or* Arc-Flash Suit Hood (4 cal/cm^2)** • **Body: Flame-Retardant long-sleeved shirt/pants or coverall (4 cal/cm^2)** • **Hand: Electrical Hazard (EH) gloves (Class 00 with leather protectors)** • **Foot: EH-rated footwear** • **Head/Ears: Class E hard hat, hearing protection (ear canal inserts)** • **Tools: ANSI/CSA-approved, voltage-rated**
Above 240 to 480 volts	• **Eye/Face: Safety glasses with side shields or goggles and Arc-Flash Face Shield and Sock Hood (8 cal/cm^2) *or* Arc-Flash Suit Hood (8 cal/cm^2)** • **Body: Flame-Retardant long-sleeved shirt/pants or coverall (8 cal/cm^2)** • **Hand: EH gloves (Class 00 with leather protectors)** • **Foot: EH-rated footwear** • **Head/Ears: Class E Hard hat, hearing protection (ear canal inserts** • **Tools: ANSI/CSA-approved, voltage-rated**

480 to 600 volts	• **Eye/Face: Safety glasses with side shields or goggles and Arc-Flash Suit Hood (8 cal/cm^2)** • **Body: Flame-Retardant long-sleeved shirt/pants or coverall (8 cal/cm^2)** • **Hand: EH gloves (Class 0 or higher with leather protectors)** • **Foot: EH-rated footwear (carbon fiber recommended)** • **Head/Ears: Class E Hard hat, hearing protection (ear canal inserts)** • **Tools: ANSI/CSA-approved, voltage-rated**

4.9 Portable Electrical Equipment

4.9.1 Refer to *S3AM-305-PR1 Hand & Power Tools*.

5.0 Records

5.1 The Shock Hazard Analysis and the Arc Flash Analysis forms shall be retained in the project file.

5.2 The completed *S3AM-302-FM1 Energized Electrical Work Permit* or equivalent shall be retained in the project file.

6.0 Attachments

6.1 S3AM-302-FM1 Energized Electrical Work Permit

6.2 S3AM-302-FM2 Electrical Hazard Checklist

6.3 S3AM-302-ATT1 Live Electrical Work

6.4 S3AM-302-ATT2 Generator Safety

Live Electrical Work

1.0 Purpose

1.1 The purpose of this attachment to *S3AM-302-PR1 Electrical Safety* is to confirm that all live electrical work conducted under the control of AECOM personnel is carried out in accordance with legislation and recognized best practices in order to provide adequate protection to workers from potential arc flash and / or electrical shock.

2.0 Definitions

2.1 **Arc Rating** – The maximum incident energy resistance demonstrated by a material prior to breakdown or at the onset of a second-degree skin burn (expressed in cal / cm2).

2.2 **Flash Hazard** – A dangerous situation associated with the release of energy caused by an electric arc.

2.3 **Energized Electrical Equipment** – Electrically connected to or having a source of voltage.

2.4 **Shock Hazard** – A dangerous situation associated with the possible release of energy caused by contact or approach to live parts.

3.0 Responsibilities

3.1 **Manager**

3.1.1 Be familiar with all precautions and Federal and State / Provincial regulations and Best Practices.

3.1.2 Provide training on this Work Instruction to Qualified Persons covering:

- Nature and control of known shock and arc flash hazards.
- Means of eliminating and controlling shock and arc flash hazards.
- Special electrical personal protective equipment (PPE) requirements (task specific).
- Procedure for reporting any deviations to this Work Instruction.

3.1.3 Confirm employees are provided with safe access to the work area.

3.1.4 Control access to energized electrical equipment with potential of shock or arc flash to Qualified Persons only.

3.1.5 Confirm availability of proper tools for the operation and maintenance of electrical equipment.

3.1.6 Proper identification and guarding of potentially hazardous electrical equipment.

3.1.7 Providing available electrical one-line diagrams.

3.1.8 Confirm proper housekeeping around energized electrical equipment at all times.

3.1.9 Provide proper working conditions, including adequate lighting, to facilitate work in a safe environment.

3.1.10 Provide proper supervision of employees.

3.1.11 Maintaining a list of authorized electrical supervisor, Qualified Person(s), and attendant.

3.1.12 Implementation an ongoing evaluation of this Best Management Practice.

3.1.13 Terminate the work and cancel the permit when live work has been completed or any new electrical hazard arises.

3.1.14 Verify that communication modes are available and have been tested.

3.1.15 Remove unauthorized individuals who enter or who attempt to enter the approach boundaries during live work.

3.1.16 Confirm that live work remains consistent with terms of the live work permit and that acceptable working conditions are maintained.

3.1.17 Withdraw the live work permit and stop all work if unsafe conditions are reported during any live work (e.g. sparking, smoldering etc.). Do not permit work on that equipment until the cause of any unsafe condition is thoroughly investigated and the live work procedure has been reviewed to prevent reoccurrence.

3.2 **Authorized Electrical Attendant**

3.2.1 Practice all precautions and Federal and State / Provincial regulations and Best Practices.

3.2.2 Understand the hazards that may be faced during live work, including the potential for arc flash, shock hazard, and other related hazards.

3.2.3 Be aware of the potential of arc flash or shock possible to the Qualified Persons.

3.2.4 Maintain an accurate count of Qualified Persons working near the live equipment or inside approach boundaries.

3.2.5 Remain near the approach boundary until relieved by another authorized electrical attendant.

3.2.6 Communicate with Qualified Persons as necessary to confirm maintenance of safe conditions at all times.

3.2.7 Monitor activities inside and outside the approach zone to determine if it is safe for the worker to continue to remain in the approach zone. Order the Qualified Persons to stop live work under any of the following conditions:

- The attendant detects a problem;
- The attendant detects the signs of short-circuiting, such as electrical sparking, smoldering, or any other abnormality;
- The attendant detects a situation outside the approach zone that could endanger the worker; and
- If the attendant cannot effectively and safely perform all assigned duties.

3.2.8 Perform no other duties that might interfere with the attendant's primary duty to monitor and protect the Qualified Persons.

3.3 **Qualified Persons (Authorized Electrical Worker)**

3.3.1 Perform all work in accordance with Federal and State / Provincial regulations, AECOM policies and procedures, and this work instruction.

3.3.2 Be continuously alert, focused, and aware of the hazards of performing the task.

3.3.3 Understand AECOM Safety, Health and Environmental policies and standards as well as site-specific electrical safe work practices.

3.3.4 Examine and understand all the documents provided by AECOM and manufacturers, including all specific hazards, advisories, cautions, etc.

3.3.5 Be knowledgeable of the use and selection of the proper tools to safely perform the electrical task safely.

3.3.6 Complete a Safe Work Plan prior to the start of a task and during work, if conditions change.

3.3.7 Maintain good housekeeping around work areas. Remove all debris, materials, etc., at the completion of tasks.

3.3.8 Report any hazardous (uncontrolled) conditions to AECOM's authorized supervisor.

3.3.9 Understand the hazards that may be faced during live work, including arc flash, shock, or other electrical hazards.

3.3.10 Properly inspect prior to use, and properly use required PPE and electrical tools as specified in this work instruction and the applicable SH&E Plan.

3.3.11 Communicate with the authorized electrical attendant as necessary.

3.3.12 Alert the attendant whenever any abnormality occurs (e.g., sparking, minor shock, burning smell, etc.) or symptoms of unsafe conditions are observed.

3.3.13 Stop all work and exit from the approach zone whenever:

- An order to evacuate is given by the authorized electrical attendant or the authorized supervisor; or
- When the worker observes any warning sign or symptom of short circuiting or a dangerous situation; or
- When the supervisor gives an order to stop work.

4.0 Multi-employer Live Electrical Work Coordination

4.1 AECOM will:

- Inform the client / owner / controlling authority, or if applicable, the host employer, of hazards presented by the work conducted by AECOM, hazards identified during the course of work not previously identified, and measures in place to control hazards identified by AECOM, client / owner or host employer.
- Inform the contractor that the workplace contains shock and / or arc flash potential and that live work is allowed only through compliance with a live work permit program meeting the requirements of the applicable Federal and State / Provincial legislation.
- Appraise the contractor of the elements of the work, including the hazards identified and all past experiences with the live work that make the live work hazardous.
- Appraise the contractor of any precautions or procedures that have been implemented for the protection of employees in the approach zone where contractor personnel will be working.
- Prior to work commencing, coordinate live work operations with the contractor when both AECOM employees and contractor employees will be working in or near approach zone, so that employees of AECOM and the contractor do not endanger each other.
- Debrief the contractor at the conclusion of the live work operations.

4.2 **Contractor Requirements** – In addition to complying with the live work permit requirements, each contractor who is retained to perform live electrical work will:

- Obtain any available information regarding live work from the Manager.
- Coordinate live work operations with the Manager when both AECOM personnel and contractor personnel will be jointly working in or near the approach zone.
- Practice work in accordance with Federal and State / Provincial regulations and industry best practices.
- Inform AECOM's Manager of the live work permit that the contractor will be using and of any hazards confronted or created during live work, either through debriefing or during live work.

5.0 Required Minimum Qualifications

5.1 All electrical work including instrumentation, installations, maintenance, troubleshooting, calibration, operation of stringing equipment, and operation of breakers will only be conducted by qualified, trained, and skilled personnel (this includes AECOM personnel and contractors / subcontractors). These personnel will

meet all qualification requirements mandated by the Federal / State / Provincial regulations as well as applicable electrical associations and trade bodies (e.g., NFPA 70E – refresher training in safety related practices and any changes to the NFPA standard shall be completed at intervals not exceeding three years).

5.2 When permitted by regulatory requirements and as applicable to the work conducted, unauthorized workers may perform specific tasks associated with electrical work (e.g., operating stringing equipment) while under the supervision of a qualified person / authorized electrical worker and according to established procedures).

5.3 The Manager, in consultation with the Safety, Health and Environment (SH&E) Department, will determine the minimum qualifications requirements for any work with the potential for arc flash.

6.0 Working on or Near Electrical Conductors of Circuit Parts

6.1 Safe work practices shall be used to safeguard employees from injury when working on or near exposed electric conductors or circuit parts that can be energized.

- Live Parts – Safe Work Conditions: Live parts to which an employee might be exposed shall be put into an electrically safe work condition before an employee works on or near them.
- Live Parts – Unsafe Work Conditions: Only qualified persons shall be permitted to work on electrical conductors or circuit parts that have not been put into electrically safe conditions.

6.2 Working on or near exposed electrical conductors OR circuit parts that are, or might become, energized – Prior to working on or near exposed electrical conductors and circuit parts operating at 50 volts or more, lockout / tagout devices shall be applied in accordance with AECOM and site-specific policies. Temporary grounding / bonding of the lines or equipment shall be conducted in accordance with regulatory requirements and in a manner that will prevent employee exposure to hazardous differences in electric potential.

6.3 Electrical Hazard Analysis – If the live parts operating at 50 volts or more are not placed in electrically safe condition, other safety-related work practices shall be used to protect employees who might be exposed to electrical hazards. Safe work practices mentioned below shall be established before any person approaches exposed live parts within limited approach boundary:

6.3.1 Shock Hazard Analysis – A shock hazard analysis shall determine the voltage to which personnel will be exposed, boundary requirements, and the PPE necessary in order to minimize the possibility of electrical shock.

6.3.2 Flash Hazard Analysis – A flash hazard analysis shall be done in order to protect personnel from the possibility of being injured by an arc flash. The analysis shall determine the flash protection boundary and the PPE that people within the flash protection boundary shall use.

7.0 Shock Hazard Analysis and Approach Boundaries

7.1 A comprehensive Shock Hazard Analysis Survey is the method used to:

7.1.1 Systematically analyze shock hazards,

7.1.2 Identify approach boundaries, and

7.1.3 Identify appropriate PPE.

7.2 Before permitting live work on electrical equipment, each project site having electrical equipment operating at more than 50 volts is required to conduct a Shock Hazard Analysis Survey. Upon completion of the survey, the applicable electrical areas / spaces will be labeled in accordance with survey results. As applicable, temporary barriers, or barricades, shall be installed when access to opened enclosures containing exposed energized electrical equipment is not controlled by authorized personnel.

7.3 Shock hazard analysis for individual equipment is not required if a facility-wide shock hazard analysis has been conducted and if conditions (including labels and signage) are maintained at all times.

NOTE: Only authorized personnel are allowed to work within the approach boundaries.

7.4 No qualified person shall approach or take any conductive object closer to exposed live parts operating at 50 volts or more than the restricted approach boundary set forth in National Fire Protection Act (NFPA) 70-E.

7.5 In the absence of a facility-wide survey, a Shock Hazard Analysis (including the identification of approach boundaries) shall be conducted (see Appendix A-1 of this procedure) for all electrical equipment operating at over 50 volts.

7.6 Results of both facility-wide as well as individual Shock Hazard Analysis Survey shall be made available to all authorized employees, including Qualified Persons and Authorized Attendants. Additionally, any recommendations given by the survey generated from the survey shall be reviewed by the Manager and shall be addressed in a timely manner.

8.0 Arc Flash Hazard Analysis and Approach Boundaries

8.1 Arc flash safety requirements apply to all electrical equipment operating at 50 volts or more.

8.2 A comprehensive Arc Flash Hazard Analysis Survey is the method used to:

8.2.1 Systematically analyze the potential for arc flash,

8.2.2 Identify the limits of the approach, and

8.2.3 Identify appropriate PPE (refer to appendix A-2).

8.3 Prior to performing any work on energized electrical systems, an Arc Flash Hazard Analysis (including the identification of approach boundaries) will be conducted and documented by a qualified person, and reviewed with affected personnel.

8.4 Once a comprehensive facility Arc Flash Hazard Analysis Survey has been conducted and electrical work areas / spaces are labeled in accordance with survey results, an individual Arc Flash Hazard Analysis is not required, provided that qualified personnel confirm that the conditions, as indicated on the labels and signs, are maintained.

NOTE: Only authorized personnel are allowed to work within the limits of approach.

8.5 Reviews of the Arc Flash Hazard Analysis shall be undertaken by a qualified person as appropriate (e.g., when changes are made to the electrical system, minimum every 5 years to confirm accuracy of labelling, etc.)

8.6 Please refer to NFPA 70-E for details.

9.0 Required PPE Categorized by Exposure

9.1 Employees shall be provided specialized PPE appropriate to the voltage that may be encountered.

9.2 The following specialized PPE requirements will be used while working on energized electrical systems. PPE appropriate to the voltage that may be encountered:

9.2.1 As prescribed by the shock hazard analysis and arc flash analysis; or

9.2.2 As identified in the location or project specific SH&E Plan.

9.3 All PPE (e.g. eye protection, flame resistant and arc rated clothing, insulated gloves, leather covers, etc.) shall be visually inspected prior to issue, prior to each use, according to manufacturer specifications, and if suspected of damage.

9.4 Damaged or defective PPE shall be immediately removed from service.

10.0 Required Tools and Equipment

10.1 Employees shall be provided tools and testing or protective equipment approved to the applicable standard (ANSI / ASTM / CSA) for the relevant voltage rating to be used when working on energized electrical systems.

10.2 All tools and testing or protective equipment (e.g. sleeves, blankets, hot sticks, etc.) shall be visually inspected and tested prior to use, and as appropriate, according to regulatory requirements (e.g., as per NFPA 70E sleeves / blankets every 12 months, gloves every 6 months, etc.), according to manufacturer's specifications, specific to task (e.g., testing for absence of voltage, equipment function must be verified using a known voltage source before and after absence of voltage test), and if suspected of damage (e.g., after an incident), to confirm that the protection systems associated with the tool or equipment are not damaged or impaired and that diagnostic meters and tools are configured properly.

10.3 Tested equipment shall be marked in a manner to identify either the most current test date or the next date testing is due.

10.4 Any tool or testing or protective equipment suspected of being compromised will be immediately taken out of service and will be tagged for disposal.

11.0 Work on Energized Electrical Systems

11.1 Electrical testing device's voltage shall be certified and operated in accordance with manufacturer's specifications and according to approved procedures appropriate to the electrical systems being tested.

11.2 High-voltage testing (in laboratories, shops, and substations, and in the field and on electric transmission and distribution lines and equipment) shall be conducted according to approved procedures appropriate to the electrical system and according to applicable regulatory requirements.

11.3 When systems are considered energized, appropriate procedures shall be established to protect workers from hazardous differences in electric potential (e.g., the use of adequate jumpers when working on a neutral conductor, neutral bus or skywire [cutting, splicing, repairing, etc.]).

11.4 All electrical maintenance or troubleshooting will be done on de-energized circuits, to the extent practical. Work on energized circuits can only be done under special circumstances using a "Live Work Permit" issued by an authorized electrical supervisor. This permit takes into consideration the voltage levels, known electrical hazards, communication requirements, insulated tool requirements, and need for watch persons, etc. The following procedure will be observed for a live work permit:

11.4.1 The person requesting the work (Qualified Person) will complete the permit and will retain the original with him or her during the work. Copy of the permit will be displayed at a prominent location in the control room as a notice that live work has been authorized in certain part of the plant / project.

11.4.2 Permit will be reviewed for correctness, proper safety precautions, and adequacy of controls by the authorized electrical supervisor. Consideration must also be given to any specific jurisdictional requirements (e.g., Ontario – equipment protection through the use of Hold-Off tags restricting device operation to previously agreed limits). After satisfying all safety requirements, an authorized electrical supervisor will sign the permit and will give the original copy to the Qualified Person.

11.4.3 Upon work completion, the Qualified Person will note any observation on the permit and will return the original to the authorized supervisor.

11.4.4 Authorized supervisor will keep both copies of the permit as a controlled record for a period of 12 months.

11.5 The following conditions will be met for live electrical work:

11.5.1 If a qualified person is working in the vicinity of live electrical line, including overhead lines, whether in an elevated position or on the ground, the person may not approach or take any conductive object without an approved insulating handle closer to exposed energized parts than shown in the below table (or as specified by the applicable jurisdiction) unless:

- The qualified person is insulated from the energized part (gloves, with sleeves if necessary, rated for the voltage involved are considered to be insulation of the person from the energized part on which work is performed), or

- The energized part is insulated both from all other conductive objects at a different potential and from the person, or
- The person is insulated from all conductive objects at a potential different from that of the energized part.

APPROACH DISTANCES FOR QUALIFIED EMPLOYEES - ALTERNATING CURRENT

300V and less	Avoid Contact
Over 300V, not over 750V	1 ft. 0 in. (30.5 cm)
Over 750V, not over 2kV	1 ft. 6 in. (46 cm)
Over 2kV, not over 15kV	2 ft. 0 in. (61 cm)
Over 15kV, not over 37kV	3 ft. 0 in. (91 cm)
Over 37kV, not over 87.5kV	3 ft. 6 in. (107 cm)
Over 87.5kV, not over 121kV	4 ft. 0 in. (122 cm)
Over 121kV, not over 140kV	4 ft. 6 in. (137 cm)

11.5.2 If any equipment or instrumentation is to be disabled while other related components or systems are still functioning, the Live Work Permit should record how process safety of the remaining systems will be maintained.

11.5.3 All electrical and instrumentation work conducted will be recorded in the applicable MCC log. The documentation will include a reference to the permit number where appropriate.

11.5.4 The worker will inform the operations supervisor that he or she intends to de-energize a circuit. He or she will also inform the operations supervisor when the work is complete and that the system can be returned to service.

11.6 See *S3AM-302-FM1 Energized Electrical Work Permit* for a suggested template for a “Live Work Permit.”

12.0 Lockout / Tagout Policy and Procedures

12.1 All equipment will be locked out prior to any work commencing in accordance with AECOM’s procedure *S3AM-325-PR1 Lockout Tagout* and applicable site-specific lockout / tagout program.

13.0 Troubleshooting Procedure

13.1 Guards and safety interlocks are not to be removed or bypassed except when testing or troubleshooting.

13.2 The troubleshooting of electrical equipment often requires working with live circuits. Where possible, work will be done on de-energized circuits following the relevant AECOM and site-specific lockout / tagout policy. However, troubleshooting may require limited work on live circuits; if such work is required it will be done using the “Live Work Permit” .Troubleshooting procedures specific to the site or electrical equipment shall be established and followed for the protection of all involved workers.

14.0 Housekeeping

14.1 All areas containing electrical equipment will:

14.1.1 Be maintained and kept clean.

14.1.2 Be well illuminated.

14.1.3 Not be used for storage of supplies.

14.1.4 Not be used for the storage of any flammable materials.

14.1.5 Be assessed for safety hazards.

14.1.6 Be suitably ventilated to control dust, temperature, and humidity.

15.0 Communication

15.1 Notifications will be provided to appropriate parties (e.g., owner, client, electrical equipment controlling authority) as necessary and required (e.g., Ontario – notification of controlling authority of duration and location of work on or in proximity of equipment energized above 750 V).

15.2 Personnel working in or around equipment with electrical hazards will employ a suitable means of communication to confirm their safety.

15.3 The means of communication may include:

15.3.1 Authorized attendant (required for ALL live work conducted on 600 volts and above).

15.3.2 Permits.

15.3.3 Two-way radios.

16.0 Signage and Labels

16.1 Motor Control Center (MCC), Electric Contact Relay (ECR) battery rooms, and electrical panels are required to have the following labeling to identify arc flash and shock hazards. The information on the label will include:

16.1.1 Flash Hazard Boundary (Arc Flash Current);

16.1.2 Flash Hazard at 18 inches in cal / cm^2 or joules;

16.1.3 PPE Category;

16.1.4 Shock Hazards;

16.1.5 Limited Approach Boundaries;

16.1.6 Restricted Approach;

16.1.7 Prohibited Approach; and

16.1.8 Log book to record all electrically related activities.

16.2 All doorways to buildings and enclosures containing energized electrical equipment will be signed to indicate that:

16.2.1 Access is restricted to authorized personnel only; and

16.2.2 Electrical hazards exist beyond this (boundary, door, etc.).

APPENDIX A-1

NFPA 70-E Approach Boundaries to Live Parts for Shock Protection

(All dimensions are distance from live part to employee.)

Nominal Voltage Range (Phase to Phase)	**Limited Approach Boundary** / **Exposed Moveable Conductor**	**Exposed Fixed Circuit Parts**	**Restricted Approach Boundary; includes inadvertent movement adder**	**Prohibited Approach Boundary**
Up to 50 Volts	Not Specified	Not Specified	Not Specified	Not Specified
50-300	10 feet	3.5 feet	Avoid Contact	Avoid Contact
300-750	10 feet	3.5 feet	1 feet	1 inch

More than 750 volts	Consult a Master Electrician, High Voltage Electrician or other authorized electrician.

APPENDIX A-2

NFPA 70-E Protective Clothing and Personal Protective Equipment (PPE) Matrix

Protective Clothing Characteristics

PPE Category	Clothing Description (Typical number of clothing layers is given in parentheses)	Required Minimum Arc Rating of PPE [(J/cm2 (cal/cm2)]
1	Arc rated shirt and pants or coverall (1)	16.74 (4)
2	Cotton underwear – conventional short sleeve and brief / shorts, plus FR shirt and FR pants (1 or 2)	33.47 (8)
3	Cotton underwear plus FR shirt and FR pants plus FR coverall, or cotton underwear plus two FR coveralls (2 or 3)	104.6 (25)
4	Cotton underwear plus FR shirt and FR pants plus multilayer flash suit (3 or more)	167.36 (40)

NOTE:

Arc rating: Arc rating is defined in Article 100 and can be either ATPV or E_{BT}.

ATPV: ATPV is defined in ASTM F 1959-99 as the incident energy on a fabric or material that results in sufficient heat transfer through the fabric or material to cause the onset of a second-degree burn based on the Stoll curve.

E_{BT}: E_{BT} is defined in ASTM F 1959-99 as the average of the five highest incident energy exposure values below the Stoll curve where the specimens do not exhibit breakopen. E_{BT} is reported when ATPV cannot be measured due to FR fabric breakopen.

When working on energized electrical systems, workers shall wear insulated rubber gloves of the class rated to the voltage to which the worker may be exposed. In addition to live electrical work, the following are examples of potential exposures that would require rubber glove use:

- controlling poles by using tools and/or ropes in the proximity of energized overhead lines.
- stringing or sagging conductors in the proximity of energized overhead lines.
- workers on the ground are guiding lifted materials where the "Safe Limits of Approach" for non-insulated booms cannot be maintained.

Americas

Generator Safety

S3AM-302-ATT2

1.0 Objective/Overview

1.1 Portable generators should be used with extreme caution in order to prevent personal injury. When using a portable generator it is important to follow the manufacturer's instructions to avoid injuring someone or damaging your generator or appliances.

1.2 Allow only trained, authorized personnel to operate the generator. Along with training, consider the need for other safety measures, including proper maintenance of equipment and personal protective equipment (PPE). It is important to note that muscle strains are the most common injury associated with portable generators.

2.0 Safe Operating Guidelines

2.1 Follow manufacturer's recommended operating instructions; every generator is not the same.

2.2 Routinely inspect all areas where generators are positioned for hazards to the operation of the generator (e.g., site congestion, rainy or wet conditions, etc.), and hazards the operation of the generator can present (e.g., flammable materials, exhaust proximity to an occupied confined space / HVAC fresh air intake, etc.).

2.3 Verify ongoing inspection and scheduled maintenance for owned and leased equipment.

2.4 Maintain adequate ventilation. Generators emit carbon monoxide (CO). Never operate a generator in an enclosed building without proper ventilation.

2.5 Turn the generator off and allow it to cool prior to re-fueling. Gasoline and its vapors may ignite if they come into contact with hot components or an electrical spark.

2.6 Gasoline shall only be stored and dispensed to portable generators using a UL/FM approved safety can of 5 gallons (19 liters) or less. No smoking or open flames within 50 feet (15.24 meters) of the refueling area is permitted.

2.7 To avoid a shock, make sure that your hands are dry and that you are standing in a dry place whenever you operate the generator.

2.8 Turn off equipment and lights supplied by the generator until it is running.

2.9 Use the right extension cord. Use only UL-listed, three-prong extension cords. Be sure the extension cord is the proper size (wire-gauge) to handle the electric load that will be plugged into it.

2.10 Ensure the generator is properly grounded prior to each use.

2.11 Position generators away from flammable / combustible materials.

2.12 When long term power is needed, evaluate alternative sources for sustainability.

2.13 Using a portable generator to tie into the wiring of an existing structure shall be done only by a licensed electrician.

2.13.1 Potential Hazards include:

- Lifting, carrying, and pulling starter cords;
- Burns from contact with the hot muffler or engine;
- Shocks/electrocution;
- Noise exposure; and
- Inhaling exhaust gases, CO.

2.13.2 Training Requirements include:

- Review of applicable standard operating procedures;
- Back Injury Prevention;
- Demonstrated knowledge on the use of a generator; and
- Review of manufacturers operating guidelines.

2.13.3 Level D PPE include:

- Leather Gloves;
- Hearing Protection; and
- FR or non-synthetic clothing when a fire hazard is present.

2.13.4 Other Safety Tips include:

- Have a Class A:B:C fire extinguisher readily available at all times.

2.14

AECOM

Americas

Energized Electrical Work Permit

S3AM-302-FM1

PART 1: To be completed by the requester

Job Work Number

(1) Description of circuit/equipment/job location:

(2) Description of work to be done:

(3) Justification of why the circuit/equipment cannot be de-energized or the work cannot be deferred until the next scheduled outage:

Requester/Title _____ Date/Time _____

PART II: To be completed by the electrically qualified persons *doing* the work:

	Check When Complete
(1) Detailed job description procedure to be used in performing the above detailed work:	☐
(2) Description of the Safe Work Practices to be employed:	☐
(3) Results of the Shock Hazard Analysis:	☐
(4) Determination of Shock Protection Boundaries:	☐
(5) Results of Flash Hazard Analysis:	☐
(6) Determination of the Flash Protection Boundary:	☐
(7) Necessary personal protective equipment to safely perform the job:	☐
(8) Means employed to restrict the access of unqualified persons from the work area:	☐
(9) Evidence of completion of a Job Briefing including discussion of any job-related hazards:	☐

(10) Do you agree that the above described work can be done safely? ☐ Yes ☐ No
(If *no*, return to requester)

Electrically Qualified Persons(s) _____ Date/Time _____ Electrically Qualified Persons(s) _____ Date/Time _____

Electrically Qualified Persons(s) _____ Date/Time _____ Electrically Qualified Persons(s) _____ Date/Time _____

Authorized by: _____ _____
Authorized Supervisor Date/Time

Notes:

Americas

Electrical Hazard Checklist

S3AM-302-FM2

Location Inspected: _____ **Job No.:** _____

Date Inspected: _____ **Name of Inspector:** _____

Check Yes, No, or NA for Not Applicable. If a comment is required, circle the number, and see Page 3.

Electrical Equipment Markings

1.	Disconnecting switches and circuit breakers are labeled to indicate their use or equipment served.	☐ Yes	☐ No	☐ NA
2.	The necessary voltage, wattage, or current ratings are labeled.	☐ Yes	☐ No	☐ NA
3.	Circuit breakers clearly indicate whether they are in the “on” or “off” position.	☐ Yes	☐ No	☐ NA
4.	Markings for arc flash hazards per NFPA 70E or CSA Z462 are on each panel or distribution box.	☐ Yes	☐ No	☐ NA

Electrical Grounding

5.	Extension cords used have a grounding conductor (third plug).	☐ Yes	☐ No	☐ NA
6.	Ground-fault circuit interrupters (GFCIs) are installed as required or an assured equipment grounding conductor program is in use.	☐ Yes	☐ No	☐ NA
7.	Portable electrical tools and equipment are of the double-insulated type.	☐ Yes	☐ No	☐ NA
8.	GFCIs open the circuit on a ground current of 5 milliamperes or greater, and are equipped with an integral push-button test circuit.	☐ Yes	☐ No	☐ NA
9.	GFCIs are installed in accordance with the manufacturer’s instructions.	☐ Yes	☐ No	☐ NA
10.	Ground-fault circuit interrupters are tested prior to initial use, and periodically thereafter.	☐ Yes	☐ No	☐ NA
11.	Grounding rods are at least 5/8-inch- (0.625-centimeter)-diameter steel or iron rods, ½-inch- (1.27-centimeter)-diameter copper-clad steel, or ¾-inch-(1.9-centimeter)-diameter galvanized pipe.	☐ Yes	☐ No	☐ NA
12.	Grounding rods are in 8-foot (2.5-meter) lengths and driven to full depth.	☐ Yes	☐ No	☐ NA
13.	The paths from circuits, equipment, structures, and conduits or enclosures to ground are:			
	• Permanent and continuous.	☐ Yes	☐ No	☐ NA
	• Have ample carrying capacity for current likely to be imposed on them.	☐ Yes	☐ No	☐ NA
	• Have resistance sufficiently low to permit current flow to operate circuit breakers and similar overcurrent devices on the circuit.	☐ Yes	☐ No	☐ NA
14.	Driven ground-rod electrodes have a resistance to ground not exceeding 25 ohms.	☐ Yes	☐ No	☐ NA
15.	Upon installation of the driven ground-rod electrode, the resistance was tested and recorded.	☐ Yes	☐ No	☐ NA
16.	Conductors, used for bonding and grounding circuits, are of sufficient size to carry the anticipated current.	☐ Yes	☐ No	☐ NA
17.	Grounds are not removed until all work is complete.	☐ Yes	☐ No	☐ NA

Electrical Guarding

18.	Switches, receptacles, etc., are provided with tight-fitting covers or plates.	☐ Yes	☐ No	☐ NA
19.	All energized parts of electrical circuits and equipment are guarded against accidental contact by approved cabinets or enclosure.	☐ Yes	☐ No	☐ NA
20.	All unused openings (including conduit knockouts) in electrical enclosures and fittings are enclosed with appropriate covers, plugs, or plates.	☐ Yes	☐ No	☐ NA
21.	Ground-fault circuit interrupters are installed on each temporary 15- or 20-ampere, 120-volt AC circuit at locations where construction, demolition, modifications, alterations, or excavations are being performed.	☐ Yes	☐ No	☐ NA
22.	Electrical switches and breakers (rated 440 volts or greater) are provided with a means for locking them out in the OFF position.	☐ Yes	☐ No	☐ NA

Electrical Systems

23.	Circuit breakers accessible to personnel are protected from physical damage, and located away from ignitable material.	☐ Yes	☐ No	☐ NA
24.	Weatherproof cabinets or enclosures are used when switches, circuit breakers, fuse panels, and motor controllers are in a wet or outside location.	☐ Yes	☐ No	☐ NA
25.	A readily accessible, manually operated switch is provided for each incoming service or supply circuit rated less than 5 kilovolts.	☐ Yes	☐ No	☐ NA
26.	Electrical raceways and enclosures are securely fastened in place.	☐ Yes	☐ No	☐ NA
27.	Overcurrent protection is provided for fuses or circuit breakers for each feeder and branch circuit.	☐ Yes	☐ No	☐ NA
28.	Insulting fuse tongs or extractors are used when removing fuses from circuits rated 50 to 600 volts.	☐ Yes	☐ No	☐ NA
29.	Fuse cabinets have close-fitting doors that can be locked.	☐ Yes	☐ No	☐ NA

Extension Cords

30.	Clamps or other securing means are provided on flexible cords or cables at plug receptacles, tools, equipment, etc., and the cord jackets are securely held in place.	☐ Yes	☐ No	☐ NA
31.	Flexible cords and cables are free of splices and taps.	☐ Yes	☐ No	☐ NA
32.	Only 3-wire grounded-type extension cords, designated for hard or extra-hard service, are used.	☐ Yes	☐ No	☐ NA
33.	Extension cords are listed by Underwriters Laboratories, Inc.	☐ Yes	☐ No	☐ NA
34.	Extension cords are checked for damage before use.	☐ Yes	☐ No	☐ NA
35.	The rated load on extension cords is not exceeded.	☐ Yes	☐ No	☐ NA
36.	Extension cords are of adequate length and multiple cords are not connected together.	☐ Yes	☐ No	☐ NA
36.	Extension cords are not fastened with staples, hung by nails, or suspended by wire.	☐ Yes	☐ No	☐ NA

Temporary Wiring

37.	Temporary wiring is guarded, buried, or isolated by elevation to prevent accidental contact by workers and equipment.	☐ Yes	☐ No	☐ NA
38.	A vertical clearance above walkways for temporary wiring is not less than 10 feet (3 meters) from circuits carrying 600 volts or less.	☐ Yes	☐ No	☐ NA

39.	All exposed temporary wiring is supported on insulators.	☐ Yes	☐ No	☐ NA
40.	Temporary wiring is protected from accidental damage.	☐ Yes	☐ No	☐ NA
41.	Nonconductive lamp sockets and connections are permanently molded to the conductor insulation on lighting strings.	☐ Yes	☐ No	☐ NA
42.	Lighting strings have lamp guards.	☐ Yes	☐ No	☐ NA
43.	Broken or defective bulbs are replaced promptly.	☐ Yes	☐ No	☐ NA
44.	Lights are protected from accidental contact or breakage.	☐ Yes	☐ No	☐ NA
45.	Wiring installed in conduit is equipped with bushings at outlets and terminals.	☐ Yes	☐ No	☐ NA
46.	Receptacles are of the grounding type, and electrically connected to the equipment-grounding conductor.	☐ Yes	☐ No	☐ NA
	Worker Practices			
47.	Personnel performing electrical repairs are properly trained and qualified.	☐ Yes	☐ No	☐ NA
48.	Workers de-energize, ground, or guard electrical circuits before working in close proximity to them.	☐ Yes	☐ No	☐ NA
49.	Workers consider all electrical systems as live until verified de-energized and grounded.	☐ Yes	☐ No	☐ NA
50.	Proper lockout/tag-out procedures are used for de-energizing electric circuits.	☐ Yes	☐ No	☐ NA
51.	Arc flash protection protocols are in place for work on circuits of 50 volts or higher.	☐ Yes	☐ No	☐ NA
	Equipment			
52.	Only fiberglass or wood ladders are used when working near electrical hazards.	☐ Yes	☐ No	☐ NA
53.	Insulation mats are placed on floors and on frames of equipment when working on energized equipment.	☐ Yes	☐ No	☐ NA
54.	Only voltage-rated tools are used on or near live circuits. Voltage rating is appropriate for the work being performed.	☐ Yes	☐ No	☐ NA
	Personal Protective Equipment			
55.	Rubber matting, blankets, insulated sleeves, and rubber gloves are inspected before use.	☐ Yes	☐ No	☐ NA
56.	Workers use safety glasses and face shields during work activities where there is a reasonable probability of eye injury (and on systems with 50 or more volts).	☐ Yes	☐ No	☐ NA
57.	Workers wear arc flash protective clothing, hoods, face shields, and gloves when working on live circuits greater than 50 volts (per NFPA 70E or CSA Z462).	☐ Yes	☐ No	☐ NA

COMMENTS:

Americas

Flammable & Combustible Liquids

S3AM-126-PR1

1.0 Purpose and Scope

1.1 This procedure applies to all AECOM Americas based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

1.2 The purpose of this procedure is to provide information regarding the proper storage, handling, and work practices associated with flammable and combustible liquids.

2.0 Terms and Definitions

2.1 **Flashpoint** – The minimum temperature at which a liquid gives off vapor within a test vessel in sufficient concentration to form an ignitable mixture with air near the surface of the liquid. The flash point is normally an indication of susceptibility to ignition.

2.2 **Safety can** – Safety can: an approved container, of not more than 5 gallons (18.9 liters) capacity, having a spring-closing lid and spout cover and so designed that it will safely relieve internal pressure when subjected to fire exposure

3.0 References

3.1 S3AM-011-PR1 Fire Protection

3.2 S3AM-115-PR1 Hazardous Material Communication

3.3 S3AM-208-PR1 Personal Protective Equipment

3.4 S3AM-332-PR1 Hot Work

4.0 Procedure

4.1 Implementation of this standard is the responsibility of the AECOM manager directing activities of the facility, site, or project location.

4.2 Appoint a Responsible Person who will:

4.2.1 Determine if flammable or combustible liquids are stored on-site. Flammable liquids and combustible liquids are classified or categorized differently by jurisdiction. As a general definition that aligns the different classifications or categories, flammable and combustible liquids are any liquid that has a flashpoint at or below 199.4°F (93°C). Refer to *S3AM-126-ATT1 Flammable & Combustible Liquid Classifications.*

4.2.2 Inspect storage areas monthly.

4.2.3 Monitor the quantity of flammable and combustible liquids on the site.

4.2.4 Review work practices involving flammable and combustible liquids.

4.2.5 Safety data sheets (SDS) for all hazardous substances, including flammable and combustible liquids, must be provided by vendors or subcontractors, and maintained on site. For more information, see *S3AM-115-PR1 Hazardous Material Communication*.

4.2.6 Furnish portable fire extinguishers in such quantities, sizes, and types as needed for the special hazards of operation and storage. For more information, see *S3AM-011-PR1 Fire Protection*.

4.3 Control flammable and combustible liquids entering the site by ordering only those materials and quantities needed to complete a job.

4.4 Cylinders – General Use & Transport

4.4.1 Open and close cylinder valves using the appropriate tools provided by the cylinder supplier.

4.4.2 Remove regulators and replace caps before transporting cylinders.

4.4.3 Do not roll or drop cylinders. Transport cylinders in a vertical and secured positing using a cylinder basket, cylinder cart or other secure equipment.

4.4.4 Do not use cylinders if the cap cannot be removed by hand. Do not use tools (e.g., hammer) to loosen caps. Tag the cylinder "Do Not Use" and return the cylinder to a designated storage area to be returned to the cylinder supplier.

4.5 General Storage

4.5.1 Use only approved containers, tanks, and pumping equipment for storage and handling of flammable and combustible liquids. Use approved (UL or FM) metal safety cans (with spring-closing lid and spout cover, and optional flash-arresting screen) for the handling and use of flammable liquids in 1- to 5-gallon (3.8- to 18.9-liter) quantities. For additional information, see *S3AM-126-ATT1 Flammable & Combustible Liquid Classifications.*

4.5.2 Place all rags, waste, etc., soiled by combustible or flammable materials in tightly closed metal containers for daily disposal.

4.5.3 Take precautions, including proper ventilation, to prevent the ignition of flammable vapors. Sources of ignition include, but are not limited to: open flames; lightning; smoking; cutting and welding; hot surfaces; frictional heat; static, electrical, and mechanical sparks; spontaneous ignition; chemical reactions; and radiant heat.

4.5.4 Require approved personal protective equipment for all persons handling flammable or combustible liquids, as outlined by the appropriate SDS.

4.5.5 Train employees exposed to flammable or combustible liquids in the hazards of these materials; in their safe handling, use and disposal; in their protection from ignition sources; in the type, use, and placement of containers and cabinets; in the location of fire extinguishers; in the protection against toxic vapors; and in the procedures to follow in case of spill or fire.

4.6 Indoor Storage

4.6.1 Keep indoor storage of flammable liquids to a minimum. Do not store more than 25 gallons (95 liters) of flammable or combustible liquids outside of an approved storage cabinet.

4.6.2 Do not store flammable or combustible liquids in areas used for exits, stairways, or normally used for the safe passage of people.

4.6.3 Do not store more than of flammable and combustible liquids in a single flammable storage cabinet in excess of that specified by the applicable jurisdiction. Refer to *S3AM-126-ATT1 Flammable & Combustible Liquid Classifications*.

4.6.4 Do not store oxidizers and other reactive chemicals in flammable cabinets.

4.6.5 Up to three cabinets may be grouped together. Groups of cabinets must be separated by at least 100 feet (30.5 meters).

4.6.6 Conspicuously label all cabinets "Flammable — Keep Fire Away."

4.6.7 Indoor flammable liquid storage rooms must conform to NFPA codes, including requirements regarding fire ratings, spill containment, maximum capacity, electrical classifications, and ventilation requirements.

4.7 Outside Storage

4.7.1 Maintain a minimum of 20 feet (6.1 meters) between flammable and combustible storage areas and any building.

4.7.2 Maintain a minimum distance of 50 feet (15.2 meters) between flammable and combustible storage areas and hot work activities. Refer to *S3AM-332-PR1 Hot Work*.

4.7.3 Grade the storage area in a manner to divert possible spills away from buildings, and curb or dike so as to contain entire volume of liquids and prevent spills from impacting soil or groundwater.

4.7.4 Keep the entire storage site free from accumulation of unnecessary combustible materials. Closely cut weeds and grass, and establish a regularly scheduled cleanup procedure for the whole area.

4.7.5 Maintain adequate access-ways to open-yard storage to allow access by fire-fighting equipment. Equipment that is blocking access must be manned at all times so that it may be readily moved if necessary.

4.8 Labeling and Signage

4.8.1 Post a "NO SMOKING OR OPEN FLAME" sign in all areas where flammable and combustible materials are stored, handled, and processed.

4.8.2 Require all containers and cylinders to be labeled with the contents and adequate hazard warnings per *S3AM-115-PR1 Hazardous Materials Communication.*

4.9 Use of Materials on Site

4.9.1 Use flammable and combustible liquids in a manner that is consistent with the label and SDS for the product.

4.9.2 Use only those amounts of materials needed for the job. Transfer of these materials to ready-to-use containers is encouraged.

4.9.3 Use personal protective equipment stated on the product label and SDS. For additional information, consult *S3AM-208-PR1 Personal Protective Equipment*.

4.9.4 For dispensing and/or fueling operations, ensure:

- Signs are posted with instructions on the dispensing or fueling process.
- Operators have been trained in the dispensing or fueling process.
- Equipment being refueled has the engine shut off prior to fueling.
- Smoking is prohibited in vehicle and equipment refueling areas.
- Adequate protection is provided to safeguard dispensing pumps from physical damage from vehicles.
- Dispensing nozzles have auto shut-off or self-closing valves and provisions for containing or controlling over-spillage.
- Heating equipment installed in lubrication or service areas, where flammable liquids are dispensed, is of an approved type, and where feasible, is installed at least 8 feet (2.4 meters) above the floor.
- Tank cars and trucks being loaded or unloaded and flammable storage tanks and systems are properly bonded and grounded.
- Transfer of flammable liquids from one container to another is done only when containers are electrically interconnected (bonded).
- Proper PPE is required during the dispensing or fueling process. For additional information, see *S3AM-208-PR1 Personal Protective Equipment*; and *S3AM-126-FM1 Flammable and Combustibles Inspection.*

4.10 Spill Control

4.10.1 Have a written spill response plan in place before materials are stored or used on site.

4.10.2 Have spill clean-up materials in the vicinity of the materials being stored.

4.10.3 Clean up or respond to spills promptly according to applicable local, state, and federal regulations. This may require notification of authorities if a Reportable Quantity (RQ) is exceeded.

4.10.4 Move leaking cylinder to a ventilated area away from ignition sources. Do not attempt to repair a leaking cylinder. Contact the cylinder supplier to determine proper response methods.

4.11 Disposal

4.11.1 Keep solvent waste and flammable liquids in fire-resistant, covered containers until they are removed from the worksite.

4.11.2 Do not place flammable or combustible waste in municipal garbage.

4.11.3 Do not pour flammable or combustible liquids down drains or onto the ground.

4.11.4 Dispose of flammable or combustible hazardous materials with a licensed and approved hazardous material disposal company.

4.12 Inspection

4.12.1 Inspect flammable and combustible storage and use areas on a monthly basis.

4.12.2 Use *S3AM-126-FM1 Flammable & Combustibles Inspection* or equivalent to inspect the storage areas.

4.12.3 Inspect cylinder regulators, gauges, valves, hoses and connections before use. Any damaged equipment shall be tagged out-of-service.

4.13 Training

4.13.1 Require that hazard communication training includes specific hazard information for the flammables and combustibles used.

4.14 Compliance

4.14.1 Review and comply with country and client/customer-specific requirements.

5.0 Records

5.1 The following information will be maintained in the project file.

5.1.1 Location of the SDS inventory.

5.1.2 Completed *S3AM-126-FM1 Flammable & Combustibles Inspection* or equivalent.

6.0 Attachments

6.1 S3AM-126-ATT1 Flammable & Combustible Liquid Classifications

6.2 S3AM-126-FM1 Flammable & Combustibles Inspection

Americas

Flammable & Combustible Liquid Classifications

S3AM-126-ATT1

NFPA 30, WHMIS Canada

Flammable Liquid	Flash Point	Boiling Point
Class 1A	< 73° F (22.8°C)	< 100° F (37.8°C)
Class 1B	< 73° F (22.8°C)	> 100° F (37.8°C)
Class 1C	> 73° F (22.8°C) < 100° F (37.8°C)	
Combustible Liquid		
Class 2	> 100° F (37.8°C) < 140° F (60°C)	
Class 3A	≥ 140° F (60°C) <200°F (93.3°C)	
Class 3B	>200°F (93.3°C)	

Do not store more than 25 gallons (95 liters) of Class IA liquids in containers of" flammable or combustible liquids outside of an approved storage cabinet.

Do not store more than 120 gallons (454 liters) of Class IB, IC, II, or III liquids in containers of flammable and combustible liquids in a single flammable storage cabinet.

Maximum Allowable Size of Containers and Portable Tanks

Container Type	Flammable Liquids			Combustible Liquids	
	Class 1A	Class 1B	Class 1C	Class II	Class III
Glass or approved plastic	1 pint (0.5 liter)	1 quart (1 liter)	1.3 gallons (5 liters)	1.3 gallons (5 liters)	1.3 gallons (5 liters)
Metal (other than drums) or approved plastic	1.3 gallons (5 liters)	5.3 gallons (20 liters)	5.3 gallons (20 liters)	5.3 gallons (20 liters)	5.3 gallons (20 liters)
Safety cans	2.6 gallons (10 liters)	5.3 gallons (20 liters)	5.3 gallons (20 liters)	5.3 gallons (20 liters)	5.3 gallons (20 liters)
Metal drums (DOT specifications)	119 gallons (450 liters)	119 gallons (450 liters)	119 gallons (450 liters)	119 gallons (450 liters))	119 gallons (450 liters)
Approved metal portable tanks	793 gallons (3,002 liters)	793 gallons (3,002 liters)	793 gallons (3,002 liters)	793 gallons (3,002 liters)	793 gallons (3,00 liters)

OSHA 29 CFR 1910.106

Flammable Liquid	Flash Point	Boiling Point
Category 1	< 73.4° F (23°C)	< 95° F (35°C)
Category 2	< 73.4° F (23°C)	> 95° F (35°C)
Category 3*	> 73.4° F (23°C) < 140° F (60°C)	
Category 4**	>140°F (60°C) ≤199.4°F (37.8°C)	

* When a Category 3 liquid with a flashpoint at or above 100 °F (37.8 °C) is heated for use to within 30 °F (16.7 °C) of its flashpoint, it shall be handled in accordance with the requirements for a Category 3 liquid with a flashpoint below 100 °F (37.8 °C).

** When a Category 4 flammable liquid is heated for use to within 30 °F (16.7 °C) of its flashpoint, it shall be handled in accordance with the requirements for a Category 3 liquid with a flashpoint at or above 100 °F (37.8 °C).

Maximum Allowable Size of Containers and Portable Tanks

Container Type	Flammable Liquids			
	Category 1	Category 2	Category 3	Category 4
Glass or approved plastic	1 pint (0.5 liter)	1 quart (1 liter)	1 gallons (3.8 liters)	1 gallons (3.8 liters)
Metal (other than drums) or approved plastic	1 gallons (3.8 liters)	5 gallons (18.9 liters)	5 gallons (18.9 liters)	5 gallons (18.9 liters)
Safety cans	2 gallons (7.6 liters)	5 gallons (18.9 liters)	5 gallons (18.9 liters)	5 gallons (18.9 liters)
Metal drums (DOT specifications)	60 gallons (227 liters)	60 gallons (227 liters)	60 gallons (227 liters)	60 gallons (227 liters)
Approved metal portable tanks	660 gallons (2498 liters)	660 gallons (2498 liters)	660 gallons (2498 liters)	660 gallons (2498liters)

Not more than 60 gallons (227 liters) of Category 1, 2 and/or 3 flammable liquids or 120 gallons (454 liters) of Category 4 flammable liquids shall be stored in any one storage cabinet. Not more than three such cabinets may be located in a single storage area. Quantities in excess of this shall be stored in an inside storage room.

Storage of containers (not more than 60 gallons [227 liters] each) shall not exceed 1,100 gallons (4164 liters) in any one pile or area. Piles or groups of containers shall be separated by a 5-foot clearance. Piles or groups of containers shall not be nearer than 20 feet (6.1 meters) to a building.

Americas

Hand & Power Tools

S3AM-305-PR1

1.0 Purpose and Scope

1.1 This procedure provides the AECOM requirements for all manually operated hand and power tools and associated use, handling and storage. These requirements apply to tools provided by AECOM for employee use as well as tools provided by employees for use on AECOM work sites.

1.2 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 None

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-118-PR1 Hearing Conservation

3.3 S3AM-208-PR1 Personal Protective Equipment

3.4 S3AM-302-PR1 Electrical Safety

3.5 S3AM-325-PR1 Lockout Tagout

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Managers/Supervisors**

- Ensure that all aspects of this procedure are followed and adhered to on all AECOM projects, sites and locations.
- If a specific tool is not included in the work instructions related to this procedure, appropriate guidelines shall be established prior to work associated with that tool, including following manufacturer's recommendations.
- Ensure compliance with applicable client requirements and restrictions regarding hand or power tools.

4.1.2 **Safety, Health and Environment (SH&E) Manager**

- Provide technical guidance and support as to this procedure and associated work instructions.

4.1.3 **Employees**

- Work only with tools for which they are appropriately trained and familiar with.
- Follow manufacturer's recommendations for its use and never modify the equipment without first obtaining authorization from the manufacturer.
- Comply with applicable client requirements and restrictions regarding hand or power tools.

4.2 Requirements

4.2.1 Always conduct a task hazard assessment (THA) prior to work commencing and include the identified hazards associated with the anticipated tool use.

4.2.2 No employee shall use any hand or power tool, unless they are familiar with the use and operation of the equipment or have received specific instruction on its use and operation.

4.2.3 All tools will be used for which they were designed and in accordance with manufacturer's specifications. Do not use tools for jobs they are not intended for. For example, do not use a slot screw driver as a chisel, pry bar, wedge or punch or wrenches as hammers.

4.2.4 Use approved tools only. Never modify or use makeshift tools.

4.2.5 Do not apply excessive force or pressure on tools unless permitted by the manufacturer's specifications. This includes additional force by hammering with body weight, foot or other tools.

4.2.6 Keep surfaces and handles clean and free of excess oil and grease to prevent slipping.

4.2.7 Do not carry sharp tools (e.g. knife, chisel, screwdriver, etc.) in pockets; this practice may cause puncture wounds.

4.2.8 All tools shall be properly maintained. Clean, dry, lubricate and repair tools as applicable, and return to a suitable toolbox, room, rack, or other storage area upon completion of a job.

4.2.9 Ensure proper ergonomics principles are observed when using hand and power tools, such as but not limited to:

- Avoid static and awkward positions when possible.
    - Move at intervals to reduce muscle fatigue.
    - Consider tools with a trigger strip, rather than a trigger button. This strip will allow the exertion of more force over a greater area of the hand that, in turn, will reduce muscle fatigue
- Do not apply excessive force or pressure on tools.
- If possible use tools with comfortable grips that are designed to allow the wrist to stay straight. Avoid using a bent wrist.
- Choose hand tools that have a centre of gravity within or close to the handle.
- Frequently used tools that weigh more than 1 pound (0.45 kilograms) should be counter-balanced.
- Ensure proper body positioning when using a tool to prevent slips or falls in the event of unanticipated tool behaviour (slip, kickback, etc.). Avoid over-reaching.
- Pull on tools such as a wrench or pliers whenever possible. Loss of balance is more likely when pushing if the tool slips. If pushing is necessary, hold the tool with an open palm.
- Hand-arm vibration exposure is associated with the use of hand tools.
    - Reduce power to the lowest setting that can complete the job safely. This action reduces tool vibration at the source.
    - Consider the need for controls such as limiting time of use.
    - If safe to do so, adjust to a looser but stable grip, and use anti-vibration gloves.
- Use of heavy tools such as jackhammers can cause fatigue and strains. Heavy rubber grips can reduce these effects by providing a secure handhold.
- Do not increase a tool's leverage by adding sleeved additions (e.g. a pipe or snipe) to increase tool handle length.

4.2.10 Avoid placing fingers and hands in danger zones:

- Ensure hands and fingers have sufficient clearance in the event the tool slips.
- Ensure stability of the work-piece. Use work-piece holders (e.g. vise, chisel holder, etc.) whenever possible to prevent injury to hands or deflection of tool or work-piece.

- Use push sticks or guides when cutting or machining smaller material.

4.2.11 Secure tools when working from heights to prevent them from falling. Never leave tools on ladders, scaffolds, or overhead work areas when they are not in use.

4.2.12 Utilize good housekeeping practices to ensure tools do not present a tripping hazard.

4.2.13 Ensure no part of a tool extends over the edge of the bench top. Place sharp tools (e.g., saws, chisels, knives) on benches so that sharp points or edges face away from the edge.

4.2.14 When using saw blades, knives, or other tools, if possible direct the tools away from aisle areas and away from other employees working in close proximity.

4.2.15 Do not throw tools from place to place or from person to person, or drop tools from heights. Hand them, handle first, directly to other workers.

4.2.16 Use non-sparking and intrinsically safe tools in atmospheres with flammable or explosive characteristics and where highly volatile liquids, and other explosive substances are stored or used.

- Iron or steel hand tools may produce sparks that can be an ignition source around flammable substances. Where this hazard exists, spark-resistant tools made of non-ferrous materials shall be used.
- Electrical tools shall be identified as intrinsically safe.

4.2.17 If the task presents electrical hazards, worker must be competent and use the appropriate insulated tools to perform work that includes the risk of electrical shock. Cushioned grip handles do not protect against electrical shock.

4.2.18 The fluid used in hydraulic power tools must be an approved fire-resistant fluid and must retain its operating characteristics at the most extreme temperatures to which it will be exposed. The exception to fire-resistant fluid involves all hydraulic fluids used for the insulated sections of derrick trucks, aerial lifts, and hydraulic tools that are used on or around energized lines. This hydraulic fluid shall be of the insulating type.

4.2.19 All tools designed to accommodate guards must have the guard(s) in place when the tool is in use. Do not modify, remove, or disable any machine guards.

4.2.20 Do not allow loose clothing, long hair, loose jewelry, rings, and chains to be worn while working with power tools.

4.2.21 Make provisions to prevent tools from automatically restarting upon restoration of power. Refer to *S3AM-325-PR Lockout Tagout*.

4.3 Training

4.3.1 Instruction in the proper use, safe handling, and maintenance of tools will be provided to employees unfamiliar with the tool.

- Assess the employee's training needs as per *S3AM-003-PR1 SH&E Training* procedure.
- Refer to the applicable work instructions associated with this procedure for any additional training specifics.
- Training shall include applicable manufacturer's recommendations and guidelines.

4.3.2 Employees shall demonstrate knowledge and competency in the use, safe handling and maintenance of the applicable tool prior to operation.

4.4 Personal Protective Equipment (PPE)

4.4.1 Utilize basic PPE appropriate to the task; gloves, safety-toed boots, hard hats and safety glasses with side shields. Refer to *S3AM-208-PR1 Personal Protective Equipment*.

4.4.2 Ensure lockout devices (padlocks, multiple lock hasps, tags) are utilized as necessary. Refer to *S3AM-325-PR Lockout Tagout*.

4.4.3 Ensure PPE is appropriate to the work and use additional PPE as required (e.g. mono-goggles, hearing protection, respiratory protection, etc.).

- Dual eye protection is required to be worn by any employee undertaking or within 3 ½ feet (1 meter) of a task that produces projected particles or material.
- Head and face protection is recommended for employees working with pneumatic tools.
- Noise hazard is associated with pneumatic and many other tools. Working with noisy tools such as jackhammers requires proper, effective use of appropriate hearing protection.

4.4.4 Screens shall also be set up to protect nearby workers from being struck by flying fragments around chippers, riveting guns, staplers, or air drills.

4.4.5 Refer to the applicable work instructions associated with this procedure for any additional specialized PPE.

4.5 Inspections

4.5.1 All tools must be inspected prior to each use.

- Any tool that is defective or has missing parts must not be used.
- Every broken or defective tool must be tagged ‘out of service’ or ‘do not use’ and immediately removed from service.
- Tagged tools will be returned to the supervisor for repair or replacement.

4.5.2 All tools must be inspected to manufacture’s specifications and according to tool rests and guard adjustment tolerances. All tools will be inspected to ascertain that all safety devices are present and functioning properly. Refer to *S3AM-305-FM1 Hand & Power Tool Maintenance Inventory* and *S3AM-305-FM2 Hand & Power Tool Inspection Report*.

5.0 Records

5.1 None

6.0 Attachments

6.1 S3AM-305-ATT1 Chainsaw

6.2 S3AM-305-ATT2 Circular Saw

6.3 S3AM-305-ATT3 Cut Off Saw

6.4 S3AM-305-ATT4 Handheld Grinder

6.5 S3AM-305-ATT5 Impact Wrench

6.6 S3AM-305-ATT6 Nail Gun

6.7 S3AM-305-ATT7 Dustless Vacuum

6.8 S3AM-305-ATT8 Power Drill

6.9 S3AM-305-ATT9 Pressure Washer

6.10 S3AM-305-ATT10 Reciprocating Saw

6.11 S3AM-305-ATT11 Sander

6.12 S3AM-305-ATT12 Knives

6.13 S3AM-305-ATT13 Clearing & Grubbing Equipment

6.14 S3AM-305-ATT14 Pneumatic Tools

6.15 S3AM-305-ATT15 Manual Hand Tools

6.16 S3AM-305-ATT16 Small Engines

6.17 S3AM-305-ATT17 Electric & Battery Hand Tools

6.18 S3AM-305-FM1 Hand & Power Tool Maintenance Inventory

6.19 S3AM-305-FM2 Hand & Power Tool Inspection Report

Americas

Chainsaw

S3AM-305-ATT1

1.0 Objective / Overview

1.1 Available in a variety of types and capacities, chainsaws are one of the most powerful, yet dangerous cutting tools available.

1.2 Working safely with a chain saw includes proper training, good body mechanics and felling technique, well-maintained equipment, and protective clothing.

2.0 Hazards

2.1 Improper operation (kickback – sudden and violent reverse movement of the saw)

2.2 Hand/arm vibration

2.3 Noise

2.4 Flying/falling debris

2.5 Sharp, moving blade

2.6 Defective tool

3.0 Safe Operating Guidelines

3.1 Only approved operators are permitted to operate a chainsaw.

3.2 Review manufacturer's operating manual, *S3AM-305-PR1 Hand & Power Tools*, and *S3AM-305-ATT16 Small Engines* for additional guidelines.

3.3 Inspect saws prior to use and periodically during use:

- 3.3.1 A sharp chainsaw is safer than a dull one. Worn chains shall be replaced immediately.
- 3.3.2 Keep the saw clean, lubricated, and adjusted.
- 3.3.3 Inspect and test the chain brake, chain catch, throttle lock, handles and guards, all nuts and bolts, spark arrestor, and muffler and air filter.
- 3.3.4 The chain tension should be properly adjusted and the carburetor tuned. The idle must be correctly adjusted; the chain should not move when the saw is in the idle mode.
- 3.3.5 Ensure the saw is fitted with an inertia break and hand guard.
- 3.3.6 Ensure the saw is fueled with the appropriate fuel type.
- 3.3.7 Do not operate a chain saw that is damaged or improperly adjusted, or is not completely and securely assembled**.** If a chainsaw is defective, remove it from service, and tag it clearly "Out of service for repair" or "Do Not Use". Replace damaged equipment immediately – do not use defective tools "temporarily." DO NOT ATTEMPT FIELD REPAIRS.

3.4 Never "drop start" the saw (the saw is held in the air with one hand on the handlebar and the other on the pull cord) as no control is provided to prevent rotation of the saw back toward the user.

3.5 Ensure an appropriately sized fire extinguisher or fire-fighting equipment is readily available.

3.6 A chainsaw is not only dangerous to the operator but also to surrounding persons. Do not allow others in the area when chainsaws are operated.

3.7 Never operate a chain saw when fatigued.

3.8 Make sure there are no nails, wire, or other imbedded material in the material to be cut that can cause flying particles or kickback.

3.9 Keep all parts of the body away from the saw chain when the engine is running.

3.9.1 Keep the saw close to the body.

3.9.2 Bend from the knees, not the waist. Improper lifting techniques and poor posture contribute to injuries.

3.9.3 Always avoid standing on the log and making cuts with the saw between your legs; always cut with the saw to the outside of your legs.

3.9.4 Always stand to one side of the limb to be cut, never straddle it.

3.9.5 Never cut above chest height.

3.10 Determine where the tree/limb will fall prior to cutting.

3.10.1 Start cutting only after a clear escape path has been made.

3.10.2 Always ensure that personnel and equipment are not in the path of the falling tree/log, and that you have time to move away.

3.10.3 If necessary, flag/or fence off the area to prevent entry.



Blade nose strikes another object



Improper starting of bore



Top or blade nose touches bottom or side of kerf during reinsertion

3.11 Always keep in mind where the chain will go if it breaks; never position body or allow others in line with the chain.

3.12 Avoid operations that could result in kickback of the saw towards the operator.

3.13 Keep the chain out of the dirt, debris will fly, the teeth will be dulled and the chain life shortened.

3.14 Shut the saw off when carrying through brush or on slippery surfaces. The saw may be carried no more than 50 feet (15 meters) while idling.

4.0 Personal Protective Equipment

4.1 Dual eye protection – safety glasses with side shields and a face shield

4.2 Chainsaw Chaps

4.3 Wear appropriate apparel. Long hair, loose or baggy clothing, ties, or jewellery can become caught in moving parts.

4.4 Safety toe work boots

4.5 Hardhat with lateral impact protection

4.6 Gloves providing impact, abrasion, cut, tear, & puncture resistance

4.7 Hearing Protection

Americas

Circular Saw

S3AM-305-ATT2

1.0 Objective / Overview

1.1 The circular saw is used in cutting wood products (e.g. plywood, construction lumber, etc.).

1.2 Safe measures for use include proper training, good body mechanics and operating technique, well-maintained equipment, and protective equipment.



2.0 Hazards

2.1 Kickback – Sudden and violent reverse movement of the saw

2.2 Noise

2.3 Flying debris

2.4 Sharp, moving blade (severe cuts)

2.5 Defective tool

2.6 Improper operation

3.0 Safe Operating Guidelines

3.1 Review manufacturer's operating manual, *S3AM-305-PR1 Hand & Power Tools*, and *S3AM-305-ATT17 Electric & Battery Hand Tools* for additional guidelines.

3.2 Use sharp blades and ensure cracked and dull blades are removed from service. Dull blades cause binding, stalling and possible kickback.

3.3 Use the correct blade for the application and check for proper operation before each cut.

3.4 Check often to ensure that guards return to their normal position quickly. Never defeat the guard to expose the blade.

3.5 Portable circular saws having a blade greater than 2 inches (5.08 centimeters) in diameter must be equipped at all times with guards. An upper guard must cover the entire blade of the saw.

3.6 A retractable lower guard must cover the teeth of the saw, except where it makes contact with the work material. The lower guard must automatically return to the covering position when the tool is withdrawn from the work position.

3.7 Before starting a circular saw, be sure the power cord and extension cords are out of the blade path and are long enough to freely complete the cut. A sudden jerk or pulling on the cord can cause loss of control of the saw and a serious accident.

3.8 Secure the work being cut to avoid movement.

3.9 For maximum control, hold the saw firmly with both hands after securing the work piece.

3.10 Keep the upper and retracting lower blade guard and the motor free from dust.

3.11 Do not hold or force the retracting lower guard in the open position.

3.12 Do not over tighten the blade-locking nut.

3.13 Do not twist the saw to change, cut or check alignment.

3.14 Do not use a saw that vibrates or appears unsafe in any way.

3.15 Do not force the saw during cutting.

3.16 Do not cut materials without first checking for obstructions or other objects such as nails and screws.

3.17 Check frequently to be sure clamps remain secure.

3.18 Avoid cutting small pieces that can't be properly secured and material on which the saw shoe can't properly rest. Use a push stick or guide when cutting operation requires the hands of the operator to come close to the blade.

3.19 Do not overreach. Keep proper footing and balance.

3.20 When starting the saw, allow the blade to reach full speed before contacting the work piece.

3.21 Circular saws are designed for right-hand operation; left-handed operation will demand more care to operate safely.

3.22 Never place hand under or in front of the shoe or guard of the saw when operating.

3.23 Cut at the proper depth (¼ inch / 0.64 centimeters) below work surface. Set the depth of the blade prior to use, when the saw is unplugged.

4.0 Personal Protective Equipment

4.1 Wear proper apparel for the task. Long hair, loose or baggy clothing, ties, or jewelry can become caught in moving parts.

4.2 Gloves that provide cut, abrasion and impact resistance.

4.3 Kickback apron as necessary.

4.4 Safety toed boots.

4.5 Safety glasses with side shields and faceshield.

4.6 Hearing Protection.

Americas

Cut Off Saw

S3AM-305-ATT3

1.0 Objective / Overview

1.1 Cut-off saws are high-speed cutting tools and very dangerous to operate. Therefore, it is very important to review the general safety rules, training, Personal Protective Equipment and procedures for working with portable cut off saws.

1.2 Cut off saws are used in a variety of activities (i.e. concrete, piping, metal, etc.).

2.0 Hazards

2.1 Noise

2.2 Flying debris

2.3 Sharp, moving blades (severe cuts)

2.4 Ignition sources (hot engine, sparks)

2.5 Hand/arm vibration

2.6 Kickback – Sudden and violent reverse movement of the saw

3.0 Safe Operating Guidelines

3.1 Review manufacturer's operating manual, *S3AM-305-PR1 Hand & Power Tools*, and *S3AM-305-ATT17 Electric & Battery Hand Tools* or *S3AM-305-ATT16 Small Engines* for additional guidelines

3.2 In addition to inspecting the general tool prior to operation, inspect the abrasive wheel for cracks and chips and appropriate wheel type.

- 3.2.1 If cracked or chipped, replace wheel before use.
- 3.2.2 Do not use abrasive-type wheels for rough grinding.

3.3 Ensure the saw is started in accordance with manufacturer's specifications:

- 3.3.1 Start the saw on firm ground or other solid surface in an open area.
- 3.3.2 Never "drop start" the saw as in the above picture (the saw is held in the air with one hand on the handlebar and the other on the pull cord) as no control is provided to prevent rotation of the saw back toward the user.

3.4 Handling

- 3.4.1 Hold the saw firmly with two hands when the engine is running, and whenever the blade is rotating until it comes to a complete stop.
- 3.4.2 Carry the saw with engine stopped, muffler away from your body, while protecting the cutting wheel from striking the ground or other objects.

3.5 Cutting

- 3.5.1 Clear the working area.
- 3.5.2 Begin cutting at full throttle and continue at full throttle until the cut is finished.
- 3.5.3 Avoid standing in a direct line with the cutting wheel.
- 3.5.4 Use only downward pressure on the saw, as lateral pressure may cause the blade to break and shatter.

3.5.5 Do not change the direction of the cut once started, as this can also cause the blade to break and shatter.

3.5.6 Do not cut above shoulder height.

3.5.7 Avoid operating the saw if the terrain is wet and/or frozen.

3.5.8 Keep flammable and combustible materials away from saw while cutting.

3.5.9 Ensure an appropriate fire extinguisher or fire-fighting equipment is readily available.

3.6 Maintenance

3.6.1 Shut off the engine and remove the spark plug wire before adjusting or working on the saw.

4.0 Personal Protective Equipment

4.1 Safety glasses with side shields and faceshield.

4.2 Chainsaw chaps.

4.3 Safety toe work boots.

4.4 Gloves that provide cut abrasion and impact resistance.

4.5 Hearing protection: earplugs and/or earmuffs.

4.6 Respirator if required (concrete operations).

Americas

Handheld Grinder

S3AM-305-ATT4

1.0 Objective / Overview

1.1 Handheld grinders are high-speed electric- or pneumatic-powered grinding tools used to shape or cut metal, and can be dangerous to operate.

1.2 Grinders are used in a variety of activities (i.e., piping installation/repair, metal, restoring, polishing, sharpening, etc.).

2.0 Potential Hazards

2.1 Kickback – Sudden and violent reverse movement of the grinder

2.2 Electric shock

2.3 Flying debris

2.4 An improperly installed or incompatible wheel can break or explode and cause injury.

2.5 Moving parts (severe cuts)

2.6 Fire hazard from sparks igniting nearby debris or objects

2.7 Noise

2.8 Hand/arm vibration

3.0 Safe Operating Guidelines



3.1 Review manufacturer's operating manual, *S3AM-305-PR1 Hand & Power Tools*, and *S3AM-305-ATT17 Electric & Battery Hand Tools* for additional guidelines.

3.2 Inspect the tool before every use. Damaged tools must be removed from use and tagged "DO NOT USE".

3.3 Grinder guards are to be used at all times and must not be altered.



3.3.1 US requirements specify a maximum of 180° of the grinding wheel to be exposed.

3.3.2 While 120° coverage may be permissible in certain jurisdictions, guards that are greater are not to be cut down.

3.3.3 Replace damaged or defective guards immediately

3.4 Grinders must be used with an unmodified manufacturer supplied handle at all times. If removal of the handle is required the reason must be appropriately documented and approved by project / location manager and SH&E manager or designee. Client approval may also be required.

3.5 Trigger locks are not permitted. If a grinder is found with a trigger lock, the lock shall be disabled.

3.6 Never use the grinder for jobs for which it is not designed (e.g. cutting with a grinding wheel vs. cutting disc).

3.7 Grinders must be permanently marked with the manufacturer's established maximum RPM (revolutions per minute).

3.8 Inspect the disk or wheel prior to operation:

3.8.1 Wire wheels must be inspected for loose and broken wires.

3.8.2 Ensure the RPM (as posted on the wheel) is equal to or greater than that posted on the grinder, the disk / wheel is the correct size for the grinder, and the type of wheel is compatible with the material being ground or cut.

3.8.3 Wheels must be replaced as specified by the manufacturer. In the absence of specifications a wheel shall not be worn down to a size which would allow the mounting flange assembly to contact the work-piece or work-piece holding fixture.

3.8.4 Ensure the disk or wheel is checked for cracks or other damage. A ring test can be conducted on clean, dry, unmounted wheels greater than 4" (10.16 centimeters) in diameter:

- Suspend the wheel by its arbor hole;
- Use a non-metallic tool (wood, plastic) to gently tap the wheel at 45° from the vertical center line on either side of the wheel, approximately 1 to 2 inches (2.5 – 5 centimeters) from the edge;
- Rotate the wheel 45° and repeat the process until the entire wheel has been tested;
- A wheel that emits a metallic ring indicates absence of damage, whereas a dull sound means the wheel should be removed from service.

3.8.5 If cracked, chipped, or there is any other evidence of damage, remove from service and replace wheel before use.

3.9 When mounting the wheels:

3.9.1 Grinders must be unplugged before changing wheels, discs or positioning guards.

3.9.2 Follow manufacturer's specifications (e.g. stamp facing grinder, mount up, mount down, etc.)

3.9.3 Ensure that the mounting flanges are clean and the mounting blotters are used.

3.9.4 Do not over tighten the mounting nut.

3.9.5 Before grinding or cutting, run newly mounted wheels at operating speed to check for vibrations.

3.10 General Safety Provisions

3.10.1 Ensure abrasive wheels are stored according to manufacturer specifications (absence of temperature extremes and solvents, dry area protected from impact, first in first out).

3.10.2 Keep the work area clean. Do not grind near flammable and combustible materials. Sparks can ignite debris and flammable vapors. A fully charged fire extinguisher must be located nearby. Use of a fire blanket may be necessary.

3.10.3 All observers should be kept at a safe distance from the work area to ensure they are protected from flying debris / sparks. Whenever practicable, use screens or shields.

3.10.4 Always secure work with clamps or a vise, freeing both hands to operate the tool. Never clamp a handheld grinder in a vice.

3.10.5 Use grinding wheels only at their rated speed.

3.10.6 Ensure safety guard(s) is positioned properly prior to start-up.

3.10.7 Allow the grinder to come to full operating speed before beginning grinding operation.

3.10.8 Do not use the side of a grinding wheel unless the wheel is designed for side grinding.

3.10.9 Always stand to the side of the wheel, never directly behind it.

- Be sure to keep your footing and maintain proper balance. Keep hands, fingers, and other body parts from coming into contact with the revolving wheel.
- While in operation, grinder shall be held with a firm grip using both hands. One engaging the trigger, and the second holding the handle.

3.10.10 Grinding aluminum is prohibited.

3.10.11 Tools shall be maintained with care. They should be kept clean and sharp for the best performance. Follow instructions in the user's manual for lubricating and care instructions.

4.0 Personal Protective Equipment (PPE)

4.1 Please refer to *S3AM-208-PR1 Personal Protective Equipment* for further information.

4.2 Gloves providing appropriate heat, impact, abrasion, cut, tear, & puncture resistance.

4.3 Wear appropriate apparel. Long-sleeved shirts and pants are required; clothing shall be made of natural fibers. Synthetics are not permitted. Note: Long hair, loose or baggy clothing, hoodie strings, ties, or jewelry can become caught in moving parts.

4.4 Dual eye protection required - Safety glasses with sideshields and properly impact-rated face shield. Welding helmets used as a face shield shall be verified as approved by CSA / ANSI for protection against impact.

4.5 Safety toe work boots.

4.6 Hearing protection: earplugs and/or earmuffs.

4.7 Other PPE as necessary for the work site/activity (e.g., hard hat, respiratory protection).

Americas

Impact Wrench

S3AM-305-ATT5

1.0 Objective / Overview

1.1 Impact wrenches are mainly used for tire changing but that does not limit their use. They can be used in all applications when a certain amount of torque is needed to loosen or tighten nuts and bolts.

1.2 The danger comes in to play when employees try to use the wrong sockets with an air wrench. Employees using air wrenches must have a general understanding of how to use them.

2.0 Potential Hazards

2.1 Flying debris

2.2 Noise

2.3 Cuts

2.4 Hand/arm vibration

3.0 Safe Operating Guidelines

3.1 Review manufacturer's operating manual, *S3AM-305-PR1 Hand & Power Tools*, and *S3AM-305-ATT14 Pneumatic Tools* for additional guidelines.

3.2 Impact wrench sockets and accessories must be used with this tool. Do not use hand sockets and accessories.

3.3 The proper fastening torque may differ depending upon the kind or size of the bolt.

3.4 Check the torque with a torque wrench.

3.5 Connect tool to air hose of recommended size.

3.6 Never use a wire, soft pin, or nail to hold the socket onto the square spindle of the impact wrench.

3.7 If the proper retaining device on the tool is broken, the tool shall be removed from service to be repaired.

3.8 On applications where a low or critical level of torque is required, it is recommended that each fastener is impacted lightly. Then perform the final tightening with a hand torque wrench.

4.0 Personal Protective Equipment

4.1 Safety toed boots

4.2 Anti-vibration gloves with impact and abrasion and cut resistance.

4.3 Safety glasses with side shields.

4.4 Hearing protection.

Americas

Nail Gun & Stapling Tool

S3AM-305-ATT6

1.0 Objective / Overview

1.1 Nail guns and stapling tools (pneumatic power-fastening devices) are useful, but must be handled with care.

1.2 Nail guns and stapling tools have been shown to be the cause of unnecessary injuries when the design of the gun places emphasis on speed, rather than safety.

2.0 Potential Hazards

2.1 Flying debris/nails

2.2 Imbedded object

2.3 Puncture wounds

2.4 Noise

3.0 Safe Operating Guidelines

3.1 Review manufacturer's operating manual, *S3AM-305-PR1 Hand &Power Tools*, and *S3AM-305-ATT14 Pneumatic Tool* for additional guidelines.

3.2 Permit only experienced and trained persons to operate pneumatic nailing and stapling tools. Never let an inexperienced worker use a nail gun without supervised training.

3.3 Never point a nail gun or stapling tool toward the body or any other personnel.

- 3.3.1 Never rest the gun against any part of your body, or try to climb a ladder with the gun cradled against your body.
- 3.3.2 Be aware of other workers in the work area.
- 3.3.3 Be aware of what is located behind the nailing surface. Never place hands or other body parts directly behind the nailing surface.
- 3.3.4 Ensure no one is in the line of fire should an incorrectly selected fastener eject out the other side of the material.

3.4 Inspect a tool before connecting it to air supply:

- 3.4.1 Check tool safety mechanisms if applicable. Never disable a safety tip on a nail gun or stapling tool.
- 3.4.2 Tighten securely all screws and cylinder caps.
- 3.4.3 Pneumatic power-fastening devices that shoot nails, rivets, staples, or similar fasteners and operate at pressures more than 100 pounds per square inch (6,890 kPa), must be equipped with a safety interlock to keep fasteners from being ejected, unless the muzzle is pressed against the work surface.

3.5 Check correct air supply and pressure before connecting a tool.

3.6 Check that the tool is correctly and securely connected to the air supply hose and that it is in good working order, with the safety mechanism operative, before using.

3.7 Always handle a tool as if it loaded with fasteners (nails, staples, etc.). Do not carry a tool with a finger on the trigger or with the trigger depressed.

3.8 Equip tools with a work-contacting element that limits the contact area to one that is as small as practical.

3.9 Make sure that the mechanical linkage between the work-contacting element and trigger is enclosed.

3.10 Disconnect a tool from the air supply and ensure the air is completely exhausted from the tool when the tool is unattended, when loading with fasteners (nails, staples), and during cleaning or adjustment.

3.11 Before clearing a blockage, be sure that depressing the trigger exhausts all air from the tool and the tool is disconnected from the air supply.

3.12 Use only fasteners recommended by the manufacturer. Ensure fasteners are appropriate to the work surface to ensure fastener does not eject completely through the material.

3.13 Avoid nailing into knots as nail can splinter wood.

3.14 Permit only properly trained people to carry out tool maintenance.

3.15 Do not depress the trigger unless the nosepiece of tool is directed onto a safe work surface and properly aligned both vertically and horizontally with the surface

3.16 Do not overreach. Keep proper footing and balance.

3.17 Ensure the hand not holding the nail gun or stapling tool is a minimum of12 inches (30cm) away from the nosepiece of the tool.

3.18 Keep the gun properly aligned with your work both vertically and horizontally.

4.0 Personal Protective Equipment

4.1 Gloves providing appropriate protection to the task (e.g. impact, puncture, chemical, etc.).

4.2 Safety toed boots.

4.3 Use hearing protection, where required.

4.4 Wear safety glasses with side shields at all times and face shield if flying debris may be encountered.

Americas

Dustless Vacuum

S3AM-305-ATT7

1.0 Objective / Overview

1.1 Dustless decontamination system (also refered to as Pentek brand name) removes and packages surface contamination from concrete and steel structures.

1.2 The Pentek integrated suite of manually operated equipment (e.g., squirrel III, corner cutter, roto-peen, and crack chaser) is designed for the safe removal of radioactive materials, lead-based paints, polychlorinated biphenyls, pesticides, chemical residues, and other contaminated coatings.

1.3 The Pentek system incorporates a high-performance vacuum and waste packaging unit, the VAC-PAC, in conjunction with pneumatically operated equipment to remove contaminated material. Dust and debris are captured at the cutting tool surface. Supporting equipment required to operate the unit includes a 60 kilowatt generator and an air compressor (minimum 350 cubic feet capacity), as well as a drum grappler for drum handling activities.

2.0 Hazards

2.1 Noise

2.2 Vibration

2.3 Tripping

2.4 Hot surfaces (vacuum unit)

2.5 Electrical (high voltage)

2.6 Pinch

2.7 Back strain

2.8 High pressure air

3.0 Safe Operating Guidelines

3.1 Review manufacturer's operating manual, *S3AM-305-PR1 Hand &Power Tools*, and *S3AM-305-ATT14 Pneumatic Tool* for additional guidelines.

3.2 Prior to use, a pre-operation inspection must be completed to determine if the unit is in safe working condition.

3.3 The vacuum unit should be placed a minimum of 50 feet (15.2 meters) away from the work area.

3.4 Once in position to begin work, apply the brake to stabilize the unit. When raising the VAC-PAC to insert/remove a drum, do not place your body or any extremity under the VAC-PAC while it is in the raised position.

3.5 Two workers should be used to maneuver the unit into place.

3.6 A minimum 10 feet (3 meters) clearance will be established around the unit while in operation.

3.7 Workers should be aware of their position in relation to the hoses and cable to minimize tripping hazards.

3.8 A competent person will train each worker in the operation of the unit.

3.9 Maintenance in excess of preventive maintenance activities (e.g., lubrication) will be performed by manufacturer personnel ONLY. Always know where the emergency stop is located.

3.10 Operators of a motorized drum grappler must be trained in agreement with the powered industrial truck

standard. Refer to *S3AM-324-PR1 Powered Industrial Trucks*.

3.11 Review *S3AM-302-PR1 Electrical Safety* prior to refueling the electrical generator and/or compressor.

4.0 Personal Protective Equipment

4.1 Leather gloves (maintenance).

4.2 As applicable, Tyvek suit (with hood).

4.3 Anti-vibration gloves (operation).

4.4 Hearing protection (plugs or muffs).

Americas

Power Drill

S3AM-305-ATT8

1.0 Objective / Overview

1.1 Available in a variety of types and capacities, portable power drills are undoubtedly the most used power tools.

1.2 Because of their handiness and application to a wide range of jobs, drills often receive heavy use. For this reason, you will need to carefully check your drill's capacity limitations and accessory recommendations.

2.0 Hazards

2.1 Electricity

2.2 Flying debris

2.3 Rotating and sharp parts

2.4 Burns (hot bits)

2.5 Manual handling (sprains/strains - wrist)

3.0 Safe Operating Guidelines

3.1 Review manufacturer's operating manual, *S3AM-305-PR1 Hand & Power Tools*, and *S3AM-305-ATT17 Electric & Battery Hand Tools* for additional guidelines.

3.2 Always keep drill bits sharp.

3.3 Disconnect the power supply before changing or adjusting bit or attachments,

3.4 Do not use high speed steel (HSS) bits without cooling or using lubrication.

3.5 Be sure the chuck is tightly secured to the spindle. This is especially important on reversible-type drills. Tighten the bit securely as described by the owner/operators manual.

3.6 The chuck key must be removed from the chuck before starting the drill. A flying key can be an injury-inflicting missile.

3.7 Secure workpiece being drilled to prevent movement.

3.8 If the bit is long enough to pass through the material, select a shorter drill bit or provide against damage and injury.

3.8.1 Prevent other workers from accessing the area.

3.8.2 Remove or provide coverage for material that could be damaged by the drill bit.

3.9 Secure magnetic drills with a chain or rope to prevent falling. Label cord connections to prevent unplugging.

3.10 Check auxiliary handles, if part of the tool. Be sure they are securely installed.

3.11 Always use the auxiliary drill handle when provided. It gives you more control of the drill, especially if stalled conditions occur.

3.12 Grasp the drill firmly by insulated surfaces.

3.13 Always hold or brace the tool securely. Brace against stationary objects for maximum control. If drilling in a clockwise -- forward -- direction, brace the drill to prevent a counter-clockwise reaction.

3.14 Do not overreach. Always keep proper footing and balance.

3.15 Don't force a drill. Apply enough pressure to keep the drill bit cutting smoothly. If the drill slows down, relieve

the pressure. Forcing the drill can cause the motor to overheat, damage the bit and reduce operator control.

4.0 Personal Protective Equipment

4.1 Wear proper apparel for the task. Long hair, loose or baggy clothing, ties, or jewellery can become caught in moving parts.

4.2 Gloves that provide cut, abrasion and impact resistance.

4.3 Safety toed boots.

4.4 Safety glasses with side shields and face shield.

4.5 Hearing protection.

Americas

Pressure Washer

S3AM-305-ATT9

1.0 Objective / Overview

1.1 Pressure washing can be divided into three categories based on the water pressure the equipment is capable of producing:

- Ultra high pressure jetting – greater than 30,000 psi
- High pressure washing – 5,000 to 30,000 psi
- Pressure washing – less than 5,000 psi

1.2 Generally, light duty portable pressure washing equipment and car washes produce less than 5,000 psi. High pressure washing equipment is often used for such tasks as cleaning vessels and process piping. Ultra high pressure jetting is also often employed to clean vessels and to remove coatings and scaling of production equipment. If not used correctly and safely, pressure washers can be dangerous piece of work equipment.

1.3 AECOM only allows trained, authorized personnel to operate the high pressure washers. Along with training, other safety measures include: reviewing the manufacturers instructional booklet, proper maintenance of equipment, and personal protective equipment.

2.0 Hazards

2.1 Kickback – Sudden and violent reverse movement of the gun

2.2 Flying debris

2.3 Slips and trips on wet surfaces and hoses

2.4 Noise

2.5 Manual handling

2.6 Exhaust fumes/carbon monoxide (CO) in enclosed spaces

2.7 Contact with high pressure / high temperature fluids

3.0 Safe Operating Guidelines

3.1 Review manufacturer's operating manual, *S3AM-305-PR1 Hand & Power Tools*, *S3AM-305-ATT17 Electric & Battery Hand Tools* or *S3AM-305-ATT16 Small Engines* for additional guidelines.

3.2 Ensure area is properly flagged with tags identifying work being performed and hazards. Keep all unauthorized workers out of area while job in progress.

3.3 Inspect all hoses, fittings, wands, cords and hose reel for damage or defects.

3.3.1 Equipment is complete and assembled correctly (i.e. nozzle tip correctly connected to the wand and not directly to hose).

3.3.2 Ensure trigger mechanism is functioning properly.

3.3.3 Fittings are securely attached.

3.3.4 Insulated components are in place.

3.4 Check fuel connections and hoses for signs of leaks, defects or damage.

3.5 Confirm nozzle / jets are clear by turning on water, without pump pressure.

3.6 Check pressure pump oil level before use. Hold the wand firmly with the trigger released when turning the pump on.

3.7 Recheck hoses once the system is pressurized.

3.8 Never service equipment while energized or pressurized.

3.9 Ensure other personnel are clear of area while pressure washer is pressurized. Non-operators must remain a minimum of 25 feet (7.6m) from the operator.

3.10 Do not wash at a 90 degree angle to minimize spray and flying debris.

3.11 Never point a pressure washer at yourself or others. Contact with high pressure fluid can result in serious cut or injection injuries.

3.12 Increase pressure slowly during operation to prevent hose kick-back.

3.13 Do not drive over, pull on, or kink the high pressure hose. Damage to the hose may compromise the wire braiding inside and cause the hose to burst.

3.14 Whip checks must be used for all high pressure connections.

3.15 High-pressure washing equipment should be cleaned often to avoid dirt buildup, especially around the trigger and guard area.

3.16 Always set the trigger safety lock when the gun valve is not in use.

3.17 Relieve the pressure in the system before coupling and uncoupling hoses.

3.18 Visually inspect the full length of high pressure discharge hose and inspect other high pressure fluid-handling components for abrasions or cuts, damage caused by exposure to chemicals and for damage caused by kinks in the hose.

3.19 High pressure washers shall be used to clean or decontaminate equipment, surfaces or structures only.

3.20 High pressure washers WILL NOT be used to clean or decontaminate workers or personal protective equipment while it is being worn.

3.21 Maintain a distance from the spray contact point to reduce noise exposure and risk of being struck by flying debris. Avoid overreaching and maintain a stable stance.

3.22 When shutting down a pressure washer, turn the pump off before turning the water supply off.

3.23 After turning off pressure washer, ensure all residual pressure is released from system by squeezing the trigger. Consult the operator’s manual for any other procedures specific to the equipment for shut-down.

3.24 Protect unit from freezing, when applicable.

4.0 Personal Protective Equipment

4.1 Hardhat.

4.2 Safety glasses with side shields and a face shield.

4.3 Gloves providing appropriate protection (rubber, chemical).

4.4 Hearing protection.

4.5 PVC (or equivalent) rain suit.

4.6 Safety toed boots with metatarsal protection.

Americas

Reciprocating Saw

S3AM-305-ATT10

1.0 Objective / Overview

1.1 The versatility of the reciprocating saw, in cutting metal, pipe, wood and other materials have made it a widely used tool.

1.2 By design, it is a simple tool to handle. Its demands for safe use, however, are very important.

2.0 Potential Hazards

2.1 Flying debris

2.2 Noise

2.3 Sharp, moving parts (cuts)

2.4 Hand/arm vibration

2.5 Electricity

3.0 Safe Operating Guidelines

3.1 Review manufacturer's operating manual, *S3AM-305-PR1 Hand & Power Tools*, and *S3AM-305-ATT17 Electric & Battery Hand Tools* for additional guidelines.

3.2 Use sharp blades. Dull blades can produce excessive heat, make sawing difficult, result in forcing the tool, and possibly cause an accident.

3.3 Ensure appropriate blade selection. Different work surfaces demand different blades

3.4 Position yourself to maintain full control of the tool, and avoid cutting above shoulder height. Always use two hands to operate the saw.

3.5 To minimize blade flexing and provide a smooth cut, use the shortest blade that will do the job.

3.6 The work piece must be clamped securely, and the shoe of the saw held firmly against the work to prevent operator injury and blade breakage.

3.7 Maintain firm contact between the saw's shoe and the material being cut.

3.8 When making a "blind" cut (cannot see behind what is being cut), be sure that hidden electrical wiring, or water pipes are not in the path of the cut.

3.9 If wires are present, they must be disconnected at their power source by a qualified person or avoided, to prevent the possibility of lethal shock or fire.

3.10 Water pipes must be drained and capped.

3.11 Always hold the tool by the insulated grouping surfaces. When making anything other than a through cut, allow the tool to come to a complete stop before removing the blade from the work piece. This prevents breakage of the blade, and possible loss of tool control. Do not operate reciprocating saw in explosive atmospheres.

3.12 Do not overreach. Keep proper footing and balance at all times.

3.13 Check for misalignment or binding of moving parts, breakage or parts and any other condition that may affect the tool's operation.

4.0 Personal Protective Equipment

4.1 Wear proper apparel for the task. Long hair, loose or baggy clothing, ties, or jewelry can become caught in moving parts.

4.2 Gloves that provide cut abrasion and impact resistance.

4.3 Kickback apron, as necessary.

4.4 Safety toed boots.

4.5 Safety glasses with side shields and face shield.

4.6 Hearing protection.

Americas

Sander

S3AM-305-ATT11

1.0 Objective / Overview

1.1 Sanders are commonly used at project sites for a variety of tasks.

1.2 Often times the hazards associated with sanders are overlooked; they don't appear threatening because they don't have sharp blades or bits. These misconceptions can be prevented through proper training and personal protective equipment (PPE) selection.

2.0 Potential Hazards

2.1 Kickback – Sudden and violent reverse of the sander

2.2 Noise

2.3 Hand/arm vibration

2.4 Dust exposure

2.5 Flying debris

2.6 Severe abrasive parts

2.7 Electricity

2.8 Fuel (fine dust) and ignition sources (electricity, friction)

3.0 Safe Operating Guidelines

3.1 Review manufacturer's operating manual, *S3AM-305-PR1 Hand & Power Tools*, and *S3AM-305-ATT17 Electric & Battery Hand Tools* for additional guidelines.

3.2 Disconnect power supply before changing a sanding belt, making adjustments, or emptying dust collector.

3.3 Inspect sanding belts before use. Replace those belts that are worn or frayed.

3.4 Install sanding belts that are the same widths as the pulley drum.

3.5 Adjust sanding belt tension to keep the belt running true and at the same speed as pulley drum.

3.6 Secure the sanding belt in the direction shown on the belt and the machine. Keep hands away from the sanding belt.

3.7 Before starting a sander, be sure the power cord and extension cords are out of the belt path and are long enough to freely complete the task. The sander must be either double insulated or connected to a ground fault circuit interrupter.

3.8 Use two hands to operate sanders – one on the trigger and the other on the front handle knob. Move sanders away from the body.

3.9 Clean dust from the motor and vents at regular intervals.

3.10 Do not use a sander without an exhaust system or dust collector present that is in good working order. The dust created when sanding can be a fire and explosion hazard. Proper ventilation is essential as well as guarding against open flame and sparks.

3.11 Empty the collector when ¼ full. Minimise dust disturbance when emptying the collector.

3.12 Do not exert excessive pressure on a moving sander. The weight of the sander provides adequate pressure for the job.

3.13 Do not work on unsecured stock unless it is heavy enough to stay in place. Clamp the stop into place or use a ‘stop block’ to prevent movement.

3.14 Do not overreach. Always keep proper footing and balance.

3.15 Do not cover air vents of the sander.

3.16 Check often to ensure that guards are in their normal position.

4.0 Personal Protective Equipment

4.1 Wear proper apparel for the task. Long hair, loose or baggy clothing, ties, or jewellery can become caught in moving parts.

4.2 Gloves that provide cut, abrasion and impact resistance.

4.3 Safety toed boots.

4.4 Safety goggles and faceshield.

4.5 Hearing protection.

4.6 Respiratory protection, as necessary.

Americas

Knives

S3AM-305-ATT12

1.0 Objective / Overview

1.1 Knives serve a variety of purposes at work sites, and can be a useful tool, when used safely and correctly.

1.2 Learning proper positioning and correct usafe of a knife will drastically reduce the potential of cut-related injuries.

2.0 Hazards

2.1 Improper body positioning

2.2 Improper knife selection

2.3 Defective knife

2.4 Improper knife operation (including storage)

3.0 Safe Operating Guidelines

3.1 Select the appropriate knife for the task. Consider using a rounded tip blade if the task allows.

3.2 Always be sure that knives are sharp and not dull. A dull blade will require more force to cut, increasing the likelihood injury (e.g. hand slipping, knife breaking, etc.). Replace dull blades – A knife that tears rather than cuts, generally indicates the blade is dull.

3.3 Be sure the blade is seated in the frame of the knife correctly, closed, and fastened together properly.

3.4 Always direct the cut away from yourself and others

- 3.4.1 Keep body parts away from the cut line, (e.g., fingers, leg, etc.)
- 3.4.2 Ensure that the material being cut is stabilized and not against a body part (e.g. cutting rope against your leg).
- 3.4.3 Always pull the knife, never push the knife (the blade may break, and momentum could cause the body to come into contact with broken blade).

3.5 Ensure knife blades are protected or retracted when not in use.

- 3.5.1 Never carry a knife with an exposed blade in your pocket.

3.6 Use of razor and break away utility knives is prohibited.

- 3.6.1 Purchase safety-equipped utility knives with guarding or automatically retracting blades.

3.7 When using a knife to cut thicker materials, use several passes. Increased force on the blade can cause it to stray from the intended cut path, or break the blade.

3.8 When changing blades, always handle from the non-sharp side. Cover blade with duct tape and dispose.

3.9 Use an alternate tool when possible (scissors, wire cutters, etc.).

3.10 Let a falling knife fall.

4.0 Personal Protective Equipment

4.1 Cut resistant gloves are mandatory when using knives (Kevlar, thick leather, etc.).

Americas

Clearing & Grubbing Equipment

S3AM-305-ATT13

The following safety precautions will be followed during site clearing and tree falling.

1.0 General

1.1 Refer to *S3AM-305-PR1 Hand & Power Tools* for additional guidance.

1.2 As applicable, refer also to *S3AM-305-ATT15 Manual Hand Tools, S3AM-305-ATT16 Small Engines,* and *S3AM-305-ATT17 Electric & Battery Hand Tools* for additional guidance.

1.3 All clearing activities shall terminate during electrical storms and periods of high winds.

1.4 Dead, broken or rotted limbs or trees (widow makers) shall be felled first.

1.5 Be aware of the presence of other personnel when using any tool, especially picks or axes.

2.0 Machete, Pick and Axe Use

2.1 A machetes, picks and axes will only be used for their designated purpose; do not carelessly swing the tool when it is not needed.

2.2 To prevent lacerations, employees will wear Kevlar gloves and Kevlar chain saw chaps.

2.3 Machetes, picks and axes shall not be used when other employees are in the immediate work area.

3.0 Use of Weed Whips

3.1 Weed whips may be used to clear vegetation such as grass, light brush, briars and tree seedlings. The L-shaped weed whip cuts grass and weeds but is unstable for use on larger growth; the triangular-frame weed whip cuts briars and woody stems up to a half-inch in diameter. A “Suwannee” sling is a heavy duty weed whip that also has an axe blade. It does the same work as a weed whip, but can also cut through large materials. The heavier weight of this tool allows it to more easily cut off larger material than a weed whip.

3.2 When using weed whips, employees should follow these safety procedures:

3.2.1 Select the correct tool for the types and size of vegetation present across the landfill.

3.2.2 Employees will wear gloves that provide impact, abrasion, cut, tear, and puncture resistance when using weed whips.

3.2.3 Weed whips are meant to be swung back and forth with both hands. Avoid using a golf swing. The tool should be swung no higher than an employee’s side.

3.2.4 Strong swings should be made to prevent the blade from bouncing or glancing off springy growth.

3.2.5 Screws hold the serrated double-edge blade in place. These screws can work loose so check them before each use.

3.2.6 At the end of the day, inspect the whips for damage. Clean, sharpen, and oil as necessary and store with a sheath in place.

4.0 Chain Saws

4.1 Refer to *S3AM-305-ATT1 Chainsaw.*

5.0 Felling Trees Manually

5.1 Before cutting begins, survey the work area for dead limbs, the lean of the tree to be cut, wind conditions and the location of other trees.

5.2 Remove lodged trees (tree has not fallen to the ground after being separated from its stump) as soon as possible. Never work under a lodged tree.

5.3 The distance between workers should be maintained at twice the height of the trees being felled.

6.0 Chipping Operations

6.1 Prior to use, make sure all safety devices and controls, such as emergency shut-off devices, are tested and verified to be functioning properly.

6.2 Access covers and doors shall not be opened until the drum or disk is at a complete stop.

6.3 Infeed and discharge ports shall be designed to prevent employee contact with disc, knives and blower blades.

6.4 The operator must be completely familiar with the controls and proper use of the equipment.

6.5 Workers feeding material into self-feeding wood chippers are at risk of being fed through the chipper if they reach or fall into the infeed hopper or become entangled in branches feeding into the machine.

6.5.1 Make sure two workers (buddy system) are in close contact with each other when operating the chipper.

6.5.2 Stand to the side of the chipper while inserting limbs into chipper, never stand directly in front.

6.5.3 Insert trunk portion of tree/limb first. This will prevent the branches from getting entangled with clothing, etc. and pulling you in with the tree/limb.

6.5.4 Bystanders should be kept at least 25 feet (7.6m) away when in operation.

6.5.5 Keep the area around the wood chipper free of tripping hazards.

6.6 Never wear loose clothing that may get caught on feed material or moving parts.

7.0 Personal Protective Equipment

7.1 Wear proper apparel for the task.

7.1.1 Long hair, loose or baggy clothing, ties, or jewellery can become caught in moving parts.

7.1.2 Wear clothing with long sleeves and full length pants of durable material.

7.2 Use gloves that provide impact, abrasion, cut, tear and puncture resistance.

7.3 Safety toed boots with ankle support.

7.4 Safety glasses with side shields and face shield.

7.5 Hearing protection as necessary.

Americas

Pneumatic Tools

S3AM-305-ATT14

1.0 Objective / Overview

1.1 Pneumatic tools utilize air pressure to perform the tool's task.

1.2 Safe measures for use include proper training, good body mechanics and operating technique, well-maintained equipment, and protective equipment.

1.3 There are several dangers associated with the use of pneumatic tools. First and foremost is the danger of getting hit by one of the tool's attachments or by some kind of fastener the worker is using with the tool.

2.0 Hazards

2.1 Improperly secured air hoses

2.2 Noise

2.3 Flying debris

2.4 Defective tool

2.5 Improper operation

3.0 Safe Operating Guidelines

3.1 Review the manufacturer's operating manual, *S3AM-305-PR1 Hand & Power Tools*, and *S3AM-305-ATT17 Electric & Battery Hand Tools* for additional guidelines.

3.2 Never use bottled gas as a power source for pneumatic tools.

3.3 Drain water from air compressor tank and condensation from air lines.

3.3.1 Blow out the air line before connecting a tool. Hold hose firmly and blow away from yourself and others.

3.4 Pneumatic tools must be checked to see that the tools are fastened securely to the air hose to prevent them from becoming disconnected. Pneumatic tools must have the air supply controlled according to manufacturer's specifications.

3.5 Make sure that hose connections fit properly and are equipped with a mechanical means of securing the connection between tool/hose/compressor to prevent whipping in case of disconnection or failure (e.g. chains, tie wires, whip checks or equivalent retaining devices).

3.6 Safety clips or tool retainers must be in place on pneumatic impact tools to prevent accessories (e.g. chisel on a chipping hammer) or attachments from being ejected.

3.7 If an air hose is more than 1/2-inch (12.7 mm) in diameter, a safety excess flow valve must be installed at the source of the air supply to reduce pressure in case of hose failure.

3.8 In general, the same precautions should be taken with an air hose that are recommended for electric cords, as the hose is subject to the same kind of damage or accidental striking, and because it also presents tripping hazards. Avoid creating trip hazards caused by hoses laid across walkways, curled underfoot, on ladders.

3.9 Airless spray guns that atomize paints and fluids at pressures of 1,000 pounds or more per square inch (6,890 kPa) must be equipped with automatic or visible manual safety devices that will prevent pulling the trigger until the safety device is manually released.

3.10 Ensure that the compressed air supplied to the tool is clean and dry. Dust, moisture, and corrosive fumes can damage a tool. An in-line regulator filter and lubricator increases tool life.

3.11 Keep tools clean and lubricated, and maintain them according to the manufacturers' instructions.

3.12 Use only the attachments that the manufacturer recommends for the tools in use.

3.13 Use the proper hose and fittings of the correct diameter and type for the pneumatic or hydraulic application.

3.13.1 The manufacturer’s recommended safe operating pressure for hoses, valves, pipes, filters, and other fittings must not be exceeded.

3.13.2 Use hoses specifically designed to resist abrasion, cutting, crushing and failure from continuous flexing.

3.13.3 Choose air supply hoses that have a minimum working pressure rating of 150 pounds per square inch gauge or 150 percent of the maximum pressure produced in the system, whichever is higher.

3.13.4 Check hoses regularly for cuts, bulges and abrasions. Tag and replace, if defective.

3.14 Install quick disconnects of a pressure-release type rather than a disengagement type. Attach the male end of the connector to the tool, NOT the hose.

3.15 Reduce physical fatigue by supporting heavy tools with a counter-balance wherever possible.

3.16 Do not operate the tool at a pressure above the manufacturer's rating.

3.17 Turn off the air pressure to the hose, exhaust the airliine and disconnect the tool from the air supply when not in use, before servicing or when changing power tools or attachments.

3.18 Do not carry a pneumatic tool by its hose.

3.19 Do not use compressed air for cleaning purposes unless the pressure is reduced to 30 pounds per square inch (psi) or less. This rule does not apply for concrete form, mill scale, green cutting, and similar cleaning operations. Proper respiratory, hand, eye, and ear protection must be worn.

3.20 Compressed air guns shall never be pointed toward anyone.

3.20.1 Employees shall never “dead-end” them against themselves or anyone else.

3.20.2 A chip guard shall be used when compressed air is used for cleaning.

3.20.3 Never use compressed air to blow debris or to clean dirt from clothes or body.

4.0 Personal Protective Equipment

4.1 Gloves providing appropriate protection to the task (e.g. impact, puncture, chemical, etc.)

4.2 Safety toed boots

4.3 Use hearing protection, where required.

4.4 Wear safety glasses with side shields at all times and face shield if flying debris may be encountered.

Americas

Manual Hand Tools

S3AM-305-ATT15

1.0 General

1.1 Review manufacturer's operating manual and *S3AM-305-PR1 Hand & Power Tools* for additional guidelines.

1.2 Carry tools using a heavy belt or apron and hang tools at your sides.

1.3 Never carry tools in your pockets or hanging behind your back.

2.0 Hammers

2.1 Hammers are designed according to the intended purpose. Select a hammer that is comfortable for you and that is the proper size and weight for the job. Misuse can cause the striking face to chip, possibly causing a serious injury.

2.2 Choose a hammer with a striking face diameter approximately ½ inch (1.3 centimeters) larger than the face of the tool being struck (e.g., chisels, punches, wedges, etc.).

2.3 Strike a hammer blow squarely with the striking face parallel to the surface being struck. Always avoid glancing blows and over and under strikes. (Hammers with beveled faces are less likely to chip or spall).

2.4 Look behind and above you before swinging the hammer.

2.5 Watch the object you are hitting.

2.6 Hold the hammer with your wrist straight and your hand firmly wrapped around the handle.

2.7 Do not use handles that are rough, cracked, broken, splintered, sharp-edged or loosely attached to the head. Remove from service and replace the handle if possible.

2.8 Do not use any hammer head with dents, cracks, chips, mushrooming, or excessive wear.

2.9 Do not use a hammer for any purpose for which it was not designed or intended.

2.10 Do not use one hammer to strike another hammer, other hard metal objects, stones or concrete.

2.11 Do not redress, grind, weld or reheat-treat a hammer head.

2.12 Do not strike with the side or cheek of the hammer.

3.0 Pipe Cutters, Reamers, Taps and Threaders

3.1 Replace pipe cutter wheels which are nicked or otherwise damaged.

3.2 Use a three- or four-wheeled cutter, if there is not enough space to swing the single wheel pipe cutter completely around the pipe.

3.3 Choose a cutting wheel suitable for cutting the type of pipe material required:

- 3.3.1 Thin wheel for cutting ordinary steel pipe.
- 3.3.2 Stout wheel for cutting cast iron.
- 3.3.3 Other wheels for cutting stainless steel, plastic and other materials.

3.4 Select the proper hole diameter and correct tap size to tap a hole. The hole should be sized so that the thread cut by the tap will be about 75 percent as deep as the thread on the tap.

3.5 Use a proper tap wrench (with a "T" handle) for turning a tap.

3.6 Use lubricant or machine cutting fluid with metals other than cast iron.

3.7 Do not permit chips to clog flutes (groves in the tap that allow metal chips to escape from the hole). The chips may prevent the tap from turning – this may result in the tap breaking if you continue to apply pressure.

3.8 Do not attempt to thread hardened steel. This can chip or damage the die.

3.9 Do not thread any rod or other cylindrical object that is larger in diameter than the major diameter of the die thread.

3.10 Do not use a spiral reamer on a rotating pipe. The reamer may snag and cause serious injury.

4.0 Pliers and Wire Cutters

4.1 Pliers are made in various shapes and sizes and for many uses. Use the correct pliers or wire cutters for the job.

4.2 Choose pliers or wire cutters that have a grip span of 2½ – 3½ inches (6.4 – 8.9 centimeters) to prevent palm or fingers from being pinched when the tools are closed.

4.3 Use adjustable pliers that allow for a firm grip of the work piece while maintaining a comfortable handgrip (i.e., hand grasp is not too wide).

4.4 Use tools only if they are in good condition.

4.4.1 Make sure that the cutting edges are sharp. Dull and worn-down cutting edges require many times more force for cutting.

4.4.2 Make sure that the toothed jaws are clean and sharp. Greasy or worn-down jaws can result in compromised safety. Such tools also require increased force to hold the work piece which, in turn, increases the risk of muscular fatigue and repetitive strain injuries.

4.5 Oil pliers and wire cutters regularly. A drop of oil on the hinge will make the tools easier to use.

4.6 Pull on the pliers; do not push away from you when applying pressure. If the tool slips unexpectedly, you may lose your balance or injure your hand.

4.7 Cut at right angles. Never rock the cutting tool from side to side or bend wire back and forth against the cutting edges.

4.8 Do not cut hardened wire unless the pliers or wire cutters are specifically manufactured for this purpose.

4.9 Do not expose pliers or wire cutters to excessive heat.

4.10 Do not bend stiff wire with light pliers. Needle-nose pliers can be damaged by using the tips to bend large wire. Use a sturdier tool.

4.11 Do not use pliers as a hammer.

4.12 Do not hammer on pliers or wire cutters to cut wires or bolts.

4.13 Do not extend the length of handles to gain greater leverage. Use a larger pair of pliers for gripping or a bolt cutter for cutting.

4.14 Do not use cushion grip handles for jobs requiring tools with electrically insulated handles. Cushion grips are for comfort primarily and do not protect against electric shock.

4.15 Do not use pliers on nuts and bolts; use a wrench.

5.0 Screwdrivers

5.1 Screwdrivers are made in various shapes and sizes and for many uses. Use the correct screwdriver for the job.

5.2 Choose contoured handles that fit the shank tightly, with a flange to keep the hand from slipping off the tool.

5.3 Use a slot screwdriver with a blade tip width that is the same as the width of the slotted screw head.

5.4 For cross-head screws, use the correct size and type of screwdriver; a Phillips screwdriver may slip out of a screw head designed for use with the slightly flatter-tipped Pozidriv screwdriver.

5.5 Use a vise or clamp to hold the stock if the piece is small or moves easily.

5.6 Keep the screwdriver handle clean. A greasy handle could cause an injury or damage from unexpected slippage.

5.7 If work must be carried out on “live” electrical equipment, use screwdrivers that have insulated handles designed for electrical work and a non-conducting shaft. Remember, most plastic handles are designed for grip and comfort.

5.8 Use non-magnetic tools when working near strong magnets (e.g., in some laboratories).

5.9 Use a screw-holding screwdriver (with screw-holding clips or magnetic blades) to get screws started in awkward, hard-to-reach areas. Square-tipped screwdrivers (e.g., Robertson) that hold screws with recessed square holes are also useful in such situations.

5.10 Use an offset screwdriver in close quarters where a conventional screwdriver cannot be used.

5.11 Use a screwdriver that incorporates the following features when continuous work is needed:

5.11.1 Use a pistol grip to provide for a straighter wrist and better leverage.

5.11.2 Use a "Yankee drill" mechanism (spiral ratchet screwdriver or push screwdriver) which rotates the blade when the tool is pushed forward.

5.11.3 Use a ratchet device to drive hard-to-move screws efficiently, or use a powered screwdriver.

5.12 File a rounded tip square making sure the edges are straight. A dull or rounded tip can slip out of the slot and cause hand injury or damage to materials.

5.13 Store screwdrivers in a rack or partitioned pouch so that the proper screwdriver can be selected quickly.

5.14 Do not lean or push on a screwdriver with any more force than necessary to keep contact with the screw. A screw properly piloted and fitted will draw itself into the right position when turned. Keep the shank directly over the screw being driven.

5.15 Do not hold the stock in one hand while using the screwdriver with the other as an injury may result if the screwdriver slips out of the slot.

5.16 Do not hammer screws that cannot be turned.

5.17 Do not grind the screwdriver tip to fit another size screw head.

5.18 Do not try to use screwdrivers on screw heads for which they are not designed (e.g., straight blade screwdrivers on Phillips, clutch head, Torx or multi-fluted spline screw heads).

5.19 Do not use defective screwdrivers (e.g. rounded or damaged edges or tips; split or broken handles; bent shafts).

5.20 Do not use a screwdriver for prying, punching, chiseling, scoring, scraping or stirring paint.

5.21 Do not use pliers on the handle of a screwdriver for extra turning power. A wrench should be used only on the square screwdriver shank designed for that purpose.

5.22 Do not expose a screwdriver blade to excessive heat. Heat can affect the temper of the metal and weaken the tool.

5.23 Do not use a screwdriver to check if an electrical circuit is live. Use a suitable meter or other circuit testing device.

5.24 Do not carry screwdrivers in clothing pockets.

6.0 Snips

6.1 Wear safety glasses and protective gloves when working with snips. Small pieces of metal may go flying in the air and cut edges of metal are sharp.

6.2 Snips are made in various shapes and sizes for various tasks. The handle can be like those on scissors with finger and thumb holes or like plier handles. Models are available for cutting in straight lines and in curves to the left or right.

6.3 Select the right size and type of snips for the job; check the manufacturer's specifications about the intended use of the snips (e.g., type of cut - straight, wide curve, tight curve, right or left, and maximum thickness and kind of metal or other material that can be cut).

- 6.3.1 Universal snips can cut in both straight and wide curves.
- 6.3.2 Straight snips and duckbill snips (flat blade, "perpendicular" to the handle, with pointed tips) are generally designed to cut in straight lines; some duckbill snips are designed for cutting curved lines.
- 6.3.3 Hawk's bill snips (with crescent-shaped jaws) are used for cutting tight circles.
- 6.3.4 Aviation snips have compound leverage that reduces the effort required for cutting.
- 6.3.5 Offset snips have jaws that are set at an angle from the handle.

6.4 Use only snips that are sharp and in good condition.

6.5 Use snips for cutting soft metal only. Hard or hardened metal should be cut with tools designed for that purpose.

6.6 Use ordinary hand pressure for cutting. If extra force is needed, use a larger tool.

6.7 Cut so that the waste is on the right if you are right-handed or on the left if you are left-handed.

6.8 Avoid springing the blades. This results from trying to cut metal that is too thick or heavy for the snips you are using.

6.9 Keep the nut and the pivot bolt properly adjusted at all times.

6.10 Oil the pivot bolt on the snips occasionally.

6.11 Do not try to cut sharp curves with straight cut snips.

6.12 Do not cut sheet metal thicker than the manufacturer's recommended upper limit (e.g., cuts up to 16-gauge cold, rolled steel or 18-gauge stainless steel). Do not extend the length of handles to gain greater leverage.

6.13 Do not hammer or use your foot to exert extra pressure on the cutting edges.

6.14 Do not use cushion grip handles for tasks requiring insulated handles. They are for comfort primarily and not for protection against electric shocks.

6.15 Do not attempt to re-sharpen snips in a sharpening device designed for scissors, garden tools, or cutlery.

7.0 Wrenches

7.1 Use the correct wrench for the job - pipe wrenches for pipes and plumbing fittings, and general-use wrenches for nuts and bolts.

- 7.1.1 Do not use pipe wrenches on nuts and bolts.
- 7.1.2 Use a box or socket wrench with a straight handle, rather than an off-set handle, when possible.
- 7.1.3 Do not use a conventional adjustable wrench for turning a tap – it will cause uneven pressure on the tap that may cause it to break.
- 7.1.4 Do not use a makeshift wrench.

7.2 Inspect pipe wrenches periodically for worn or unsafe parts and replace them:

7.2.1 Wrenches must not be used when jaws are sprung to the point that slippage occurs.

7.2.2 Ensure that the teeth of a pipe wrench are sharp, clean and free of oil and debris.

7.2.3 Do not use worn adjustable wrenches. Inspect the threads, knurl, jaw and pin for wear.

7.2.4 Discard any bent or damaged wrenches (e.g., open-ended wrenches with spread jaws or box wrenches with broken or damaged points).

7.3 Select the correct jaw size to avoid slippage.

7.3.1 Ensure that the jaw of an open-ended wrench is in full contact (fully seated, “flat,” not tilted) with the nut or bolt before applying pressure.

7.3.2 Face a pipe wrench or adjustable wrench “forward,” adjust tightly and turn the wrench so pressure is against the permanent or fixed jaw. Do not pull on a wrench that is loosely adjusted.

7.3.3 Adjust the pipe wrench grip to maintain a gap between the back of the hook jaw and the pipe. This concentrates the pressure at the jaw teeth, producing the maximum gripping force. It also aids the ratcheting action.

7.3.4 Do not insert a shim in a wrench for better fit.

7.3.5 Before applying pressure, ensure that the jaws have a good bite.

7.3.6 Make sure adjustable wrenches do not "slide" open during use.

7.3.7 Do not increase the leverage by adding sleeved additions (e.g., a pipe) to increase tool handle length. Use a larger wrench as necessary.

7.4 Ensure that the pipe or fitting is clean to prevent unexpected slippage and possible injury.

7.5 Maintain a proper stance with feet firmly placed to maintain balance.

7.5.1 Position the body in a way that will prevent loss of balance and injury if the wrench slips or something (e.g., a bolt) suddenly breaks.

7.5.2 Pull, rather than push on the wrench handle as body balance is more likely to be maintained if the wrench slips.

7.5.3 Pull using a slow, steady pull; do not use fast, jerky movements.

7.6 Apply a small amount of pressure to a ratchet wrench initially to ensure that the ratchet wheel (or gear) is engaged with the pawl (a catch fitting in the gear) for the direction you are applying pressure.

7.7 Support the head of the ratchet wrench when socket extensions are used.

7.8 Stand aside when work is done with wrenches overhead.

7.9 Do not use a wrench on moving machinery.

7.10 Do not use the wrong tools for the job. For example: Do not use pliers instead of a wrench or a wrench as a hammer. Do not use pipe wrenches for lifting or bending pipes.

7.11 Do not strike a wrench (except a "strike face" wrench) with a hammer or similar object to gain more force.

7.12 Do not expose a wrench to excessive heat (like from a blow torch) that could affect the temper of the metal and ruin the tool.

8.0 Files/Rasps

8.1 Do not use a file as a pry bar, hammer, screwdriver, or chisel.

8.2 When using a file or a rasp, grasp the handle in one hand and the toe of the file in the other.

8.3 Do not hammer on a file.

9.0 Chisels and Punches

9.1 Use the right size and type of chisel (metal or wood) or punch (drift pin, centre, pin) for the job.

9.2 Use tools only if they are good condition (i.e., cutting edges are sharp, struck head is not mushroomed or chipped).

9.2.1 Do not use chisels or punches if the cutting edge is dull, mushroomed or chipped, or if the point of a punch is slanted or damaged.

9.2.2 Choose smooth, rectangular handles that have no sharp edges and are attached firmly to the chisel. Replace broken or splintered handles.

9.2.3 Redress striking tools with burred or mushroomed heads.

- Redress the point or cutting edge to its original shape.
- Do not use a grinder to redress heat-treated tools. Use a whetstone.
- Grind to a slightly convex cutting edge.
- The point angle of the chisel should be 70° for hard metals, 60° for soft.
- Do not apply too much pressure to the head when grinding a chisel. The heat generated can remove the temper. Immerse the chisel in cold water periodically when grinding.

9.2.4 Replace any chisel or punch that is bent, cracked, shows excessive wear or cannot successfully be redressed.

9.3 Check stock thoroughly for knots, staples, nails, screws, or other foreign objects before chiseling or punching.

9.4 Hold the chisel, for shearing and chipping, at an angle which permits the bevel of the cutting edge to lie flat against the shearing plane.

9.5 Use the appropriate type and size of hammer for the chisel or punch, such as:

9.5.1 A wooden or plastic mallet with a large striking face on chisels.

9.5.2 Heavy-duty or framing chisels made of a solid or molded handle can be struck with a steel hammer.

9.5.3 Ball-peen hammers are generally chosen for use with punches.

9.5.4 Refer to the ‘Hammers’ section of this document for further guidance.

9.6 Chip or cut away from the body. Keep hands and body behind the cutting edge.

9.7 Make finishing or paring cuts with hand pressure alone.

9.8 Provide hand protection if possible:

9.8.1 Use a sponge rubber shield, punch or chisel holder.

9.8.2 Clamp small work pieces in a vise and chip towards the stationary jaw when working with a chisel.

9.8.3 Do not allow bull point chisels to be hand-held by one employee and struck by another. Use tongs or a chisel holder to guide the chisel so that the holder's hand will not be injured.

9.9 Do not use cold chisels for cutting or splitting stone or concrete.

9.10 Do not use a drift pin punch (also called an aligning punch) as a pin punch intended for driving, removing, or loosening pins, keys, and rivets.

9.11 Do not use a wood chisel on metal.

9.12 Do not use a wood chisel as a pry or a wedge.

9.13 Place chisels safely within the plastic protective caps to cover cutting edges when not in use.

9.14 Store chisels in a “storage roll,” a cloth or plastic bag with slots for each chisel, and keep them in a drawer or tray.

10.0 Hacksaws

10.1 Select correct blade for material being cut.

10.2 Keep saw blades clean and lightly oiled using light machine oil on the blade to keep it from overheating and breaking.

10.3 Secure blade with the teeth pointing forward. Tighten the nut until the blade is under tension.

10.4 Keep blade rigid, and frame properly aligned.

10.5 Cut using steady strokes, directed away from you.

10.6 Use entire length of blade in each cutting stroke.

10.7 Cut harder materials more slowly than soft materials.

10.8 Clamp thin, flat pieces requiring edge cutting.

10.9 Do not apply too much pressure on the blade as the blade may break.

10.10 Do not twist when applying pressure.

10.11 Do not use when the blade becomes loose in the frame.

11.0 Vises

11.1 When clamping a long work piece in a vise, support the far end of the work piece by using an adjustable pipe stand, saw horse or box.

11.2 Position the work piece in the vise so that the entire face of the jaw supports the work piece.

11.3 Do not use a vise that has worn or broken jaw inserts, or has cracks or fractures in the body of the vise.

11.4 Do not slip a pipe over the handle of a vise to gain extra leverage.

12.0 Clamps

12.1 Do not use a C-clamp for hoisting materials.

12.2 Do not use a C-clamp as a permanent fastening device.

13.0 Pry Bars

13.1 Establish balance and stable footing when using a bar for prying.

13.2 Pry bars must be appropriate to the task to prevent slipping or tool breakage.

14.0 Jacks

14.1 All jacks—including lever and ratchet jacks, screw jacks, and hydraulic jacks—must have a stop indicator, and the stop limit must not be exceeded.

14.2 The manufacturer’s load limit must be permanently marked in a prominent place on the jack, and the load limit must not be exceeded.

14.3 A jack should never be used to support a lifted load. Once the load has been lifted, it must immediately be blocked up. Put a block under the base of the jack when the foundation is not firm, and place a block between the jack cap and load if the cap might slip.

14.4 To set up a jack, make certain of the following:

14.4.1 The base of the jack rests on a firm, level surface;

14.4.2 The jack is correctly centered;

14.4.3 The jack head bears against a level surface; and

14.4.4 The lift force is applied evenly.

14.5 Clear all tools, equipment and any other obstructions from under the load before lowering the jack.

14.6 Proper maintenance of jacks is essential for safety. All jacks must be lubricated regularly. In addition, each jack must be inspected according to the following schedule:

14.6.1 For jacks used continuously or intermittently at one site—inspected at least once every 6 months;

14.6.2 For jacks sent out of the shop for special work—inspected when sent out and inspected when returned; and

14.6.3 For jacks subjected to abnormal loads or shock—inspected before use and immediately thereafter.

Americas

Small Engines

S3AM-305-ATT16

1.0 Objective / Overview

1.1 Operate small engine machines (liquid fuel tools), such as push mowers, weed trimmers, pumps and leaf blowers, in a safe manner.

1.2 Workers must be trained and competent in the safe operation and maintenance of the tool.

2.0 Potential Hazards

2.1 Flying debris

2.2 Noise

2.3 Moving and sharp parts

2.4 Hot surfaces

3.0 Safe Operating Guidelines

3.1 Review *S3AM-305-PR1 Hand & Power Tools* and the manufacturer's operating manual for further guidance.

3.2 Do not wear loose or baggy clothing around tools with rotating parts.

3.3 Never run the engine indoors, in poorly ventilated areas, or in a location where the exhaust could be drawn into a building through an opening.

3.3.1 When an engine must be operated in an enclosed space, effective ventilation and/or proper respirators such as atmosphere-supplying respirators must be utilized to avoid breathing carbon monoxide.

3.4 Never store engine with fuel in fuel tank inside a building with potential sources of ignition such as hot water and space heaters, clothes dryers, electric motors, etc.

3.5 Ensure the fuel cap is in place. Never start or operate the engine with the fuel fill cap removed.

3.6 Refuelling:

3.6.1 Never remove fuel cap or add fuel when engine is running.

3.6.2 Shut down the engine and allow it to cool prior to refueling to prevent accidental ignition of hazardous vapors.

3.6.3 Never pour gasoline on hot surfaces.

3.6.4 Fill in well-ventilated area.

3.6.5 Do not re-fuel around an open flame or while smoking.

3.7 Use only properly labelled, American National Standards Institute/Canadian Standards Association-approved red gasoline containers to store and dispense fuel.

3.8 The worker must be careful to handle, transport, and store gas or fuel only in approved flammable liquid containers, according to proper procedures for flammable liquids.

3.9 Noise hazards associated with gasoline engines must be mitigated by the use of proper hearing protection. Ear plugs, ear muffs or a combination of the two must be used to protect workers from excessive noise levels.

3.10 Appropriate fire extinguishers must also be available in the area.

3.11 Do not pour fuel from engine or siphon fuel by mouth.

3.12 Never leave the engine unattended while it is running.

3.13 Never operate the engine with an unguarded engine shaft.

3.14 Do not modify the engine or tamper with the factory setting of the engine governor.

3.15 Never operate the engine without a muffler guard in place and avoid touching hot areas of the engine.

3.16 Keep all flammable materials away from the muffler and the rest of the engine; do not idle or park the engine in dry grass or ground cover.

3.17 When working on the equipment, avoid accidental starts by removing the ignition key, turn off all engine switches, disconnect the battery and disconnect the spark plug, keeping it away from metal part.

4.0 Personal Protective Equipment

4.1 Always wear safety glasses with shields. Add face shield if potential for flying debris.

4.2 Gloves providing the appropriate protection (e.g. impact, abrasion, chemical, etc.).

4.3 Wear proper apparel for the task. Long hair, loose or baggy clothing, ties, or jewellery can become caught in moving parts. Long pants and long sleeve shirt.

4.4 Safety toe work boots.

4.5 Hearing protection (earmuffs or earplugs).

Americas

Electric & Battery Hand Tools

S3AM-305-ATT17

1.0 Objective / Overview

1.1 Electric and battery hand tools, also known as power tools, allow the user to perform their task more easily by providing more torque, speed, etc.

2.0 Hazards

2.1 Electricity

3.0 Safe Work Practices (General)

3.1 Review manufacturer's operating manual and *S3AM-305-PR1 Hand & Power Tools* for additional guidelines.

3.2 All electrical tools and equipment must be operated in accordance with the requirements of *S3AM-302-PR1 Electrical Safety.*

3.3 Keep all people not involved with the work at a safe distance from the work area.

3.4 Inspect power tools prior to each use.

- 3.4.1 Ensure that the power tool has the correct guard, shield or other attachment that the manufacturer recommends.
- 3.4.2 Ensure that the tools are properly grounded using a three-prong plug (no loose or faulty prongs), are double insulated (and are labeled as such), or are powered by a low-voltage isolation transformer; this will protect users from an electrical shock.
- 3.4.3 Check the handle and body casing of the tool for cracks or other damage.
- 3.4.4 If the tool has auxiliary or double handles, check to see that they installed securely.
- 3.4.5 Inspect cords for defects: check the plug and power cord for cracking, fraying, and other signs of wear or faults in the cord insulation.
- 3.4.6 Ensure power tool switches and triggers are fully functional.
- 3.4.7 If equipped with a trigger-lock, ensure it is disabled.
- 3.4.8 If a power tool is defective, remove it from service, and tag it clearly "Out of service for repair" or "Do Not Use". Replace damaged equipment immediately – do not use defective tools "temporarily." DO NOT ATTEMPT FIELD REPAIRS.

3.5 Maintain tools with care; keep them sharp and clean for best performance.

3.6 Follow instructions in the user's manual for lubricating and changing accessories.

3.7 Do not over-reach. Be sure to keep good footing and maintain good balance when operating power tools.

3.8 If they are available, choose tools with double handles to permit easier holding and better manipulation of the tool.

3.9 Do not brush away sawdust, shavings or turnings while the power tool is running. Never use compressed air for cleaning surfaces or removing sawdust, metal turnings, etc.

3.10 Do not operate power tools that are not specified as intrinsically safe in an area containing explosive vapors or gases.

3.11 Do not clean tools with flammable or toxic solvents.

3.12 Do not surprise or touch anyone who is operating a power tool. Startling an operator could result in injury or

property damage.

3.13 Hand-held power tools must be equipped with a constant-pressure switch or control that shuts off the power when pressure is released.

3.13.1 Powered hand tools shall not be capable of being locked in the ON position. Trigger locks are not permitted.

3.13.2 All power tools should be ordered without trigger locks; if a tool is found with a trigger lock intact it must be disabled.

3.14 Avoid accidental starting. Do not hold fingers on the switch button, and ensure it is in the OFF position while plugging the tool in or while carrying an energized (plugged-in, battery in place) tool.

3.15 Do not leave a running tool unattended and ensure the power tool will not re-energize when not in use and when servicing, cleaning, making adjustments, applying flammable solutions or changing accessories:

3.15.1 Ensure it has stopped running completely.

3.15.2 Ensure the trigger or switch is OFF.

3.15.3 Ensure the power tool is disconnected from the power supply (unplugged or battery removed).

3.16 Operate power tools within their design limitations.

3.17 Store power tools, batteries and electrical cords in a clean, dry area off the ground when not in use.

3.18 Do not use power tools in damp or wet locations unless they are approved for that purpose.

3.19 Keep work areas well lighted when operating power tools.

3.20 Equipment must have proper guards or shields and they must remain in place to protect the operator and others from the following:

3.20.1 Point of operation.

3.20.2 In-running nip points.

3.20.3 Rotating parts.

3.20.4 Flying chips and sparks.

3.21 If a guard is removed to clean or repair parts, replace it before testing the equipment and returning the machine to service

3.22 If, due to damage or deterioration, the original guard provided on a piece of equipment cannot be put in place, the tool must be removed from service.

3.23 Do not modify, remove, or disable any machine guards.

3.24 Remove any wrenches and adjusting tools before turning on a tool.

3.25 Use clamps, a vice or other devices to hold and support the piece being worked on, when practical to do so. This will allow you to use both hands for better control of the tool and will help prevent injuries if a tool jams or binds in a work piece.

4.0 Battery Powered Tools

4.1 Use only the type of battery specified by the tool manufacturer for the battery-powered tool to be used.

4.2 Recharge a battery or battery-powered tool only with a charger that specified for the battery.

4.3 Store a battery pack safely so that no metal parts, nails, screws, wrenches and so on can come in contact with the battery terminals; this could result in shorting out the battery and possibly cause sparks, fires or burns.

5.0 Safe Work Practice (Electric)

5.1 During use, keep power cords clear of tools and the path that the tool will take.

5.2 Employees' hands shall not be wet when plugging and unplugging cord and plug connected equipment and extension cords.

5.3 Portable electric equipment shall be disconnected when not in use, before servicing, and when changing accessories such as blades, bits, and cutters.

5.4 Portable electric equipment and extension cords used in potentially wet locations shall be approved for use in those locations by a nationally recognized testing laboratory, inspection agency, or other organization concerned with product evaluation (e.g., F.M., UL, etc.).

5.5 The outlet box for portable extension cords for outdoor use shall be weatherproof and shall be maintained in good condition.

5.6 Maintain electrical cords and connections in good working order:

5.6.1 Cords and connection must be American National Standards Institute/Canadian Standards Association approved and bear a standardized certification marking (e.g., CSA, ANSI, UL, CE etc.).

5.6.2 To prevent overheating, use only approved extension cords that have the proper wire size for the length of cord and power requirements of the electric tool to be used.

- Do not connect or splice extension cords together to make a longer connection.
- For outdoor work, use outdoor extension cords marked “W-A” or “W.”

5.6.3 Eliminate octopus connections: if more than one receptacle plug is needed, use a power bar or power distribution strip that has an integral power cord and a built-in overcurrent protection.

5.6.4 Portable electrical equipment shall not be carried by the cord, nor raised or lowered by the cord.

5.6.5 Electrical cords shall not be removed from a receptacle by pulling on the cord line.

5.6.6 Cords shall not be placed across walkways unless appropriate cord and worker protection is in place to prevent damage to the cord and worker tripping hazards (e.g. cable protectors, cords suspended over walkway, etc.).

5.6.7 Do not walk on or allow vehicles or other moving equipment to pass over unprotected power cords. Cords should be put in conduits or protected by placing planks on each side of them.

5.6.8 A cord should not be pulled or dragged over nails, hooks, or other sharp objects that may cause cuts in the insulation.

5.6.9 Keep cords away from heat, oil, sharp edges and moving parts.

5.6.10 Never use extension cords as permanent wiring as they are for temporary use only. Do not run behind bookshelves, or furniture if the cord cannot be monitored for severe bending or damage.

5.6.11 Inspect cords frequently for such damage such as fraying, kinks, cuts, and cracked or broken outer jackets. Any cord that exhibits damage or feels more than comfortably warm to the touch shall be removed from service, tagged “Do Not Use’ and checked by an electrician.

5.6.12 Do not tie power cords in knots. Knots can cause short circuits and shocks. Loop the cords or use a twist lock plug.

5.7 Electrical shock associated with power tool use can cause heart failure and burns, as well as injury from falls. Under certain conditions, even a small amount of electric current can result in fibrillation of the heart and death.

5.7.1 Verify that the power source is the same voltage and current as indicated on the nameplate of the tool. Using a higher voltage can cause serious injury to the operator as well as burn out the tool.

5.7.2 All electrical connections for these tools must be suitable for the type of tool and the working

conditions (wet, dusty, flammable vapors).

5.7.3 To protect the worker from shock and burns, electric tools must have a three-wire cord with a ground and be plugged into a grounded receptacle, be double insulated, or be powered by a low-voltage isolation transformer.

5.7.4 All outdoor receptacles must be protected by means of a ground fault circuit interrupter (GFCI or GFI) available in portable or fixed models. Do not use any electric power tools outdoors in a receptacle that is not properly protected.

5.7.5 Three-wire cords contain two current-carrying conductors and a grounding conductor. Any time an adapter is used to accommodate a two-hole receptacle, the adapter wire must be attached to a known ground.

5.7.6 The third prong must never be removed from the plug.

5.7.7 Double-insulated tools are available that provide protection against electrical shock without third-wire grounding. On double-insulated tools, an internal layer of protective insulation completely isolates the external housing of the tool.

5.7.8 Avoid body contact with grounded surfaces like refrigerators, pipes and radiators when using electric powered tools; this will reduce the likelihood of shock if the operator's body is grounded.

5.7.9 Report all shocks and/or sparks from electrical tools, no matter how minor. The tool in question should be tagged out and not be used until it has been checked for ground fault.

5.8 Only authorized persons are permitted to activate, de-activate or lockout electrical equipment.

5.9 Where there is or may be a danger to a worker, from the inadvertent operation of electrical equipment, then that equipment must be locked out and tagged prior to commencing work. Refer to *S3AM-325-PR1 Lockout Tagout*.

5.9.1 Switch off all appropriate devices (MCC, Distribution Panel, Disconnect).

- Stand to one side when engaging or disengaging an electrical circuit breaker to avoid electrical flash backs Lock and tag Electrical Supply devices in the “OFF” position.

5.9.2 Test to be sure the equipment cannot be operated at the STOP-START switch.

5.9.3 Test to be sure electrical equipment is de-energized.

5.9.4 After completion of task, remove padlocks and destroy tags.

6.0 Personal Protective Equipment (Level D PPE)

6.1 Wear proper apparel for the task. Long hair, loose or baggy clothing, ties, or jewellery can become caught in moving parts.

6.2 Use gloves with protection appropriate to the task (e.g. impact, abrasion, puncture, etc.).

6.3 Safety toed boots.

6.4 Use hearing protection as necessary.

6.5 Kickback aprons as necessary.

6.6 Wear safety glasses with side shields at all times (or safety goggles) and face shield if flying debris may be encountered.

7.0 Belt Sanders

7.1 Refer to *S3AM-305-ATT11 Sanders.*

8.0 Drills

8.1 Refer to *S3AM-305-ATT8 Power Drill*.

9.0 Planers and Joiners

9.1 Use blades of the same weight and set at the same height.

9.2 Ensure that the blade-locking screws are tight.

9.3 Guard planers and joiners to prevent contact with the blades throughout the full length of the cutting area.

9.4 Support the material (stock) in a comfortable position that will allow the job to be done safely and accurately.

9.5 Check stock thoroughly for staples, nails, screws, or other foreign objects before using a planer.

9.6 Start a cut with the infeed table (front shoe) resting firmly on the stock and with the cutter head slightly behind the edge of the stock.

9.7 Use two hands to operate a planer - one hand on the trigger switch and the other on a front handle.

9.8 Do not put fingers or any object in a deflector to clean out chips while a planer is running.

9.9 Disconnect the power supply when stopping to dump out chips.

9.10 Do not set a planer down until blades have stopped turning.

9.11 Keep all cords clear of cutting area.

10.0 Routers

10.1 Ensure that the bit is securely mounted in the chuck and the base is tight.

10.2 Put the base of the router on the work, template or guide. Make sure that the bit can rotate freely before switching on the motor.

10.3 Secure stock. Never hold or have another individual hold the material. Sudden torque or kickback from the router can cause damage and injury.

10.4 Before using a router, check stock thoroughly for staples, nails, screws or other foreign objects.

10.5 Keep all cords clear of cutting area.

10.6 Always hold both hands on router handles, until a motor has stopped. Do not set the router down until the exposed router bit has stopped turning.

10.7 When inside routing, start the motor with the bit above the stock. When the router reaches full power, lower the bit to two times the required depth.

10.8 When routing outside edges, guide the router counter clockwise around the work.

10.9 When routing bevels, moldings and other edge work, make sure the router bit is in contact with the stock to the left of a starting point and is pointed in the correct cutting direction.

10.10 Feed the router bit into the material at a firm, controlled speed.

10.11 Softwood may enable fast router cutting speed. With hardwood, knotty and twisted wood, or with larger bits, cutting may be very slow.

10.12 The sound of the motor can indicate safe cutting speeds. When the router is fed into the material too slowly, the motor makes a high-pitched whine. When the router is pushed too hard, the motor makes a low growling noise.

10.13 When the type of wood or size of the bit requires going slow, make two or more passes to prevent the router from burning out or kicking back.

10.14 To decide the depth of cut and how many passes to make, test the router on scrap lumber similar to the work.

11.0 Circular Saws

11.1 Refer to *S3AM-305-ATT2 Circular Saw*.

12.0 Other Saws

12.1 Use lubricants when cutting metals.

12.2 Keep all cords clear of cutting area.

12.3 Cut green or wet material slowly and with caution. Check all material being cut for nails, hard knots, etc.

12.4 Make sure guards are installed and are working properly.

12.4.1 Table saws must be fitted with blade guards and a splitter to prevent the work from squeezing the blade and kicking back on the operator.

- Exposed parts of the saw blade under the table must be properly guarded.
- All swing cutoff and radial saws that are drawn across a table with limit stops to prevent the saw from traveling beyond the edge of the table

12.4.2 Ensure band saw blades are fully enclosed except at the point of operation.

12.4.3 Ensure swing cut-off saws have a guard completely covering the upper half of the saw.

12.5 Remember sabre saws cut on the upstroke.

12.6 Position the saw beside the material before cutting and avoid entering the cut with a moving blade.

12.7 Secure and support stock as close as possible to the cutting line to avoid vibration.

12.7.1 Hold the material being cut firmly against a back guide or fence and cut with a single, steady pass.

12.7.2 Use a push stick or guide when cutting operation requires the hands of the operator to come close to the blade.

12.7.3 When cutting long stock, provide extension tables and a helper to assist the operator.

12.7.4 Keep the base or shoe of the saw in firm contact with the stock being cut.

12.7.5 Automatic feed devices should be used whenever feasible.

12.8 Select the correct blade for the material being cut and allow it to cut steadily. Do not force it. Clean and sharp blades operate best.

12.9 Set the blade to go no further than 1/8 to 1/4 inch deeper than the material being cut.

12.10 Do not start cutting until the saw reaches its full power.

12.11 Do not force a saw along or around a curve. Allow the machine to turn with ease.

12.12 Do not insert a blade into or withdraw a blade from a cut or lead hole while the blade is moving.

12.13 Do not put down a saw until the motor has stopped.

12.14 Do not reach under or around the stock being cut.

12.15 Maintain control of the saw always. Avoid cutting above shoulder height.

12.16 External Cuts

12.16.1 Make sure that the blade is not in contact with the material or the saw will stall when the motor starts.

12.16.2 Hold the saw firmly down against the material and switch the saw on.

12.16.3 Feed the blade slowly into the stock, maintaining an even forward pressure.

12.17 Internal Cuts

12.17.1 Drill a lead hole slightly larger than the saw blade. With the saw switched off, insert the blade in the hole until the shoe rests firmly on the stock.

12.17.2 Do not let the blade touch the stock until the saw has been switched on.

Americas

Hand & Power Tool Maintenance Inventory

S3AM-305-FM1

Equipment (*Make, Model, Serial #*)	Equipment Owner	Equipment Status (*On Hire, Active, Decommissioned*)	Frequency of service	Service Type	Manufacturer's Standards	Industry Standards	Legislated Requirements	Location of Equipment

Americas

Hand & Power Tool Inspection Report

S3AM-305-FM2

TOOL	DATE	INSPECTED BY	RESULTS	ACTION REQUIRED	ACTION COMPLETED (DATE)

Americas

Hazardous Materials Shipping

S3AM-116-PR1

1.0 Purpose and Scope

1.1 This procedure prescribes the minimum requirements for shipping samples, hazardous materials (HzM) and dangerous goods. These minimum requirements are intended to prevent shipping-related incidents and prevent injuries to employees, members of the public, and emergency response personnel. This procedure is also designed to provide a framework for compliance with the requirements of:

- The U.S. Department of Transportation (DOT) Hazardous Materials Regulations (HMR) published under 49 CFR;
- Transport Canada Transportation of Dangerous Goods Regulations (TDG Regulations) for shipment of hazardous materials/dangerous goods by land;
- The International Air Transportation Association (IATA) Dangerous Goods Regulations (DGR) for shipping dangerous goods by air; and
- Other related regulations applicable to the Americas.

1.2 This document is not a replacement for the regulatory requirements, but is intended to provide information surrounding the shipment of HzM and/or Dangerous Goods.

1.3 Examples of hazardous materials / dangerous goods regulated by the DOT and IATA that may be encountered or used during AECOM business may include, but are not limited to, certain field environmental samples, compressed gases (fire extinguishers, calibration gases, compressed air, and welding and cutting gases), ionizing radiation sources used to calibrate detection equipment or analytical equipment, nuclear-density meters, laboratory reagents, hazardous wastes, materials used for bench-scale and pilot plant operations, oils, greases, lubricating fluids, cleaning solvents, degreasing solvents, paints, spray paints, paint removers and/or strippers, diesel fuel, gasoline, pesticides, inks, glues and other adhesives, battery fluids, ammonia cleaning solutions, and peroxide solutions.

1.4 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

A complete list of definitions can be found in their entirety in the HMR, the TDG Regulations, and the IATA DGR. The terms and definitions below are representative of those most likely applicable to AECOM operations.

2.1 **Agency Letter** – A letter approved by both AECOM's Legal Department and the client and that authorizes AECOM to act as its agent for the purpose of arranging for the transport and/or disposal of waste, and indemnifies AECOM's liability when acting "As an Agent of [client's name]".

2.2 **Carrier** – Also called the transporter. A person engaged in the transportation of passengers or property by land, water, or air either as a common, contract, private carrier, or civil aircraft.

2.3 **Consignor** – Also referred to as **Offeror**. The person who, prior to offering goods for transport, performs functions including selecting packaging, classifying hazardous materials, physical transfer (not to be confused with transport) of hazardous materials, preparing shipping papers, signing hazardous material certifications on shipping papers (as agent for), marking or placarding vehicles or packagings, or providing placards to carriers. See also **Generator**.

2.4 **Consignee** – Also called the receiver. The person or place shown on a shipping document, package marking, or other media as the location to which a carrier is directed to transport a hazardous material.

2.5 **Dangerous Goods** – Products, substances, or organisms which are capable of posing a risk to health, safety, property, or the environment and which are shown in the list of dangerous goods in the TDG Regulations and/or IATA DGR or which are classified according to the TDG Regulations and/or IATA DGR, generally synonymous with hazardous materials.

2.6 **Delegation of Authority (DoA)** – The framework of authority within which AECOM (Americas) carries out its day-to-day operations.

2.7 **Generator** – Any person, by site, whose act or process created the hazardous waste; hazardous waste generators are divided into categories based on the amount of waste they produce each month. A generator may also be a referred to as a **Consignor** when offering the hazardous waste for transport.

2.8 **Hazardous Materials (HzM)** – A substance or material which has been determined by the U.S. Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and includes hazardous substances, hazardous wastes, marine pollutants, and elevated temperature materials. Hazardous materials may include, but are not limited to: batteries, adhesives, paints, compressed gases, nuclear density meters, laboratory reagents, field samples, soil and sand siftings, hazardous wastes, and materials used for bench scale and pilot plant operations. While most environmental samples (both water and soil) do not meet the definition of hazardous material, extreme care must be taken to properly classify materials. HzM Classifications:

- Class 1 Explosives
- Class 2 Gases
- Class 3 Flammable Liquid and Combustible Liquid
- Class 4 Flammable Solid, Spontaneously Combustible, and Dangerous When Wet
- Class 5 Oxidizer, Organic Peroxide
- Class 6 Poison (Toxic), Poison Inhalation Hazard, Infectious Substance
- Class 7 Radioactive
- Class 8 Corrosive
- Class 9 Miscellaneous Hazardous Material.

2.9 **Hazardous Waste (HzW)** – A “solid waste” which because of its quantity, concentration, or physical, chemical, or infectious characteristics may

(1) pose a substantial hazard or potential hazard to human health or the environment when improperly treated, stored or disposed of, or otherwise mismanaged; or

(2) cause or contribute to an increase in mortality, or an increase in irreversible or incapacitating illness.

Four types of hazardous waste exist:

- Listed Waste: Wastes that USEPA has determined are hazardous. The lists include the F-list (waste from common manufacturing and industrial processes), K-list (wastes from specific industries), and P- and U-lists (wastes from commercial chemical products);
- Characterized Wastes: Wastes that do not meet any of the listings above but that exhibit ignitability, corrosivity, reactivity, or toxicity;
- Universal Wastes: Batteries, pesticides, mercury-containing equipment and lamps;
- Mixed Wastes: Waste that contains both radioactive and hazardous waste components.

2.10 **Hazardous Waste Manifest System** – A set of forms, reports, and procedures designed to track hazardous waste from the time it leaves the generator facility where it was produced, until it reaches the off-site waste management facility that will store, treat, or dispose of the hazardous waste.

2.11 **HzM Employee** – A person who is employed by a HzM employer, who in the course of employment directly affects dangerous goods/hazardous materials transportation safety. This term includes employees who prepare hazardous materials for transportation, or are responsible for safety of transporting hazardous materials.

2.12 **HzM Employer** – A person who uses one or more of its employees in connection with transporting dangerous goods/hazardous materials in commerce, causing hazardous materials to be transported or shipping in commerce.

2.13 **HMR** – Hazardous Material Regulation.

2.14 **IATA** – International Air Transport Association.

2.15 **ICAO** – International Civil Aviation Organization.

2.16 **Hazardous Waste Manifest** – A paper document that contains information on the type and quantity of the waste being transported, instructions for handling the waste, and signature lines for all parties involved in the disposal process, which must be signed by each party that handles the waste.

2.17 **Materials of Trade (MOT)** – A hazardous material, other than a hazardous waste, that is carried on a motor vehicle:

- For the purpose of protecting the health and safety of the motor vehicle operator or passengers;
- For the purpose of supporting the operation or maintenance of a motor vehicle (including its auxiliary equipment); or
- By a private motor carrier in direct support of a principal business that is other than transportation by motor vehicle.
- Refer to *S3AM-116-ATT1 Materials of Trade Limits.*

2.18 **NAPL** – Non-aqueous phase liquid

2.19 **Offeror** – Refer to **Consignor**.

2.20 **Reportable Quantity (RQ)** – The spill-related or incident-related quantity of a material listed in the applicable Federal, State, or Provincial regulations requiring a formal report.

2.21 **TDG** – Transportation of Dangerous Good – Canadian Act and Regulation.

2.22 **Transporter** – Refer to **Carrier.**

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-004-PR1 Incident Reporting, Notification & Investigation

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager / Supervisor**

- Verifying the potential to ship HzM via a carrier during the planned scope of services and if confirmed, identify the appropriately trained individuals are available to support the HzM shipment;
- Prior to authorizing an AECOM employee to sign a client's Hazardous Waste Manifest, the Manager will:
    - Verify with the Office of Risk Management that the necessary Delegations of Authority (DoA), Americas approvals are in-place.

- Obtain an Agency Letter approved by both the client and AECOM Counsel.

- Prior to assignment, confirm that employees are properly trained to perform their job-specific assignments.
- Filing copies of all HzM shipping documents in the associated program or project files.
- As applicable, providing for the appropriate storage of the HzM in the office or other necessary location.
- Verifying that the HzM to be shipped is prepared / packaged by the designated AECOM DOT Level 1 or 2 Shipper (United States), appropriately TDG trained personnel (Canada), or personnel trained to the requirements of the applicable jurisdiction, type of HzM and method of transport.
- Immediately reporting any incident, spill, release, mishandling, mislabeling, etc. related to an HzM shipment to AECOM's Incident Reporting Line, refer to *S3AM-004-PR1 Incident Reporting, Notifications & Investigations*.

4.1.2 **SH&E Department**

- Contracting a 24-hour emergency response service with a telephone number that will be answered by a person either with information on the hazards of the shipment or with immediate access to such a person.
- Maintaining the annual renewal of AECOM's U.S. DOT Hazardous Materials Registration and applicable renewals of Canadian TDG Permits.
- Posting AECOM's Hazardous Materials Registration and Permits on the AECOM intranet.
- Defining the training to be required of employees involved in HzM shipping and facilitating the delivery of that training.

4.1.3 **SH&E Manager**

- Providing resources to employees involved in shipping hazardous materials.
- Approving the designation of a AECOM DOT Level 2 Shipper (United States).
- Supporting the delivery of HzM shipping and Hazardous Waste Manifest training.

4.1.4 **Counsel**

- Reviewing and approving the Agency Letter authorizing AECOM to sign a client's Hazardous Waste Manifest "As an Agent of [client's name]".
- Updating the template Agency Letter to address additional liabilities, as necessary.
- Providing the template Agency Letter to Managers, as requested.

4.1.5 **Office of Risk Management**

- Supporting Managers in understanding the applicable *Sub-Delegations of Authority, Americas* requirements as it pertains to signing a client's Hazardous Waste Manifest "As an Agent of [client's name]".

4.1.6 **Employee**

- Completing training appropriate to role(s) in hazardous materials shipping.
- Shipping or transporting HzM as authorized and in compliance with training.
- Signing a client's Hazardous Waste Manifest as authorized.
- Immediately reporting any incident, spill, release, mishandling, mislabeling, etc. related to a HzM shipment to the Manager or Supervisor and in accordance with *S3AM-004-PR1 Incident Reporting, Notifications & Investigations*.

- As required and applicable, initiating emergency response procedures.

4.1.7 **AECOM DOT Level 1 Shipper (United States)**

- Identifying, with the support of an AECOM DOT Level 2 Shipper, the appropriate HzM shipping requirements (e.g., mode of transportation, packaging, labelling, regulated status, and shipping documents, etc.).
- Preparing the HzM for shipment (e.g., packaging, labelling, etc.).
- Preparing the necessary HzM shipping documents.
- Contacting a AECOM DOT Level 2 Shipper if uncertain of the shipping requirements.
- Maintaining the appropriate training as required by the HMR, TDG, and IATA.

4.1.8 **AECOM DOT Level 2 Shipper (United States)**

- Serving as the HzM shipping Subject Matter Expert for the Geography, Business Group, or business unit, as appropriate.
- Supporting information requests from AECOM DOT Level I Shippers.

4.2 General Requirements

4.2.1 Do not offer packages for shipment without knowing the contents and classifying the packages in accordance with the DOT or TDG requirements, and, if applicable, IATA regulations.

4.2.2 Select the best way to ship the hazardous material based on the quantity, hazard(s), and mode of transportation (e.g., air, land, water). When possible, only use ground carriers for transportation of hazardous material, since more restrictive requirements apply to air shipments.

- The air shipment of environmental samples represents a significant percentage of hazardous materials/dangerous goods shipped by AECOM.
- Although most environmental samples (both water and soil) do not meet the definition of hazardous, extreme care must be taken to properly classify materials.
- AECOM employees must follow the IATA Dangerous Goods Regulations for any air transportation of hazardous materials.

4.2.3 Employees trained and designated as AECOM HzM DOT Level 1 or 2 Shippers (United States), appropriately TDG trained personnel (Canada), or personnel trained to the requirements of the applicable jurisdiction, are the only individuals authorized to physically transport or prepare documents to ship HzM via a carrier.

- Employees shall confirm training documentation is valid and readily available when handling or transporting dangerous goods.

4.2.4 Shipments of HzM must be placed in appropriate containers to prevent any leaks or releases of the HzM. Containers of dangerous materials, no matter what shape or size, shall be labeled;

- Specific packaging and shipping instructions apply to all hazardous material shipments. These instructions vary by chemical/product and are different for passenger aircraft and cargo aircraft.
    - Carrier-specific requirements can be obtained from the Internet or by calling the carrier's customer service line.
- Carrier (transporter) shall confirm cargo is securely loaded, properly segregated and free of leaks prior to departure.
- Carrier (transporter) shall refuse consignments of hazardous materials that are offered for transport that do not meet the requirements of the applicable regulations.

- Vehicles that transport dangerous materials as per regulations shall appropriately display the applicable placards (e.g. correct placard(s), clean and in appropriate locations) and any other required information (e.g. motor vehicle carrier number, etc.).
- Carrier (transporter) shall replace any marks that are damaged or lost while in transport.

4.2.5 Proper shipping documents or the appropriate exemption Permit, must accompany every shipment of dangerous materials.

4.2.6 Specific technical names must be used on shipping documents (i.e., Shipper's Declaration for Dangerous Goods); never use an acronym (i.e., LNAPL) as the technical name.

4.2.7 AECOM has selected INFOTRAC® (http://www.infotrac.net/) to provide 24-hour emergency response support service in the United States and Canada. All HzM shipping papers which list INFOTRAC® for 24-hour emergency response must list AECOM's account number 74984.

- All HzM shipments via a carrier must be reported to INFOTRAC.

4.2.8 If AECOM is the consignor (shipper or generator), registration with CANUTEC (Canada) to provide 24-hour emergency contact is permitted and shall be confirmed prior to shipment. If AECOM is listed on the shipping document (Canada) as carrier (transporter) only, registration with CANUTEC does not apply, and an alternate 24-hour emergency number shall be in place (e.g. INFOTRAC).

- Emergency response procedures applicable to the dangerous materials transported shall be developed and followed in the event of an incident.
- Employees shall be appropriately trained to these procedures, AECOM incident reporting requirements (refer to *S3AM-004-PR1 Incident Reporting, Notification & Investigation*) and any applicable external reporting requirements.
- A copy of applicable emergency response information should be supplied with the shipping papers for responders to use in emergency situations (e.g. Canada – Emergency Response Assistance Plan [ERAP, appropriate pages from the DOT Emergency Response Guidebook [ERG], and/or Safety Data Sheets [SDS]).
- The external reporting requirements and to which agency or body, as specified in regulation, vary according to jurisdiction and the class of the goods spilled, released, lost, stolen or misplaced (e.g. local authorities or police, National Response Center, Center for Disease Control, etc.).
    - External reporting requirements for spills, releases, loss, theft or misplacement of hazardous materials are dependent upon the quantities or levels of the hazardous materials involved in the incident.
- AECOM shall submit a written report of all incidents involving the transportation of hazardous materials as required to all appropriate entities, that could include:
    - The U.S. Department of Transportation;
    - U.S. National Response Center
    - Transport Canada within 30 days of a reportable occurrence (Dangerous Occurrence Report); or
    - Any other agency as required by regulation.
- Report in any other manner as specified by the applicable jurisdiction.

4.2.9 Employees are not authorized to physically transport HzM quantities, in a motor vehicle, in excess of the MOT limits. Refer to *S3AM-116-ATT1 Materials of Trade Limits*.

4.2.10 Carrier (transporter) shall inspect for transportation of dangerous materials compliance as a part of vehicle inspections.

4.2.11 AECOM will never be identified as the GENERATOR on a client's Hazardous Waste Manifest.

- Employees are only authorized to sign a client's Hazardous Waste Manifest if:

- The necessary approvals have been obtained per the *Sub-Delegations of Authority, Americas*;
- The client could not logistically sign the manifest given they were not on the site;
- An Agency Letter was signed by the client and approved by AECOM Counsel; and
- Employees completed the required training.

- Never sign a client's Hazardous Waste Manifest as AECOM; sign "As an Agent of [client name]".

4.2.12 Carrier (transporter) shall transport materials using identified "Dangerous Goods Routes" as applicable.

4.2.13 Carrier (transporter) shall verify that trans-national movement of waste meets requirements of the Basel Convention, as well as appropriate internationally recognized standards for the mode (e.g., International Maritime Dangerous Goods [IMDG] Code, International Air Transport Association [IATA] Dangerous Goods Regulations [DGR], etc.).

4.3 Security

4.3.1 AECOM sites that transport or offer the following types or quantities of materials for transportation in the United States must have a Hazardous Material Transportation Security Plan on site and must ensure that all applicable employees are trained in the plan:

- Any quantity of a Division 1.1, 1.2, or 1.3 material.
- A quantity of a Division 1.4, 1.5, or 1.6 material requiring placarding in accordance with subpart F.
- A large bulk quantity of Division 2.1 material.
- A large bulk quantity of Division 2.2 material with a subsidiary hazard of 5.1.
- Any quantity of a material poisonous by inhalation, as defined in 49 CFR 171.8.
- A large bulk quantity of a Class 3 material meeting the criteria for Packing Group I or II.
- A quantity of desensitized explosives meeting the definition of Division 4.1 or Class 3 material requiring placarding in accordance with subpart F.
- A large bulk quantity of a Division 4.2 material meeting the criteria for Packing Group I or II.
- A quantity of a Division 4.3 material requiring placarding in accordance with subpart F.
- A large bulk quantity of a Division 5.1 material in Packing Groups I and II; perchlorates; or ammonium nitrate, ammonium nitrate fertilizers, or ammonium nitrate emulsions, suspensions, or gels.
- Any quantity of organic peroxide, Type B, liquid or solid, temperature controlled.
- A large bulk quantity of Division 6.1 material (for a material poisonous by inhalation see paragraph (e) above).
- A select agent or toxin regulated by the Centers for Disease Control and Prevention under 42 CFR 73 or the United States Department of Agriculture under 9 CFR 121.
- A quantity of uranium hexafluoride requiring placarding under 49 CFR 172.505(b).
- International Atomic Energy Agency (IAEA) Code of Conduct Category 1 and 2 materials including Highway Route Controlled quantities as defined in 49 CFR 173.403 or known radionuclides in forms listed as RAM-QC by the Nuclear Regulatory Commission.
- A large bulk quantity of Class 8 material meeting the criteria for Packing Group I.

4.3.2 The specific HzM security plan shall be reviewed annually and updated if required.

4.4 Training

4.4.1 Employees involved in shipping hazardous materials/dangerous goods (e.g., packaging, preparing paperwork, loading and/or unloading, and transporting hazardous materials) are required to have documented training prior to shipping activities, refer to *S3AM-003-PR SH&E Training*. Training requirements are based on the type of materials shipped (e.g., calibration/compressed gases, laboratory reagents, field samples, hazardous wastes, etc.) and employee responsibility.

- AECOM (US) DOT Level 1 Shipper Performance Training: The specific content of this training (typically 4 hours) is focused on proper procedures for packaging, labeling and shipping HzM/HzW over land and sea. This training has a three year renewal requirement.
- AECOM (US) DOT Level 2 Shipper Performance Training: A comprehensive 2-day HzM shipping training course typically completed in an in-person seminar.
- IATA Performance Training: This training supplements (US) DOT Level 1 training and provides additional information for the proper shipment of HzM/HzW via air transportation. This training has a two year renewal requirement.
- Resource Conservation and Recovery Act (RCRA) Part B Awareness Training (US Project Sites): Applicable to employees shipping HzW, including listed wastes, from US project sites. General RCRA Awareness training can be completed through online vendors. Additional project-specific training regarding HzW generation, project site roles and responsibilities, HzW management and shipment will need to be coordinated between the Manager and Client. Training may also include procedures for signing waste documents, i.e. profiles and characterization forms, where permitted by client contracts. Training will be provided in accordance with Permits, Consent Orders or other Regulatory Agency-issued agreements regarding project site HzW generation. This training has an annual renewal requirement.
- TDG Training: Training is focused on proper procedures for labeling, placarding, documenting and shipping of HzM/HzW. This training has a three year renewal requirement.

4.5 Documentation

4.5.1 Permits

- The carrier (transporter) shall obtain any required permits prior to transporting hazardous materials.

4.5.2 Bills of Lading

- Bills of Lading documents include those generated when shipping non-hazardous materials and hazardous materials and include Oilfield Waste Manifests and Hazardous Waste Manifests. Bills of Lading are to be completed as follows:
  - Consignor (shipper or generator) shall input or provide the appropriate information, including the consignor's information (e.g. name, address, etc.) and the appropriate identifiers for the materials to be transported.
    - If the item is a dangerous material, it must be clearly identified as a dangerous good (e.g. marked with an "X" in the DG column), and the primary class and subsidiary class must be entered along with the UN number, name, packing group (if applicable) and quantity.
  - The carrier (transporter) shall enter in full the Carrier information, such as:
    - Company name, address, date, truck unit number, and telephone number.
    - The applicable emergency response information, including the 24-hour emergency number.
    - Carrier's employee shall confirm the bill of lading has been properly completed, print his/her name and sign the form prior to transport.
  - The carrier (transporter) driver shall maintain the bill of lading within immediate reach when restrained by a seatbelt and visible to a person entering the vehicle, or in a holder mounted on the inside of the driver's door.

    - Once the waste is transported to the destination, the consignee (receiver) completes their appropriate sections.
- Copies are maintained by the consignor, carrier and consignee.

5.0 Records

5.1 Bill of Lading and Shipper's Declaration for Dangerous Goods shall be retained in the project files for a minimum of 2 years.

5.2 Agency Letters and hazardous waste manifests shall be retained in the project files for at least 3 years after the initial carrier accepted the material.

6.0 Attachments

6.1 S3AM-116-ATT1 Materials of Trade Limits

Americas

Materials of Trade Limits

S3AM-116-ATT1

1.0 United States

1.1 The Department of Transportation (DOT) "Materials of Trade" or "MOTs" exception applies to hazardous materials, other than hazardous waste, that are carried on a motor vehicle for one of the following purposes:

1.1.1 To protect the health and safety of the motor vehicle operator or passengers, such as insect repellant or a fire extinguisher;

1.1.2 To support the operation or maintenance of a motor vehicle (including its auxiliary equipment), such as a spare battery or gasoline; or

1.1.3 To directly support a principal business of a private motor carrier (including vehicles operated by a rail carrier) that is other than transportation by motor vehicle – for example, landscaping, pest control, painting, plumbing, or welding services.

1.2 Some AECOM activities (e.g., environmental sampling and other field services), may be able to use this exception. The exception is found in the Code of Federal Regulations at 49 CFR 173.6. A HzM-trained employee should make the determination as to whether this exception will apply to the shipment.

1.3 The MOTs exception allows AECOM employees to transport certain amounts of chemicals aboard their vehicles without preparing shipping papers, emergency response information, placarding, or formal training.

1.4 MOTs must be packaged in the manufacturer's original packaging, or a packaging of equal or greater strength or integrity. Gases must be in DOT specification cylinders. If the inner container (such as the bottle) is secured against movement inside the vehicle (if it is kept in a cabinet or tool box), then no outer packaging (such as a cardboard box) is required. The MOT must be marked with a common name or the technical name.

1.5 No HzM training is required, except that the driver must have general knowledge of the MOT regulations, quantity limitations, packaging requirements, and marking and labeling requirements. The driver is not allowed to exceed total aggregate weight of 440 pounds of MOTs aboard the vehicle.

1.6 The HzM classes and quantities of HzM items typically transported by AECOM can be transported as MOTs:

1.7 The inner container of a Packing Group II and III material in Class 3, 8, 9, Division 4.1, 5.1, 5.2, 6.1, or ORM-D cannot exceed 66 pounds (30 kilograms) or 8 gallons each.

1.8 A Division 2.1 or 2.2 cylinder cannot exceed 220 pounds (100 kilgrams).

1.9 The inner container of a Packing Group II or II material in Division 4.3 cannot exceed 1 ounce (28 grams).

2.0 Canada

2.1 Canada's TDG Regulations apply to everyone. They even apply when an individual transports dangerous goods such as gasoline, oxygen and propane for personal use. However certain exemptions exist for small quantities or for specific situations.

2.1.1 Most of these exemptions, which are called "special cases", are found in Part 1 of the TDG Regulations, under section 1.15 to 1.48. This document contains a basic overview of a few of these "special cases."

2.1.2 These "special cases" may exempt the parties involved from documentation requirements, or placarding and training requirements of the TDG Regulations.

2.1.3 Please refer to the TDG Regulations for further guidance before applying exemptions.

2.2 150 kilogram gross mass exemption

2.2.1 The total gross mass of all dangerous goods (i.e. oxygen, propane, gasoline, etc.) must not be greater than 330 pounds (150 kilograms). "Gross mass" includes the weight of the container and all of its contents.

2.2.2 The dangerous goods must be packed in containers that weigh 66 pounds (30 kilograms) or less (except for gases).

2.2.3 The dangerous goods must be available to the general public and transported by the user/purchaser or by a retailer to or from a user/purchaser.

2.2.4 The containers must be designed not to leak under normal conditions of transport.

2.2.5 When using the "150 kilogram Gross Mass Exemption" for class 2 gases, remember:

- If transporting a gas such as propane or oxygen, the cylinder must be certified for use in Canada and marked with the letters TC or DOT/TC;
- Flammable gases, such as propane or acetylene, are limited to a cylinder size of 46L.

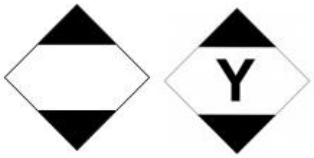
2.3 Limited Quantity

2.3.1 A limited quantity is a small quantity of dangerous goods to which the general public normally has access, such as aerosol sprays and small cans of paint.

2.3.2 Since dangerous goods cannot all be shipped as limited quantities, consult Column 6(a) of Schedule 1 of the TDG Act and Regulation.

2.3.3 Do not ship dangerous goods as a "limited quantity" when a “0” is in Column 6(a) of Schedule 1.

2.3.4 Each means of containment (i.e. box, etc.) must have a gross mass of 66 pounds (30 kilograms) or less and display one of the following international marks:



2.4 Gases in Small Means of Containment

2.4.1 This exemption allows for the transport up to 1102 pounds (500 kilograms) of the gases listed below. When using this exemption, the maximum amount of cylinders is limited to five. The cylinders must be visible from outside the vehicle.

- UN1001, ACETYLENE, DISSOLVED;
- UN1002, AIR, COMPRESSED;
- UN1006, ARGON, COMPRESSED;
- UN1013, CARBON DIOXIDE;
- UN1060, METHYLACETYLENE AND PROPADIENE MIXTURE, STABILIZED;
- UN1066, NITROGEN, COMPRESSED;
- UN1072, OXYGEN, COMPRESSED; or
- UN1978, PROPANE.

Americas

Hazardous Waste Operations

S3AM-117-PR1

1.0 Purpose and Scope

1.1 Provides requirements for AECOM operations pertaining to hazardous waste and emergency response (HAZWOPER) services. In Canada and South America, there is no direct counterpart to HAZWOPER; however, as due diligence and in compliance with applicable duty of care/general duty clauses, staff working in Canada and South America will comply with this procedure as far as it aligns with the location's respective legislation.

1.2 Provides a procedure intended to address small incidental spills from work related equipment and supplies. For operations with bulk quantities of fuels, chemicals, oils, and for operations where AECOM is providing emergency response services for spills, the SH&E Manager or designee shall specify spill prevention and preparedness criteria including training, equipment, and proficiency.

1.3 To define appropriate procedures to decontaminate both equipment and personnel when exposure to hazardous chemicals or physical agents has occurred.

1.4 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 **Contamination Reduction Zone (CRZ)** – The transition area between the contaminated area and the clean area where decontamination activities occur.

2.2 **Decontamination** – The process of removing or neutralizing contaminants that have accumulated on personnel or equipment.

2.3 **Emergency Response** – A response effort by employees from outside the immediate release area or by other designated responders (e.g.., mutual-aid groups, local fire departments, etc.) to an occurrence that results, or is likely to result, in an uncontrollable release of a hazardous substance or whenever a release requires that a federal, state, territorial or provincial agency be notified, such as:

- A release at or above a reportable quantity (RQ) of a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) hazardous substance (40 CFR 302.8) is required to be reported to the National Response Center (NRC).
- A release at or above provincial reporting thresholds, if any, or alternatively those specified under the Canadian Transportation of Dangerous Goods Act are reportable under the Canadian Environmental Protection to the respective provincial or territorial Environmental Regulatory Agency .
- A hazardous chemical release at or above an RQ under the Emergency Planning and Community Right-to-Know Act (EPCRA) (Title III under the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 350-372) is required to be reported to state and local officials.
- A release in violation of a facilities Spill Prevention, Control, and Countermeasure (SPCC) Plan (40 CFR 112).

Responses to incidental release of hazardous substances where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area or by maintenance personnel are not considered to be emergency responses within the scope of the HAZWOPER standard. Responses to releases of hazardous substances where there is no potential safety or health hazard are not considered to be emergency responses.

2.4 **Exclusion Zone (EZ)** – The area where contamination does or could occur.

2.5 **First Responder** – First responders are individuals who are likely to witness or discover a hazardous substance release, injury, fire, or other incident and who have been trained to initiate an emergency response sequence by notifying the proper authorities of the release. They would take no further action beyond first aid, initial control of the incident, and notifying the authorities and others of the incident.

2.6 **Hazardous Materials** – A hazardous material is any item or agent (biological, chemical, physical) that has the potential to cause harm to humans, animals, or the environment, either by itself or through interaction with other factors. Additionally a hazardous material may be defined as any substance or chemical which is a "health hazard" or "physical hazard," including chemicals that are carcinogens, toxic agents, irritants, corrosives, sensitizers; agents that act on the hematopoietic system; agents that damage the lungs, skin, eyes, or mucous membranes; chemicals that are combustible, explosive, flammable, oxidizers, pyrophoric, unstable-reactive, or water-reactive; and chemicals that in the course of normal handling, use, or storage may produce or release dusts, gases, fumes, vapor, mists, or smoke that may have any of the previously mentioned characteristics. This may be caused when released by spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, disposing into the environment, by being transported or moved, and items or chemicals that are "special nuclear source" or by-product materials or radioactive substances.

2.7 **Hazardous Materials Specialist** – Hazardous materials specialists are individuals who respond with and provide support to hazardous materials technicians. Their duties parallel those of the hazardous materials technician; however, those duties require a more directed or specific knowledge of the various substances they may be called upon to contain. The hazardous materials specialist would also act as the site liaison with federal, state, local, and other government authorities in regards to site activities.

2.8 **Hazardous Materials Technician** – Hazardous materials technicians are individuals who respond to releases or potential releases for the purpose of stopping the release. They assume a more aggressive role than a first responder in that they will approach the point of release in order to plug, patch, or otherwise stop the release of a hazardous substance.

2.9 **Hazardous Waste** – Hazardous waste is waste that is dangerous or potentially harmful to our health or the environment. Hazardous wastes can be liquids, solids, gases, or sludge. They can be discarded commercial products, like cleaning fluids or pesticides, or the by-products of manufacturing processes. Hazardous waste are divided into:

- Listed wastes (http://www.epa.gov/osw/hazard/wastetypes/listed.htm);
- Characteristic wastes (http://www.epa.gov/osw/hazard/wastetypes/characteristic.htm);
- Universal wastes (http://www.epa.gov/osw/hazard/wastetypes/universal/index.htmwastes); and
- Mixed wastes;
- Specific procedures determine how waste is identified (http://www.epa.gov/osw/hazard/wastetypes/wasteid/index.htm), classified, listed, and delisted.

2.10 **Health and Safety Plan (SH&E PLAN)** – A document prepared for each project that contains site-specific information including the Emergency Response Plan for the project.

2.11 **Incidental Releases** - A response to a spill or release of a hazardous substance (in quantities below its RQ) where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area using equipment and materials available to them at the time or the spill or release. Any spill or release that cannot be managed with the personnel, materials, and equipment at the site shall be considered an Emergency Response.

- Responses to releases of hazardous substances where there is no potential safety or health hazard (i.e., fire, explosion, or chemical exposure) are not considered to be emergency responses. Handling of incidental releases shall be in accordance with applicable standard operating procedures.

2.12 **Incident Command System (ICS)** – ICS is a standardized on-scene incident management concept designed specifically to allow responders to adopt an integrated organizational structure equal to the complexity and demands of any single incident or multiple incidents without being hindered by jurisdictional boundaries. In the ICS the first person responding to an incident becomes the Incident Commander and turns that title and duties over to more qualified responders as they arrive on scene.

2.13 **Incident Commander** – The Incident Commander (IC) is responsible for all aspects of the response, including developing incident objectives and managing all incident operations. The title and responsibilities are typically assumed by a qualified IC from the client or public sector.

2.14 **Support Zone (SZ)** – An uncontaminated zone where administrative and other support functions (e.g. first aid, equipment supply, emergency information, etc.) are located.

3.0 References

3.1 SR1-003-WI2 Disruptive Event Response Instruction

3.2 S3AM-003-PR1 SH&E Training

3.3 S3AM-004-PR1 Incident Reporting, Notifications & Investigation

3.4 S3AM-010-PR1 Emergency Response Planning

3.5 S3AM-012-PR1 First Aid

3.6 S3AM-017-PR1 Injury & Illness Recordkeeping

3.7 S3AM-127-PR1 Exposure Monitoring

3.8 S3AM-128-PR1 Medical Screening & Surveillance

3.9 S3AM-208-PR1 Personal Protective Equipment

3.10 S3AM-209-PR1 Risk Assessment & Management

3.11 S3AM-213-PR1 Subcontractor Management

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager**

- Enforces and supports the implementation of SH&E Plans, Location Specific Emergency Response Plans, and Spill Response Plans;
- Prepare or request a SH&E Plan for every AECOM project with Hazardous Waste Operations and Emergency Response Activities, refer to *S3AM-209-PR1 Risk Assessment & Management*;
- Verify that all personnel working on the project are qualified to perform the activities they are assigned (see HAZWOPER and Emergency Spill Response Training requirements below);
- Request client's emergency response procedures;
- Appoint a Site Safety Officer (SSO) with appropriate qualifications for the specific hazardous waste project;
- Confirm that the SSO for complex projects, such as those with complicated remediation activities, has no duties other than site safety and health of the field team;
- Confirm the communication of the location-specific emergency response plan details to all employees assigned to a field project;
- Authorize the procurement of the necessary decontamination supplies;

- Verify that the applicable decontamination steps are clearly defined in the approved SH&E Plan;
- Verify staff are appropriately trained to execute the defined decontamination procedures;
- Verify that adequate staffing is available to safely conduct the applicable decontamination steps;
- Confirm that the necessary communications equipment for the project is available;
- Confirm that incident investigations are performed as required and a report is filed. Refer to *S3AM-004-PR1 Incident Reporting, Notifications & Investigation*;
- During spill response, all AECOM emergency responders and their communications shall be coordinated and controlled through the Manager. The individual in charge shall implement the and shall be responsible for the following tasks:
    - Become the individual in charge at the incident until relieved by more qualified personnel;
    - Notify the appropriate agency, the AECOM incident Reporting line, and operations. Refer to *S3AM-117-ATT1 Spill Notification Numbers North America* for US and Canadian required notifications;
    - Designate a safety supervisor who is knowledgeable about the operations being implemented at the emergency response site and who will have specific responsibility to identify and evaluate hazards and to provide direction on the safety of operations for the emergency at hand. If the safety supervisor judges activities to be an Immediately Dangerous to Life or Health (IDLH) and/or to involve an imminent danger condition, the safety supervisor shall have the authority to alter, suspend, or terminate those activities. The safety official shall immediately inform the individual in charge of the ICS of any actions needed to be taken to correct these hazards at the emergency scene;
    - Identify all hazardous substances or conditions present and address as appropriate site analysis, use of engineering controls, maximum exposure limits, hazardous substance, and handling procedures;
    - Implement appropriate emergency operations. Refer to *S3AM-010-Emergency Response Planning*;
    - Limit the number of emergency response personnel at the emergency site;
    - Implement the buddy system in groups of two or more;
    - Confirm that the PPE worn is appropriate for the hazards to be encountered;
    - Implement appropriate decontamination procedures after emergency operations have terminated.
- Responsibility for the emergency response shall be transferred upon arrival of a more qualified AECOM Incident Commander or a Public Service Incident Commander.
- Confirm appropriate communications concerning an emergency event are initiated as per *S3AM-010-PR1 Emergency Response Planning* and *SR1-003-WI2 Disruptive Event Response Instruction*.

4.1.2 **SH&E Manager or designee**

- Provide technical guidance for:
    - The development and implementation of SH&E Plans and Emergency Response Plans;
    - The Incident Commander regarding the correct way to respond to the spill;
    - Project-specific Spill Response Plans when required;

- Prepare emergency action plans as part of project SH&E Plans and emergency reference sheets;
- Interface with the local emergency responders when necessary;
- Interface with clients regarding facility emergency response procedures;
- Decide whether AECOM or an outside emergency response company will clean up the spill;
- Report spills, as necessary, to state/provincial environmental agencies;
- Review the incident report and facilitate the post-response discussion;
- Review and revise this procedure as necessary based on recommendations from post-response discussions;
- Advise Managers and Supervisors on the necessary decontamination procedures for the known or reasonably anticipated chemical hazards and physical agents associated with the planned scope of work;
- Support the project team to verify that adequate protective measures are in-place (e.g. Engineering Controls, Administrative Controls, Personal Protective Equipment, etc.).

4.1.3 **Site Safety Officer (SSO)**

- Verify that a SH&E PLAN is available for the project and is reviewed prior to the commencement of site activities;
- Conduct pre-entry briefing and daily tailgate meetings and review facility, site-specific emergency procedures, and site specific decontamination procedures;
- Communicate the site-specific emergency response details to all employees assigned to a field project;
- Establish the designated site work zones (e.g., EZ, CRZ, SZ, etc.);
- Enforce the applicable decontamination steps as defined in the approved SH&E Plan;
- Initiate Stop Work and emergency response procedures as required;
- Account for all AECOM and subcontractor employees after site evacuation;
- Brief on-site and off-site responders in the event of an emergency;
- Conduct site-specific training on the applicable decontamination steps/procedures;
- Procure the necessary decontamination supplies and establishing the decontamination line;

4.1.4 **Employees**

- Maintain HAZWOPER training, or equivalent training as it relates to the given jurisdiction;
- Follow the SH&E Plan and emergency procedures prepared for the project;
- Initiate Stop Work if necessary;
- Initiate emergency response via verbal communications or the alarm system if first to encounter an emergency;
- Follow the defined decontamination steps as stated in the approved SH&E Plan;
- Follow precautions and safe handling practices to avoid spills;
- Alert Manager to any deteriorating hazardous materials containers within the office or project area;
- Report all spills and leaks to the Manager immediately;
- Secure the spill area as quickly as possible and prevent the migration of exterior spilled materials or substances to drains or other openings; and

4.1.5 **All personnel** (e.g., AECOM employees, general laborers, equipment operators, chemists, supervisors, etc.) performing activities at hazardous waste sites that expose or potentially expose them to hazardous wastes and health hazards are considered HAZWOPER site workers and shall meet the training and medical surveillance requirements specified in 29 CFR 1910.120(e) and (f), respectively. Additional training may be required based on site activities including related exposures and risks (e.g., confined space entry, excavations, fall protection, other materials [lead], etc.). These additional training requirements are to be outlined in the project- or site-specific SH&E Plan.

4.2 Project SH&E Documentation—SH&E Plan

4.2.1 The project SH&E documentation prepared for HAZWOPER activities is referred to as a site-specific SH&E Plan, and shall meet the requirements presented in 29 CFR 1910.120(b)(4).

4.2.2 A safety and health risk or hazard analysis for each on-site task that will be performed.

4.2.3 The required SH&E Plan elements include:

- A description of the work location, the site history, and a summary of any information available concerning site hazards (including both physical hazards and contamination conditions);
- A summary of the work activities to be performed under AECOM's scope of activities;
- Identified risks shall include both chemical and physical hazards to which personnel may be exposed during the conduct of the work task;
- Protective measures for each work task to prevent or mitigate the potential hazards identified in the hazard analyses;
- Personal protective equipment (PPE) requirements for each work task**.** Refer to *S3AM-208-PR1 Personal Protective Equipment*;
- Frequency and types of air monitoring, personal monitoring, and environmental sampling techniques and instrumentation to be used;
- Site control measures;
- Decontamination procedures;
- An emergency response plan, *S3AM-010-PR1 Emergency Response Planning*, addressing actions to be taken in the event of each type of credible incident that might result during the performance of planned work activities, including minor and major injuries, and chemical release and fire. Response plans shall address the means for coordinating the evacuation of all on-site personnel in the event of a catastrophic incident.

4.2.4 Responsibility for development of each AECOM SH&E Plan will be coordinated between the Manager and the SH&E Manager or SH&E Department designee as part of project initiation. Regardless of where the SH&E Plan is developed, it will be reviewed and approved by the SH&E Manager prior to submission to any agency outside of AECOM.

4.2.5 Contractors and Subcontractors

- The health and safety of the employees of any contractor or subcontractor who does not have a contract directly with AECOM, and for whom AECOM does not have contractual safety oversight, is the responsibility of that contractor or subcontractor. The contractor or subcontractor shall evaluate the hazards and potential hazards to their own employees and shall adhere to their own Health and Safety Plan;
- Subcontractors who maintain a contract directly with AECOM shall comply with AECOM SH&E program requirements. Refer to *S3AM-213-PR1 Subcontractor Management*;
- In addition, all AECOM subcontractors' Health and Safety Plans shall, at a minimum conform to the requirements of the AECOM SH&E Plan. The AECOM SH&E Plan does not, nor is it intended to, address procedures of contractors or subcontractors during their site activities.

4.3 Personnel Qualifications— Training and Medical Surveillance

4.3.1 HAZWOPER-qualified employees shall participate in the following medical surveillance and training requirements. Medical surveillance and SH&E training requirements are further described in *S3AM-128-PR1 Medical Screening & Surveillance* and *S3AM-003-PR1 SH&E Training* respectively.

4.3.2 Employees receiving initial and refresher responder training shall be issued a certificate indicating training competency. Copies of all training records shall be maintained in accordance with the *S3AM-003-PR1 SH&E Training*.

4.3.3 Medical Surveillance

- Specific HAZWOPER medical examination protocols have been developed by AECOM's Corporate Medical Provider (CMP) to meet the requirements of 29 CFR 1910.120(f). To be medically qualified to perform HAZWOPER work, employees receive the following medical examinations:
    - Initial (Baseline) Examination — The initial examination is part of pre-employment requirements and shall be completed (with results received) prior to the employee's start of work date;
    - Annual Examination — HAZWOPER-qualified employees will complete a medical examination once each year. Medical qualification expires on the anniversary date of the last examination completed. There will be no "grace period" exemptions beyond this date without the express approval of the Region SH&E Manager. At the recommendation of the SH&E Department, the CMP may approve an alternate examination frequency at periods of up to two years (biennial) in cases in which the worker's exposures to environmental contaminants are infrequent and typically well below any occupational exposure limits (e.g., senior management personnel);
    - Termination Examination — When reassigned to non-HAZWOPER duties or at the conclusion of employment at AECOM, HAZWOPER-qualified personnel will be provided with the opportunity to receive a termination medical examination;
    - Special Examinations — The SH&E Department and the CMP will jointly determine the need for special examinations because of:
        - Unusual exposure conditions; and
        - In response to possible overexposures.
- The CMP will determine the medical protocol elements for each of these examinations based on exposure information provided by the SH&E Department. The CMP will evaluate the results of each Employee's examination and will provide a written statement of medical clearance clearly stating medical compliance with the HAZWOPER regulatory standard (29 CFR 1910.120(f)) and approval of the Employee to perform unrestricted HAZWOPER activities. For initial and annual examinations, the CMP will also evaluate the Employee for the use of air purifying and supplied air respiratory protection. The written evaluation from these examinations will indicate the CMP's approval/limitations on the Employee's use of respiratory protection;
- If an Employee does not wish to participate in part or in the complete medical surveillance program, and is permitted by the given jurisdiction, the employee shall provide a written statement of refusal. Refer to *S3AM-128-PR1 Medical Screening & Surveillance*;

4.3.4 Training - HAZWOPER

All personnel assigned to work at a hazardous waste site, sampling at Treatment, Storage and/or Disposal Facilities (TSDFs), or are performing Remediation and Investigation Activities, shall participate in training meeting the requirements of 29 CFR 1910.120(e), or equivalent training as it relates to the given jurisdiction. All personnel shall have the following training:

- 40-hour initial Training — Before being assigned to a HAZWOPER site, AECOM Employees shall complete 40 hours of off-site training meeting the requirements of 29 CFR 1910.120(e)(3)(i). At the conclusion of training, personnel will receive a written certification of course completion, signed by the instructor, that indicates the course of instruction (40-hour HAZWOPER) and training dates. A copy of this certification shall be provided to the employee's SH&E Manager. Employees are responsible for maintaining their own copy of this certificate and for presenting it to the SSO when working on any HAZWOPER site;
- 3 days of on-the-job training — The Employee shall receive 3 days of actual supervision by a trained experienced supervisor;
- Refresher 8-Hour Training — To remain qualified to perform on-site HAZWOPER work activities, each AECOM Employee will complete 8 hours of HAZWOPER refresher training meeting the requirements of 29 CFR 1910.120(e)(8) at yearly intervals following completion of Initial 40-hour training. At the conclusion of training, personnel will receive a written certification of course completion, signed by the instructor, that indicates the course of instruction (8-hour HAZWOPER Refresher) and the training date. A copy of this certification shall be provided to the employee's SH&E Manager. Employees are responsible for maintaining their own copy of this certificate and for presenting it to the SSO when working on any HAZWOPER site;
- 8-hour Supervisor 8-Hour Training - any AECOM Employee acting in a management capacity for HAZWOPER activities (e.g., project manager, site safety officers, etc.), including oversight of subcontractor HAZWOPER activities, shall complete an additional 8 hours of HAZWOPER Supervisor training meeting the requirements of 29 CFR 1910.120(e)(4). Although this training is required only once, supervisors shall maintain their overall HAZWOPER qualification through annual completion of refresher training. At the conclusion of Supervisor 8-Hour Training personnel will receive a written certification of course completion, signed by the instructor that indicates the course of instruction and the training date. A copy of this certification shall be provided to the SH&E Manager. Employees are responsible for maintaining their own copy of this certificate and for presenting it to the SSO when working on any HAZWOPER site;
- 24-Hour HAZWOPER Training — Site support contractors and site visitors may qualify to substitute 24-hour HAZWOPER training in place of 40-hour training, as specified in 29 CFR 1910.120(e)(3)(ii). Personnel potentially qualifying for this alternative training include:
    - Site support personnel who will not work in any Exclusion Zone areas;
    - Subcontractors and site visitors whose duties will not entail significant exposure to site contaminants defined as not working in any areas where airborne contaminant concentrations exceed one-half of any applicable occupational exposure limit, and no contact or exposure to materials with site contaminant concentrations exceeding natural background levels. The SH&E Manager shall approve the substitution of 24-hour training for initial 40-hour training. Persons qualifying for 24-hour training shall provide written certification of course completion prior to beginning work on site. Persons completing 24-hour training shall complete 8 hours of annual refresher training at the required interval to maintain eligibility for on-site work and shall provide proof of this training (as necessary to demonstrate retraining) prior to beginning work on site.

Available Training Sources:

- On-site training provided by the SH&E Department;
- Outsourced training providers approved by the SH&E Department;

4.3.5 Training – Emergency Response

On an as-needed basis, if a project requires AECOM to provide a HAZMAT emergency response team, the following training requirements shall be met:

- Operations Level – a minimum of 8 hours of initial and refresher training for those responsible for acting defensively in the case of a release, attempting to contain the release from a safe distance;
- HAZMAT Technician – at least 24 hours of initial training and 8 hours of refresher training. They will participate in operations-level training and know how to implement the emergency response plan for the facility/site/project location;
- HAZMAT Specialist – at least 24 hours of initial training and 8 hours of refresher training. They will be trained in the same content as the HAZMAT Technician, as well as in how to develop a site safety and control plan;
- Incident Commander – will have at least 40 hours of training covering the Operations Level training and techniques for implementing the emergency response plan and directing the incident. They will be knowledgeable in relevant regulations. The Incident Commander will become the individual in charge of a site-specific incident command system and will coordinate and control communications with external agencies;

4.3.6 Subcontractor Personnel Training Records

Any subcontractor organization whose employees will support AECOM operations at a HAZWOPER site will:

- Provide the Manager with a copy of their written HAZWOPER medical surveillance and training program requirements. The elements of the program(s) shall be similar to those for AECOM's own program, as detailed above. Refer to *S3AM-213-PR1 Subcontractor Management*;
- Provide the Manager with written certification of a physician's approved medical clearance for each employee who will work on the site. Certification can be demonstrated by:
    - A copy of the physician's signed medical clearance for each employee (preferred); or
    - A letter identifying the medical status and clearance expiration date of every employee, signed by the company's safety director or an officer of the company.
    - A copy of the each employee's training certifications, which will include:
        - The initial 40-hour training certificate (24-hour training may be substituted with SH&E Manager approval);
        - The most current Refresher training certificate (shall be current within the previous one-year period);
        - A copy of the Supervisor training certificate for each person serving in a site supervisory capacity (e.g., project manager, site safety officers, etc.).

4.4 HAZWOPER and Spill Response Equipment

4.4.1 Specific HAZWOPER activity and spill response equipment shall be identified in the site specific SH&E PLAN. All AECOM offices and project sites that store chemicals at their location shall have the appropriate spill response equipment. Such equipment may include the following:

- Over-pack containers of varying capacities;
- Absorbent material such as vermiculite or commercially prepared, absorbent containing pillows, rolls, sheets, or booms;
- Acid and base neutralizing agents;
- Chemically resistant gloves for solvents, alcohols, and acids;
- Poly-coated Tyvek coveralls;
- Safety goggles;
- Respiratory protection;

4.4.2 Spill response equipment shall be placed adjacent to areas where chemicals are routinely handled, stored, and/or where shipments are received. Similar types of spill response equipment shall also be available in any AECOM vehicle or rented vehicle in which chemicals are being transported. Location of spill response equipment shall be selected to permit access outside of likely spill locations.

4.4.3 Spill Response Equipment for Field Programs

- The amount of chemicals being used during a field program will dictate the types and quantity of spill response equipment that is brought to the site;
- If several squirt bottles of decontamination solution are all that is being brought to a site, a few spill pillows and a one-gallon bucket (3.8 liters) may be sufficient to respond to a spill of these materials;
- If gallons of chemicals are being delivered to the site in drums or bulk tanks, a greater variety of spill response equipment will be needed. As indicated previously, during these types of field programs, a separate spill plan will be incorporated into the project or site specific SH&E Plan, and will provide a greater level of detail regarding the specific spill response effort for that field program. Refer to *S3AM-209-PR1 Risk Assessment & Management*;

4.5 Personal Protective Equipment (PPE) Ensembles

4.5.1 Defined HAZWOPER PPE ensembles are specified for general use on all AECOM HAZWOPER operations. The project SH&E Plan may specify modifications to these requirements to meet site-specific conditions. Refer also to *S3AM-208-PR1 Personal Protective Equipment* for additional information concerning PPE requirements.

4.5.2 Level D Ensemble

The Level D ensemble provides a minimal level of skin protection (primarily against physical rather than chemical hazards) and no respiratory protection. Level D PPE is the minimum work uniform to be used on HAZWOPER sites. Its use is appropriate when there is no significant potential for encountering hazardous substances or health hazards while working in controlled work areas.

Level D Equipment List:

- Hard hat;
- Eye protection;
- Safety-toe work boots;
- Shirts with sleeves and long pants (shorts are unacceptable for use); and
- Hearing protection (as required).

4.5.3 Modified Level D Ensemble

The Modified Level D ensemble provides moderate skin protection against contact with hazardous substances, but no respiratory protection. Its use is appropriate where there is a moderate-to-low potential for skin contact with known hazardous substances and health hazards, but no significant inhalation hazard is anticipated. The Modified Level D ensemble will consist of the Level D ensemble, supplemented by the addition of one or more of the following items:

Modified Level D Equipment List:

- Full faceshield;
- Plain (uncoated) disposable coveralls;
- Chemical-resistant disposable outer coveralls;

- Chemical-resistant outer gloves taped to outer coveralls;[1]
- Chemical-resistant inner gloves; and[1]
- Chemical-resistant safety-toe boots (taped to outer coveralls).

4.5.4 Level C Ensemble

The Level C ensemble provides moderate skin protection against contact with hazardous substances and moderate respiratory protection. Its use is appropriate where there is the potential for skin contact with known hazardous substances and health hazards, together with a limited and well-defined potential for exposure via inhalation.

Level C Equipment List:

- Full-face air-purifying respirator (APR) equipped with cartridge types as designated in the project SH&E PLAN;[2]
- Plaind (uncoated) disposable coveralls;
- Chemical-resistant disposable outer coveralls;
- Chemical-resistant outer gloves taped to outer coveralls;[3]
- Chemical-resistant inner gloves;
- Hard hat;
- Safety-toe boots taped to coveralls; the use of boot covers (e.g., booties) or chemical-resistant boots may be specified; and
- Hearing protection (as required).

4.5.5 Level B Ensemble

The Level B ensemble provides both the highest level of inhalation exposure protection and considerable skin contact protection. Its use is appropriate where there are significant known or suspected hazardous substances and health hazards, involving both skin and inhalation exposure (up to and including Immediately Dangerous to Life or Health [IDLH] conditions) or where adverse atmospheric conditions cannot be mitigated by use of air purifying respirators (e.g. oxygen deficient atmospheres or chemicals with poor warning properties). The use of Level B PPE requires prior approval by the SH&E Manager.

Level B Equipment List:

- Supplied air respirator (SCBA or airline system with Grade D or better breathing air);
- Chemical-resistant disposable outer coveralls;
- Chemical-resistant outer glove taped to outer coveralls;[3]
- Chemical-resistant inner gloves;[3]
- Hard hat;
- Chemical resistant safety-toe boots taped to coveralls; and
- Hearing protection (as required).

1 Selection of specific glove types/materials will be provided in the project SH&E Plan based on consideration of the contaminants and the physical conditions of the work.

2 Selection of specific cartridges will be made by the SH&E Department (or Competent Person – Respiratory Protection as designated by the SH&E manager) based on contaminants present. A cartridge change-out frequency will also be specified in the SH&E based on the manufacturer's cartridge performance data.

3 Selection of specific glove types/materials will be provided in the project SH&E based on consideration of the contaminants and the physical conditions of the work.

4.5.6 Level A Ensemble

The Level A ensemble provides the highest level of both respiratory and skin protection, up to and including protection against skin contact with vapor-phase contaminants. The use of Level A PPE requires prior approval by the Americas SH&E Director.

Specific Level A ensemble components will be determined on a case-by-case basis by the SH&E Department.

4.6 Emergency Response Plans

4.6.1 A Location Specific Emergency Response Plan shall be developed and implemented to handle anticipated emergencies prior to performing emergency response operations. The plan shall be in writing and available for inspection and copying by employees, their representatives, and OSHA personnel. The plan shall be reviewed and approved by the SH&E Manager prior to issue.

4.6.2 AECOM'S *S3AM-010-PR1 Emergency Response Planning* shall apply and employees shall evacuate from the danger area whenever an emergency occurs, provided the associated contract does not require AECOM to provide emergency response services

4.6.3 AECOM Employees are not expected to take action or to participate in rescues or responses to chemical releases beyond the initial discovery of the release and immediate mitigation actions such as closing a valve, placing absorbents, and notifying the client and or public emergency response system (911).

- If AECOM Employees are to participate in the response to a chemical release beyond the initial reaction, there shall be a contractual provision for this response and the Employees shall be specifically trained for this response;
- This document is designed to provide guidelines on how to prepare a written plan that will confirm prompt and proper response to an emergency situation that arises during field investigations and to outline the duties of AECOM Employees during a field emergency and the associated training requirements.

4.6.4 Site specific SH&E plans that are prepared to comply with the HAZWOPER standard (29 CFR 1910.120) shall address emergency response. This standard specifically outlines the elements that shall be contained in an emergency response plan. However, the definition of emergency response, as written in 29 CFR 1910.120, focuses on emergencies involving the uncontrolled release of hazardous substances. Under 29 CFR 1910.120, an employer can opt to evacuate employees from the danger area when such an emergency occurs. AECOM does not expect its Employees to actively assist in the handling of uncontrollable chemical releases that may occur during the implementation of field programs. As such, and as provided by the HAZWOPER standard, AECOM is exempt from the emergency response plan requirements of the standard as long as it provides an emergency action plan within the SH&E PLAN that complies with 29 CFR 1910.38 (a). Therefore, all emergency response plans required under 29 CFR 1910.120 will be written to comply with 29 CFR 1910.38 (a).

- There are two types of emergency situations that AECOM personnel shall be prepared for and that shall be addressed in the emergency response plan. These include:
  - Emergencies related to the operations of our clients at the facility where AECOM is working;
  - Emergencies related to our own on-site activities/investigations.
- Employees are not to accept the role of Incident Commander without specific authority from the SH&E Manager and the Manager responsible for the project. Assuming the role of the Incident Commander requires training beyond the scope of this Procedure.

4.6.5 The HAZWOPER standard does not prohibit AECOM Employees from performing limited response activities.

- Appropriately trained AECOM Employees can provide voluntary First Aid services;
- AECOM Employees can provide response assistance by placing absorbent pillows or vermiculite around a small, contained spill that occurs during sampling efforts;
- Refer to Spill Response, Incidental procedures contained herein which describes the specific procedures that AECOM will follow when responding to an incidental chemical spill.

4.6.6 Field Project Preparation

- Every SH&E Plan that is prepared by AECOM will contain a Location Specific Emergency Response Plan in which the required elements of an emergency action plan will be addressed. Refer to *S3AM-010-PR1 Emergency Response Planning*;
- When AECOM is working at an operating facility, the emergency response procedures of the facility will be appended to the SH&E Plan or the Location Specific Emergency Response Plan;
- As a minimum, each emergency response plan shall contain the following topics as required by 29 CFR 1910.38 (a):
    - Procedures and contact information for reporting emergencies to public service responders and on-site (client or host employer) emergency control centers;
    - Pre-emergency planning and coordination with outside parties;
    - Emergency escape procedures and emergency escape route assignments;
    - Procedures to be followed by employees who remain to operate critical site operations before they evacuate;
    - Procedures to account for all employees after emergency evacuation is complete;
    - Rescue and medical duties for those employees who are trained to perform them;
    - Preferred means of reporting fires and other emergencies;
    - PPE to protect employees from expected exposures and potential exposures during an emergency;
    - Names of persons or departments who can be contacted for further information (i.e. emergency reference sheet);
    - Site security and control;
    - Availability of medical surveillance for workers who might have been exposed to chemicals, bloodborne pathogens, or other biological agents as a result of project work or emergency response;
    - Emergency medical treatment and first aid;
    - Emergency alerting and response procedures;
    - Critique of response and follow-up.
- In addition, each plan shall establish the specific alarm system that will be used on site to warn employees of an AECOM emergency. The chosen alarm signals should not conflict with alarm signals already in place at the facility.

4.6.7 Client Facility Emergency Response Procedures

- AECOM implements field programs on active properties, including manufacturing facilities. These facilities have typically developed an emergency response plan that is specific to facility-related emergencies. If AECOM is working at an operating facility, emergency procedures established by the facility shall be followed in the event of a facility catastrophe.

AECOM personnel shall be aware of and familiar with the alarm signals used at the facility to alert personnel to an emergency. AECOM personnel shall also know where to assemble in the event of a facility evacuation as the facility shall be able to account for all personnel, including subcontractors such as AECOM in the event of an evacuation.

- The first priority in AECOM's preparation of a project emergency action plan is to confirm that the responsibilities under the client's emergency response plan are fully understood. Because of the nature of their business, many of our clients have in-house fire brigades, medical staff, and hazardous materials teams that can assist AECOM in the event of an emergency related to our field activities. In many instances, our clients prefer or require that subcontractors seek emergency assistance through their facility first before calling outside responders to the site.
- A copy of the facility's procedures shall be made available to AECOM so that the information can be incorporated into the SH&E Plan or attached to the Location Specific Emergency Response Plan. If this information is not available to AECOM prior to arriving on site, the SSO shall meet with client representatives upon arrival to the facility to review procedures in the event of an emergency related to plant operations.

4.6.8 Escape Routes and Procedures

Although emergency evacuation procedures are included in AECOM's initial 40-hour HAZWOPER training, emergency procedures at each site will be different. Employees shall be instructed about the location specific emergency response plan. Updating training is required anytime escape routes or procedures change. An evacuation drill will be conducted for projects that are scheduled for one month or longer. Visitors and untrained employees shall not be allowed into the project area until they receive a safety briefing including evacuation alarms and procedures.

Prior to the commencement of on-site activities, the SSO shall determine how AECOM employees will evacuate each AECOM work area of the site:

- Two or more routes that are separate or remote from each other for each work area shall be identified. Multiple routes are necessary in case one is blocked by fire or chemical spill. These routes shall not overlap because, if a common point were obstructed, all intersecting routes would be blocked;
- Prominent wind direction should also be considered when designating escape routes and assembly areas. Escape routes and assembly areas should be upwind of the site whenever possible;
- Upon arrival to the site, the SSO shall verify that the selected routes are appropriate for evacuation. During an emergency, the quickest and most direct route should be selected. However, when working at an operating facility, the established escape routes of the facility should be used whenever possible;
- In the event of a facility-related emergency, all AECOM employees shall meet at the facility's assembly area so that the client can verify that AECOM has evacuated the property.

4.6.9 Alarm Signals

An emergency communication system shall be in effect at all sites.

- The most simple and effective emergency communication system in many situations will be direct verbal communications. However, verbal communications shall be supplemented any time voices cannot be clearly perceived above ambient noise levels and any time a clear line of sight cannot be easily maintained among all AECOM personnel because of distance, terrain, or other obstructions;
- Portable two-way radio communications may be used when employees shall work out of the line of sight of other workers;
- When it is necessary to supplement verbal communications, Employees shall be informed of the established emergency signals. The following emergency signals, or other appropriate signals, shall be implemented using handheld portable air horns, whistles, or similar devices.

Signals shall be capable of being perceived above ambient noise by all employees in the affected portions of the workplace:

- One Blast: General Warning—A relatively minor and localized, yet important, on-site event. An example of this type of an event would be a minor chemical spill where there is no immediate danger to life or health yet personnel working on the site should be aware of the situation so that unnecessary problems can be avoided. If one horn blast is sounded, personnel shall stop all activity and equipment on-site and await further instructions from the SSO;
- Three Blasts: Medical Emergency—A medical emergency for which immediate first aid or emergency medical care is required. If three horn blasts are sounded, all First Aid Providers should respond as appropriate. All other activity and equipment should stop and personnel should await further instructions from the SSO;
- Three Blasts Followed by One Continuous Blast: Immediate Threat to Life and Health — A situation that could present an immediate danger to life and health of personnel onsite. Examples include fires, explosions, large hazardous chemical release, severe weather-related emergencies, or security threats. If three horn blasts followed by a continuous blast are sounded, all activity and equipment shall stop. All personnel shall evacuate the site and meet in the designated assembly area where the SSO will account for all employees. The SSO will arrange for other emergency response actions if necessary. Information concerning the need to follow decontamination procedures during an emergency evacuation will be addressed in the Location Specific Emergency Response Plan;

- The SSO or his designate will acknowledge the distress signal with two short blasts on the air-horn or whistle;
- One Continuous Blast Following Any of the Above: All Clear/Return to Work — Personnel who sound the initial alarm are required to send an all clear signal when the emergency is over.

4.6.10 Accounting Method for All Employees after Evacuation

The SSO is responsible for determining that all AECOM employees have been successfully evacuated from the work area(s):

- It is the responsibility of each AECOM subcontractor to verify that all of its employees evacuated the site and to report this information to the SSO. All employees shall meet at the designated assembly area;
- A headcount is an acceptable way to determine complete evacuation when the field team is of a small size. The site log-in book or equivalent should be referenced when attempting to account for more than 10 people. In the event of a facility-related emergency, the SSO shall notify facility representatives that all AECOM employees and AECOM subcontract employees have successfully evacuated the work area(s);
- The SSO shall notify emergency responders if any employee is unaccounted for and where on the site they were last seen;
- In the event of a project-related emergency, the SSO will provide off-site emergency responders or on-site HAZMAT teams or fire brigades (Incident Commander) with all available knowledge about the emergency situation upon their arrival to the scene.

4.6.11 Employees Who Remain to Operate Critical Site Operations Before They Evacuate

All equipment and operations are required to cease in accordance with the established alarm signal procedures. The only exception will be related to health and safety:

- The SSO shall determine at the time of the emergency if health and safety will be jeopardized by immediate stoppage of any particular piece of equipment;

- If such a determination is made, personnel involved in critical operations shall be minimized. Once it is determined that the operation is no longer needed or the threat to the operators is imminent, operations will cease and the operators will immediately evacuate.

4.6.12 Rescue and Medical Response

- Only currently trained individuals will administer first aid, CPR or an AED. Refer to *S3AM-012-PR1 First Aid*.
- In the event of an incident, refer to material's SDS labels to confirm proper first aid is administered for the hazardous material and call the nearest Poison Centre or 911. Refer to *S3AM-012-PR1 First Aid*.
    - The American National Standards Institute (ANSI) Standard for Emergency Eyewash and Shower Equipment (ANSI Z358.1-1998) recommends that the affected body part shall be flushed immediately and thoroughly for at least 15 minutes using a large supply of clean fluid under low pressure. However, other references recommend a minimum 20-minute flushing period if the nature of the contaminant is not known. The flushing or rinsing time can be modified if the identity and properties of the chemical are known. For example, at least:
        - 5 minutes flushing time for mild irritants;
        - 20 minutes for moderate to severe irritants;
        - 20 minutes for non-penetrating corrosives;
        - 60 minutes for penetrating corrosives;
        - If irritation persists, repeat the flushing procedure.
- It is important to note that ingestion of any chemical is not likely to occur in the workplace. If ingestion does occur, evidence indicates that inducing vomiting is not necessary in most situations where there has been an occupational chemical ingestion.
    - Induction of vomiting should only be recommended if the chemical has very high, short-term (acute) toxicity, and medical follow-up is not readily available;
    - In these cases, first aiders should receive special training on how to safely and effectively induce vomiting in the appropriate circumstances.
- If the injury is life threatening, the Emergency Medical System (EMS) should be called (911). Depending on the procedures established for the project, the SSO would contact an emergency responder directly or notify the facility representatives for medical assistance;
- If the employee needs medical attention that cannot be provided on-site, the SSO shall escort the individual to the local hospital identified on the emergency reference sheet and shall remain with the person until release or admittance is determined. The escort will relay all appropriate medical information to the Manager and SH&E Manager.

4.6.13 On-site and Off-site Communications

Regardless of the size or location of AECOM's field projects, it is extremely important that both on-site and off-site communications be maintained so that in the event of an emergency employees can contact each other or place a phone call immediately with the appropriate responder(s).

A reliable and approved form of communication (e.g. two way radio, cell phone, etc.) is required when members of the field team are working in separate areas of the site and verbal communications are no longer effective because of distance. A communication device shall be available for each team that is working in a separate area of the site.

When AECOM is working at an occupied facility, a telephone may be accessible. When AECOM is working on abandoned properties or when there is no access to a phone, as appropriate, a cellular telephone, two-way radio, or satellite telephone shall be brought to the work location.

4.6.14 Preferred Means of Reporting

Employees shall immediately notify the Supervisor of incidents and emergencies, and report in accordance with *S3AM-004-PR1 Incident Reporting, Notification & Investigation*:

- Unless facility representatives specifically indicate that they prefer AECOM personnel to notify them first of an emergency, the SSO will directly contact the appropriate emergency responders listed on the Location Specific Emergency Response Plan;
- Additional communications within AECOM concerning an emergency event may be required as per *S3AM-010-PR1 Emergency Response Planning* and *SR1-003-WI2 Disruptive Event Response Instruction*;
- "Dangerous occurrences" shall be reported immediately to the police, employer, vehicle owner/leaser and the dangerous goods owner. Such events would include spills, bulk container damage, fire, explosion, and transportation accidents involving dangerous goods;
- Confirm and seek direction on external reporting requirements. Each jurisdiction has regulations governing the minimum quantities for reporting based on the type of product spilled or release refer to *S3AM-117-ATT1 Spill Notification Numbers for North America*;

Individuals who have knowledge of a spill, release, or unlawful discharge, shall notify authorities immediately. Reporting does not imply guilt or assign blame. The following details are to be reported:

- Location and time of spill;
- Description of circumstances leading to spill;
- Type and quantity of material or substance spilled;
- Details of any action taken at the site of the spill;
- Description of location of spill and immediately surrounding the area;
- Any additional information in respect of the spill that the Minister, Environmental Protection Officer or person designated by regulations requires.

4.6.15 First Responder

First responders shall have sufficient training or have had sufficient experience to objectively demonstrate competency in the following areas:

- An understanding of what hazardous substances are, and the risks associated with them in an incident;
- An understanding of the potential outcomes associated with an emergency;
- The ability to recognize the presence of hazardous substances and physical hazards in an emergency;
- An understanding of the role of the first responder;
- The ability to realize the need for additional resources and to make appropriate notifications to the communication center.

4.6.16 First Responder HAZWOPER Operations Level

First responders at the operations level are individuals who respond to releases or potential releases of hazardous substances as part of the initial response to the site for the purpose of protecting nearby persons, property, or the environment from the effects of the release:

- They are trained to respond in a defensive fashion without actually trying to stop the release; Their function is to contain the release from a safe distance, keep it from spreading, and prevent exposures;

- First responders at the operational level shall have received at least eight hours of training or have had sufficient experience to objectively demonstrate competency in the following areas in addition to those listed for the awareness level and the employer shall so certify:
    - Knowledge of the basic hazard and risk assessment techniques;
    - Know how to select and use proper personal protective equipment provided to the first responder operational level;
    - An understanding of basic hazardous materials terms;
    - Know how to perform basic control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available with their unit;
    - Know how to implement basic decontamination procedures;
    - An understanding of the relevant standard operating procedures and termination procedures;

4.6.17 Hazardous Materials Technician

Hazardous materials technicians shall have received at least 24 hours of training equal to the first responder operations level and in addition have competency in the following areas and the employer shall so certify:

- Know how to implement the employer's emergency response plan;
- Know the classification, identification, and verification of known and unknown materials by using field survey instruments and equipment;
- Be able to function within an assigned role in the Incident Command System, refer to *Federal Emergency Management Agency—FEMA: Incident Command System*;
- Know how to select and use proper specialized chemical PPE provided to the hazardous materials technician;
- Understand hazard and risk assessment techniques;
- Be able to perform advance control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available with the unit;
- Understand and implement decontamination procedures;
- Understand termination procedures;
- Understand basic chemical and toxicological terminology and behavior.

4.6.18 Hazardous Materials Specialist

Hazardous materials specialists shall have received at least 24 hours of training equal to the technician level and in addition have competency in the following areas and the employer shall so certify:

- Know how to implement the local emergency response plan;
- Understand classification, identification, and verification of known and unknown materials by using advanced survey instruments and equipment;
- Know the state or applicable jurisdictional emergency response plan;
- Be able to select and use proper specialized chemical PPE provided to the hazardous materials specialist;
- Understand in-depth hazard and risk techniques;
- Be able to perform specialized control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available;

- Be able to determine and implement decontamination procedures;
- Have the ability to develop a site safety and control plan;
- Understand chemical, radiological, and toxicological terminology and behavior.

4.7 Decontamination Procedures

4.7.1 When possible, all necessary steps shall be taken to reduce or minimize contact with chemicals and impacted materials while performing field activities (e.g., avoid sitting or leaning on, walking through, dragging equipment over, tracking, or splashing potential or known impacted materials).

4.7.2 All personal decontamination activities shall be performed with an attendant (buddy) to provide assistance to personnel that are performing decontamination activities. An attendant may not be required for Level D equipment removal and decontamination. Depending on specific site hazards, attendants may be required to wear a level of protection that is equal to the required level in the exclusion zone.

4.7.3 All persons and equipment entering the EZ shall be considered contaminated, and thus, shall be properly decontaminated prior to entering the SZ. No equipment, including personal protective equipment or contaminated clothing shall be taken or worn into the SZ.

4.7.4 Decontamination procedures may vary based on site conditions and nature of the contaminant. If chemicals or decontamination solutions are used, care should be taken to minimize reactions between the solutions and contaminated materials. In addition, personnel shall assess the potential exposures created by the decontamination chemical(s) or solutions. The safety data sheets shall be reviewed, implemented, and filed by personnel contacting the chemicals/solutions.

4.7.5 All contaminated personal protective equipment (PPE) and decontamination materials shall be stored and disposed of in accordance with site-specific requirements identified in the approved work plan.

4.7.6 For all Level A and B ensembles, adequate supplied air shall be available to allow the employee to safely complete all necessary decontamination steps.

4.7.7 Where decontamination procedures involving radioactive materials are required, the removable limits for both personnel and equipment will be specified by a Certified Health Physicist or Certified Industrial Hygienist in the project's approved Radiation Protection Plan or approved safety planning document.

4.7.8 Materials Needed to Decontaminate Personnel and/or Equipment

- The equipment required to perform decontamination may vary based on site-specific conditions and nature of the contaminant(s). The following equipment is commonly used for decontamination purposes:
  - Soft-bristle scrub brushes or long-handled brushes to remove contaminants;
  - Hoses, buckets of water or garden sprayers for rinsing;
  - Large plastic/galvanized wash tubs or children's wading pools for washing and rinsing solutions;
  - Large plastic garbage cans or similar containers lined with plastic bags for the storage of contaminated clothing and equipment;
  - Metal or plastic cans or drums for the temporary storage of contaminated liquids;
  - Paper or cloth towels for drying protective clothing and equipment; and
  - Poly or plastic sheeting to lay down and form the base for the CRZ, as well as to contain contaminants and decontamination fluids.

4.7.9 Personal Decontamination Steps

- The decontamination plan shall be in writing and shall specify the exact steps in either wet or dry decontamination or personnel exiting the EZ to the SZ. The decontamination plan shall also address respirator cartridge change out, SCBA bottle changes and equipment decontamination.

4.7.10 Decontamination Steps during a Medical Emergency

- If decontamination can be done:
  - Wash, rinse and/or cut off protective clothing and equipment.
- If decontamination cannot be done:
  - Wrap the victim in blankets, plastic sheeting, or rubber to reduce contamination of other personnel;
  - Alert emergency and offsite medical personnel to potential contamination;
  - Instruct them about specific decontamination procedures if necessary;

4.7.11 Equipment Decontamination Steps

- All equipment leaving the EZ shall be considered contaminated and shall be properly decontaminated to minimize the potential for exposure and off-site migration of impacted materials. Such equipment may include, but is not limited to: sampling tools, heavy equipment, vehicles, PPE (hoses, cylinders, etc.), and various handheld tools;
- All Employees performing equipment decontamination shall wear the appropriate PPE to protect against exposure to contaminated materials. The level of PPE may be equivalent to the level of protection required in the EZ. Other PPE may include splash protection, such as face-shields and splash suits, and knee protectors. Following equipment decontamination, Employees may be required to follow the proper personal decontamination procedures above;
- For larger equipment, a high-pressure washer may need to be used. Some contaminants require the use of a detergent or chemical solution and scrub brushes to confirm proper decontamination. Personnel operating a high pressure washer will be trained in the operation of the equipment and follow the manufacturer's operational instructions;
- For smaller equipment, use the following steps for decontamination:
  - Remove majority of visible gross contamination in EZ;
  - Wash equipment in decontamination solution with a scrub brush and/or power wash heavy equipment;
  - Rinse equipment;
  - Visually inspect for remaining contamination;
  - Follow appropriate personal decontamination steps outlined above.
- All decontaminated equipment shall be visually inspected for contamination prior to leaving the CRZ. Signs of visible contamination may include an oily sheen, residue or contaminated soils left on the equipment. All equipment with visible signs of contamination shall be discarded or re-decontaminated until clean. Depending on the nature of the contaminant, equipment may have to be analyzed using a wipe method or other means.

4.8 Employee Exposure Monitoring

4.8.1 Explosive levels, oxygen levels, and airborne contaminants may present potential hazards to HAZWOPER personnel working within controlled work areas and to non-HAZWOPER workers and the general public present outside the controlled work areas.

4.8.2 As appropriate, exposure monitoring at HAZWOPER sites will be conducted to determine explosive and oxygen levels, monitor and control employee exposures to airborne contaminants, and to determine and regulate controlled work area boundaries (e.g., support zone, contamination reduction zone, and exclusion zone) for the protection of non-HAZWOPER workers and the general public.

4.8.3 Specific exposure monitoring requirements will be established in individual SH&E Plans. Refer to *S3AM-127-PR1 Exposure Monitoring*. All monitoring efforts using direct reading instruments and will remain part of the project file.

4.8.4 Work Area Exposure Monitoring

- Work area exposure monitoring will include breathing zone readings for the maximum exposed worker(s);
- Results will be used to determine adequacy of PPE (especially respiratory protection). Specific criteria for upgrade/downgrade will be established in the SH&E Plan.

4.8.5 Perimeter Exposure Monitoring

- Perimeter air samples will be collected when the potential exists for airborne contaminants to migrate off-site and will be collected near the work zones when performing work at an active client facility. Refer to *S3AM-127-PR1 Exposure Monitoring*;
- Perimeter exposure monitoring will be conducted at locations downwind from the project activities at a minimum (also upwind if the potential exists for offsite contamination to migrate onto the site).

4.8.6 Exposure results will be posted on site and explained in a safety briefing.

4.8.7 Employees will receive a written statement of results within 15 days of receipt from the laboratory.

4.8.8 Results of all personal exposure monitoring will be provided to the SH&E department for inclusion in the employee medical records, refer to *S3AM-017-PR1 Injury & Illness Recordkeeping***.**

5.0 Records

5.1 All forms and documents generated during a HAZWOPER project will be maintained in the project file.

5.2 All medical screening and surveillance documentation shall be retained for 30 years.

6.0 Attachments

6.1 S3AM-117-ATT1 Spill Notification Number for North America

Americas

Spill Notification Numbers for North America

S3AM-117-ATT1

Jurisdiction	Name	Phone
Within the United States		
National Response Center		1-800-424-8802
AECOM Incident Reporting Number		1-800-348-5046
Within Canada		
AECOM Incident Reporting Number		1-800-348-5046
Alberta	Environmental Service Response Centre	1-800-222-6514
British Columbia	Provincial Emergency Program	1-800-663-3456
Manitoba	Conservation Emergency Response Program	1-204-944-4888
New Brunswick	Canadian Coast Guard	1-800-565-1633
Newfoundland & Labrador	Canadian Coast Guard	1-800-563-9089
NWT & Nunavut	Spill Report Line	1-867-920-8130
Nova Scotia	Canadian Coast Guard	1-800-565-1633
Ontario	Spill Action Centre	1-800-268-6060
Prince Edward Island	Canadian Coast Guard	1-800-565-1633
Quebec	National Environmental Emergencies Center	1-866-283-2333
Saskatchewan	Spill Report Centre	1-800-667-7525
Yukon Territory	Spill Report Centre	1-867-667-7244

Americas

Daily Heat Illness Prevention Log

S3AM-113-FM2

Date: _____ Project: _____ Site Safety Officer: _____

☐ Light Workload ☐ Moderate Workload ☐ Heavy Workload ☐ Very Heavy Workload

ADJ. FORECASTED MORNING HIGH:_____

EXPECTED WORK REST CYCLE:_____
(USE CODE (0-SW) FROM TABLE)

ADJ. FORECASTED AFTERNOON HIGH:_____

EXPECTED WORK REST CYCLE:_____
(USE CODE (0-SW) FROM TABLE)

WORK REST CYCLE, Adjusted Temperature Method (see page 2)*

CODE	Work Rest Cycle
0	No specified requirements
1	15 minute break every 90 minutes of work
2	15 minute break every 60 minutes of work
3	15 minute break every 45 minutes of work
4	15 minute break every 30 minutes of work
5	15 minute break every 15 minutes of work
SW	Stop work

BREAK SCHEDULE

START TIME	END TIME	WATER CONSUMPTION	BREAK LOCATION

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***FOR COMPLETION BY SSO** FORECASTED TEMP + ADJUSTMENT FACTORS (SEE TABLE BELOW) = ADJUSTED TEMP

Morning High Calculation: _____ +_____ =_____

Afternoon High Calculation: _____ +_____ =_____

Time of Day	
Before daily temperature peak[1]	+2°F (+1.11°C)
10 am – 2 pm (peak sunshine)	+2°F (+1.11°C)
Sunshine	
No clouds	+1°F (+0.56°C)
Partly Cloudy (3/8 – 5/8 cloud cover)	-3°F (-1.67°C)
Mostly Cloudy (5/8 – 7/8 cloud cover)	-5°F (-2.78°C)
Cloudy (>7/8 cloud cover)	-7°F (-3.89°C)
Indoor or nighttime work	-7°F (-3.89°C)
Wind (*ignore if indoors or wearing CPC*)	
Gusts greater than 5 miles per hour at least once per minute	-1°F (-0.56°C)
Gusts greater than 10 miles per hour at least once per minute	+2°F (+1.11°C)
Sustained greater than 5 miles per hour	-3°F (-1.67°C)
Sustained greater than 10 miles per hour	-5°F (-2.78°C)
Humidity (*ignore if wearing CPC*)	
Relative Humidity greater than 90%	+5°F (+2.78°C)
Relative Humidity greater than 80%	+2°F (+1.11°C)
Relative Humidity less than 50%	-4°F (-2.23°C)
Chemical Protective Clothing (CPC)[2]	
Modified Level D (coveralls, no respirator)	+5°F (+2.78°C)
Miscellaneous	
Unacclimated work force	+5°F (+2.78°C)
Partially acclimated work force	+2°F (+1.11°C)
Working in shade	-3°F (-1.67°C)
Breaks taken in air conditioned space	-3°F (-1.67°C)

Apply the adjusted temperature to the below table given the anticipated Workload to determine the appropriate Work-Rest Regimen code.

Code	Work-Rest Regimen	Adjusted Temperature			
		Light Work	Moderate Work	Heavy Work	Very Heavy Work
0	No specified requirements	**< 80°F** (26.67°C)	**< 75°F** (23.88°C)	**< 70°F** (21.11°C)	**< 65°F** (18.33°C)
1	15 minute break every 90 minutes of work	**80°F – 90°F** (26.67 - 32.22°C)	**75 – 85°F** (23.88 - 29.44°C)	**70 – 80°F** (21.11 - 26.67°C)	**65 – 75°F** (18.33 - 23.88°C)
2	15 minute break every 60 minutes of work	**>90 – 100°F** (32.22 - 37.77°C)	**> 85 – 95°F** (29.44 - 35°C)	**>80 – 85°F** (26.67 - 29.44°C)	**>75 – 80°F** (23.88 - 26.67°C)
3	15 minute break every 45 minutes of work	**>100 – 110°F** (37.77 - 43.33°C)	**>95 – 100°F** (35 - 37.77°C)	**>85 – 90°F** (29.44 - 32.22°C)	**>80 – 85°F** (26.67 - 29.44°C)
4	15 minute break every 30 minutes of work	**>110 – 115°F** (43.33 - 46.11°C)	**>100 – 105°F** (37.77 – 40.55°C)	**>90 – 95°F** (32.22 - 35°C)	**>85 – 90°F** (29.44 - 32.22°C)
5	15 minute break every 15 minutes of work	**>115 – 120°F** (46.11 - 48.88°C)	**>105 – 110°F** (40.55 - 43.33°C)	**>95 -100°F** (35 - 37.77°C)	**>90 – 95°F** (32.22 - 35°C)
SW	**Stop Work**	**>120°F** (48.88°C)	**>110°F** (43.33°C)	**>100°F** (37.77°C)	**>95°F** (35°C)

°F = degrees Fahrenheit °C = degrees Celsius

[1] This adjustment accounts for temperature rise during the day. If the temperature has already reached its daytime peak, it can be ignored.

[2] Refer to S3AM-113-ATT1 for addition Chemical Protective Clothing (Type C – A)

****Attach copy of receipts for water purchases**

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Americas

Heat Stress

S3AM-113-PR1

1.0 Purpose and Scope

1.1 Establishes a Heat Illness Prevention Program to guide employees in preventing heat illness, recognition of the symptoms of heat stress-related illnesses and in taking the appropriate corrective action.

1.2 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 **Acclimated –** Employees who have developed physiological adaptation to hot environments characterized by increased sweating efficiency, circulation stability, and tolerance of high temperatures without stress. Acclimatization occurs after 7 to 10 consecutive days of exposure to heat and much of its benefit may be lost if exposure to hot environments is discontinued for a week.

2.2 **Chemical Protective Clothing (CPC)** – Apparel that is constructed of relatively impermeable materials intended to act as a barrier to physical contact of the Employee with potentially hazardous materials in the workplace. Such materials include Tyvek® coveralls (all types) and polyvinyl chloride coveralls and rain suits.

2.3 **Heat Cramps** – A form of heat stress brought on by profuse sweating and the resultant loss of salt from the body.

2.4 **Heat Exhaustion** – A form of heat stress brought about by the pooling of blood in the vessels of the skin and in the extremities.

2.5 **Heat Rash** – A heat-induced condition characterized by a red, bumpy rash with severe itching.

2.6 **Heat Stress** – The combination of environmental and physical work factors that constitute the total heat load imposed on the body.

2.7 **Heat Stroke** – The most serious form of heat stress, which involves a profound disturbance of the body's heat-regulating mechanism.

2.8 **Sunburn** – Caused by unprotected exposure to ultraviolet radiation present in sunlight that is damaging to the skin (Refer to *S3AM-121-PR1 Non-Ionizing Radiation*). The injury is characterized by red painful skin, blisters, and/or peeling.

2.9 **Unacclimated** – Employees who have not been exposed to hot work conditions for one week or more or who have become heat-intolerant due to illness or other reasons.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-004-PR1 Incident Reporting, Notifications & Investigation

3.3 S3AM-010-PR1 Emergency Response Planning

3.4 S3AM-121-PR1 Non-Ionizing Radiation

3.5 S3AM-208-PR1 Personal Protective Equipment

3.6 S3AM-209-PR1 Risk Assessment & Management

4.0 Procedures

4.1 Roles and Responsibilities

4.1.1 Managers

- Evaluate the need for heat illness prevention measures and incorporate as appropriate into the Safe Work Plan or Task Hazard Analysis.
- Allocate sufficient resources for the management of heat illness in the field including the provision of water, a shaded break area, and sufficient schedule to allow for breaks.

4.1.2 Safety, Health and Environment (SH&E) Manager

- Provide heat illness awareness training.
- Assist in developing appropriate work-rest schedules.
- Conduct/support incident investigations related to potential heat stress-related illnesses.

4.1.3 Supervisor

- Identify those tasks that may be most impacted by heat stress and communicate the hazard to the assigned Employees.
- Confirm that Employees have been trained on the recognition of heat illness.
- Confirm that this procedure, along with any applicable Safe Work Plan and/or Task Hazard Analysis (and heat exposure control plan that may be contained therein) are made available to affected Employees.
- Confirm that adequate supplies of appropriate fluids are readily available to Employees.
- Confirm that a proper rest area is available.
- Conduct heat illness monitoring, as applicable.
- Implement the work-rest schedule.
- Confirm that first aid measures are implemented once heat stress symptoms are identified.
- Confirm personnel are physically capable of performing the assigned tasks and are not in a physically compromised condition.
- Report all suspected heat illnesses.

4.1.4 Employee

- Observe each other for the early symptoms of heat illnesses.
- Maintain an adequate intake of available fluids.
- Be familiar with heat stress hazards, predisposing factors, and preventative measures.
- Report to work in a properly vested and hydrated condition.
- Report all suspected heat stress-related illnesses.

4.2 Restrictions

4.2.1 The Buddy System is required when working in high heat conditions; Employees shall not work alone.

4.2.2 Employees shall not be exposed to levels exceeding those specified for the given work level and work-rest regimen as listed in *S3AM-113-ATT1 Temperature Thresholds*.

4.2.3 Clothing corrections shall be applied in accordance with the tables provided in *S3AM-113-ATT1 Temperature Thresholds*.

4.3 Exposure Controls

4.3.1 It shall be determined whether Employees are or may be exposed to hazardous heat levels. The Supervisor shall:

- Conduct a heat stress assessment to determine the potential for hazardous exposure of Employees. Assessment shall include, but not limited to:
  - Ambient temperature.
  - Amount of sunshine (cloudy, clear). Refer to *S3AM-121-PR1 Non-Ionizing Radiation* additional direction concerning ultraviolet radiation exposures.
  - Other radiant heat sources (e.g. motor, fire, etc.).
  - Humidity.
  - Air flow.
  - Amount or type of physical labor being performed,
  - Physical condition of the Employees (e.g., acclimated/not)
  - Protective clothing in use.
  - Referral to *S3AM-113-ATT1 Temperature Thresholds* to assist in determining whether hazardous heat exposures may exist.
- If potential for hazardous exposure is identified, the Supervisor shall develop and implement a heat stress exposure control plan within the Safe Work Plan and/or Task Hazard Analysis. Refer to *S3AM-209-PR1 Risk Assessment & Management.*

4.3.2 If Employees are or may be exposed, the Supervisor shall implement engineering controls (e.g., shelters, cooling devises, etc.) to reduce the exposure of Employees to levels below those specified for the given work level and work-rest regimen as listed in *S3AM-113-ATT1 Temperature Thresholds*.

4.3.3 If engineering controls are not practicable, the Supervisor shall reduce the exposure of Employees to levels below those listed in *S3AM-113-ATT1 Temperature Thresholds* by providing administrative controls, including a work-rest cycle or personal protective equipment, if the equipment provides protection equally effective as administrative controls.

4.3.4 If Employees are or may be exposed, the Supervisor shall provide and maintain an adequate supply of cool, fresh, potable water close to the work area for the use of a heat exposed Employee. Water shall be provided (paid) by the project or program; if Employees purchase their own drinking water because water is not otherwise available on site, they shall be reimbursed.

4.3.5 If an Employee shows signs or reports symptoms of heat stress or strain, they shall be removed from the hot environment and treated by an appropriate first aid attendant on site, if available, or by a physician, refer to *S3AM-113-ATT2 Symptoms & Treatment* for more specifics.

4.4 Heat Stress Planning

4.4.1 Heat stress can be a significant site hazard, especially for Employees wearing CPC. To prepare for emergency response planning, refer to *S3AM-010-PR1 Emergency Response Planning* procedure.

4.4.2 The project and site specific risks need to be planned using the SH&E Plan and the Task Hazard Assessments (THA). Refer to the *S3AM-209-PR1 Risk Assessment & Management* procedure.

4.4.3 The heat a worker is exposed to may be a combination of air temperature, radiant heat, and humidity. The WBGT (wet-bulb globe thermometer) is a useful index of the environmental contribution to heat stress. Because WBGT is only an index of the environment, the contributions of

work demands, clothing, and state of acclimatization shall also be accounted for, as described in the following steps.

- Monitor ambient temperatures and conduct heat stress monitoring in accordance with the location specific SH&E Plan. Revise the heat stress monitoring and controls if there are any reports of discomfort due to heat stress.
- Monitor temperatures in each unique environment in which workers perform work (e.g., take WBGT measurements inside truck cabs for truck drivers, and take separate WBGT measurements in the outdoor area where field employees work, etc.). Follow manufacturer's instructions on proper use of the WBGT.
- Determine if individual workers are acclimatized or un-acclimatized. Full heat acclimatization requires up to 3 weeks of continued physical activity under heat-stress conditions similar to those anticipated for the work. Its loss begins when the activity under those heat-stress conditions is discontinued, or when there is a sustained increase in temperatures of 10 °F (5.6 °C) or more, and a noticeable loss occurs after 4 days. A worker can be considered acclimatized for the purpose of this procedure when they have been exposed to the site conditions (including level of activity) for 5 of the last 7 days.
- Determine the approximate workload of each worker or group of workers. The following examples (Table 1) can be used for comparison:

Table 1
Examples of Activities within Workload Categories

Categories	Example Activities
Resting	Sitting quietly
	Sitting with moderate arm movements
Light	Sitting with moderate arm and leg movements
	Standing with light work at machine or bench while using mostly arms
	Using a table saw
	Standing with light or moderate work at machine or bench and some walking about
Moderate	Scrubbing in a standing position
	Walking about with moderate lifting or pushing
	Walking on level at 3.5 miles/hr (6 km/hr) while carrying 6.6 lbs (3kg) weight load
Heavy	Carpenter sawing by hand
	Shoveling dry sand
	Heavy assembly work on a non-continuous basis
	Intermittent heavy lifting with pushing or pulling (e.g., pick-and-shovel work)
Very Heavy	Shoveling wet sand

- Determine the approximate proportion of work within an hour during a typical shift. Typically, the initial work schedule will be 60 minutes of work per hour (100 percent work) with a small break in the morning and afternoon, as appropriate, and a 30-minute lunch break mid-day.
- For workers wearing cloth coveralls (e.g., Nomex fire resistant clothing), add 3 to the measured WBGT. For impermeable clothing, such as Tyvek or Saranex, the WBGT procedures cannot be used. For these situations, workers should begin physiological monitoring as soon as the temperature in the work area exceeds 70ºF (21°C).
- Use the collected information to develop appropriate work to rest schedules as detailed in *S3AM-113-ATT1 Temperature Threshold*.

4.4.4 Given the work demands (light, moderate, heavy or very heavy), heat of the work environment, and such aspects as PPE in use, workload will be adjusted appropriately to allow for proper acclimation.

- This is the process by which the body "gets used to" hot work environments. This is achieved by slowly increasing workloads.
- New and returning Employees (absent one week or more) who have not had time to acclimatize may be more susceptible to heat related illnesses, even in seemingly low risk heat exposures.
- All Employees shall be allowed time to acclimatize in the event of a heat wave. All Employees assigned to a new process with additional heat exposures shall be allowed to acclimatize.
- Minimize workload and gradually increase as tolerance is built up. Allow for more frequent breaks.
- While acclimatization normally takes approximately 5 to 7 days, heightened monitoring of these Employees will be maintained for the first 14 days.

4.4.5 Employees shall be instructed in the recognition of heat stress symptoms, the first aid treatment procedures for severe heat stress, and the prevention of heat stress injuries. Employees shall be encouraged to immediately report any heat stress that they may experience or observe in fellow Employees. Supervisors shall use such information to adjust the work-rest schedule to accommodate such problems.

4.4.6 Wherever possible, a designated break area should be established in an air conditioned space, or in shaded areas where air conditioning is impractical. The break area should be equipped to allow Employees to loosen or remove protective clothing, and sufficient seating should be available for all Employees. During breaks, Employees shall be encouraged to drink plenty of water or other liquids, even if not thirsty, to replace lost fluids and to help cool off. Cool water should be available at all times in the break area, and in the work area itself unless hygiene/chemical exposure issues prevent it.

4.5 Symptoms and Treatment

4.5.1 Refer to *S3AM-113-ATT2 Symptoms & Treatment*.

4.5.2 Employees who exhibit ANY signs of significant heat stress (e.g., profuse sweating, confusion and irritability, pale, clammy skin) shall be relieved of all duties at once, made to rest in a cool location, and provided with large amounts of cool water.

4.5.3 Anyone exhibiting symptoms of heat stroke (red dry skin, or unconsciousness) shall be taken immediately to the nearest medical facility. Steps shall be taken to cool the person during transportation (clothing removal, wet the skin, air conditioning, etc.).

4.5.4 Severe heat stress (heat stroke) is a life-threatening condition that shall be treated by a competent medical authority.

4.6 Prevention

4.6.1 Requirements for working in extreme heat may be triggered by a regulatory established criteria (e.g. CAL/OSHA requires high heat procedures when temperature equals or exceeds 95°F) or as a result of a hazard analysis assessing various contributory factors (refer to *S3AM-113-ATT1 Temperature Thresholds*). Employees working in extreme heat or sun should understand and apply the following guidelines for preventing and detecting heat exhaustion and heat stroke.

- When possible, begin hydrating at least three days prior to working in high heat conditions.
- Review the heat stress exposure control plan within the Safe Work Plan and/or Task Hazard Analysis.
- If the supervisor is not immediately available confirm a reliable method of communication is in place to allow for contact with supervision. In the absence of cellular reception a satellite phone or similar device may be required.

- Take frequent short breaks in areas sheltered from direct sunlight; eat and drink small amounts frequently.
- Try to schedule work for the coolest part of the day, early morning and evening.
- Avoid strenuous physical activity outdoors during the hottest part of the day.
- Avoid sudden changes of temperature. Refer *to S3AM-113-ATT1 Temperature Thresholds*.
- Air out a hot vehicle before getting into it.
- Obtain medical direction if taking diuretics during hot weather (a lower dose may be necessary).
- When working in heat, drink 1 quart of water per hour of work.
- Avoid caffeine and alcohol as they increase dehydration.
- Monitor urine frequency and color to detect dehydration. Refer to the *S3AM-113-ATT3 Dehydration Chart.*
- The Buddy System is required when working in high heat conditions to enable effective communication and cross-observation for indications of heat stress.
- Initiate emergency response procedures when necessary, including contacting emergency medical services as appropriate and in accordance with the Emergency Response Plan.

4.6.2 Personal Protective Equipment

- Review the *S3AM-208-PR1 Personal Protective Equipment* procedure.
- Wear a hat and light-colored, loose-fitting clothing to reflect the sun.
- Apply sunscreen to exposed skin (SPF 30 or greater, follow directions on label).
- Wear sunglasses with UV protection.
- Pack extra water to avoid dehydration (try freezing water in bottles overnight to help keep the water cooler for longer during the day).

4.7 Work-Rest Schedule Practices

4.7.1 Intake of fluid will be increased beyond that which satisfies thirst, and it is important to avoid "fluid debt," which will not be made up as long as the individual is sweating.

- Two 8-ounce glasses of water should be taken prior to beginning work, then up to 32 ounces (1 quart) per hour during the work shift; fluid replacement at frequent intervals is most effective.
- The best fluid to drink is water; liquids like coffee or soda do not provide efficient hydration and may increase loss of water.
- If commercial electrolyte drinks (e.g., Gatorade) are used, the drink should be diluted with water, or 8 ounces of water should be taken with each 8 ounces of electrolyte beverage.

4.7.2 Additional salt is usually not needed and salt tablets should not be taken.

4.7.3 Replacement fluids should be cool and fresh, but not cold.

4.7.4 Breaks will be taken in a cool, shaded location, and any impermeable clothing should be opened or removed.

- A relatively cool, shaded area shall be provided for breaks when working in hot environments. For hazardous waste sites, the rest area should be located in the support zone adjacent to the contamination reduction zone, situated so that part of it is in the decontamination area so workers can take breaks without going through full decontamination.

- If shade is not available, shaded areas shall be constructed. This same type of canopy can be set up to shade personnel performing various types of work in hot weather.
- Cooling measures other than shade (e.g., misting, air conditioned break areas, air conditioned vehicles, etc.) can be used in lieu of shade provided it can be demonstrated that they are at least as effective in cooling employees.
- Employees should have access to these rest areas at break times and at any other time when suffering from heat illness or believing a preventive recovery period is needed.

4.7.5 Dry clothing or towels will be available to minimize chills when taking breaks.

4.7.6 Manual labor will not be performed during breaks, other than paperwork or similar light tasks.

4.7.7 Other controls that may be used include:

- Scheduling work at night or during the cooler parts of the day (6 am–10 am, 3 pm–7 pm).
- Erecting a cover or partition to shade the work area.
- Auxiliary cooling - wearing cooling devices beneath protective garments, but over any underclothing.
    - If cooling devices are worn, only physiological monitoring will be used to determine work activity.
    - These vests typically provide cooling via one of two methods: the use of ice or other frozen media, or the use of a vortex cooler. Each method has its advantages and disadvantages.
    - The frozen media vest requires a means for freezing the media, and the media (usually water or "blue ice") will melt, requiring replacement.
    - The vortex cooler tends to cool more uniformly. Instead of frozen media, this vest uses the expansion of compressed air to cool the wearer. The drawback is the compressed air requirement, but this is negated when the wearer is already using an airline respirator supplied by a compressor. A vortex cooler should not be supplied from air cylinders, as this will draw down the cylinders rapidly.
- Auxiliary cooling should be considered when the following conditions exist:
    - Ambient temperature over 80°F (26°C).
    - Workers are wearing impermeable garments (i.e., Tyvek, Saranex, Chemrel, etc.).
    - It is desirable to have long work shifts with minimum interruption.

4.8 Evaluating the Work-Rest Schedule's Effectiveness

4.8.1 Once a work-rest schedule is established, the Supervisor shall continually evaluate its effectiveness through observation of Employees for signs/symptoms of heat stress. Have workers assess themselves and their body's reaction to the heat and work conditions (self-assessment), and report any signs or symptoms of heat illness. These can include nausea or dizziness, heat cramps, extreme thirst, or very dark urine.

4.8.2 Measurement or physiological monitoring of each Employee's vitals (e.g., pulse, blood pressure, and temperature) can provide additional information in determining if the schedule is adequate. Refer to *S3AM-113-ATT1 Temperature Thresholds* for additional guidance on when physiological monitoring should be conducted.

4.8.3 Frequency of physiological monitoring is increased or decreased depending upon such factors as worker fitness, acclimatization, temperature of the work environment, type of PPE, etc.

Based on the results of the physiological monitoring and on the workers' self-assessments, the work period may be adjusted as follows:

- The work period may be increased (generally, by 5- to 10-minutes intervals, up to a maximum of 4 hours) if the results of the first 2 hours of the physiological monitoring and the workers' self-assessments indicate that workers are recovering adequately (see below), and on the judgment of the SH&E Manager.
- The work period shall be decreased if the results of the physiological monitoring and the workers' self-assessment indicate that workers are NOT recovering adequately (see below).

4.8.4 If physiological monitoring is conducted, the Employee and/or the SH&E Manager (or appropriate designate) shall measure and record body temperature and pulse rate as described below.

4.8.5 Monitor body temperature to determine if Employees are adequately dissipating heat build-up. Ear probe thermometers which are adjusted to oral temperature (aural temperature) are convenient and the preferred method of measurement. Determine work/rest regimen as follows:

- Measure oral body temperature at the end of the work period. Oral body temperatures are to be obtained prior to the employee drinking water or other fluids.
- If temperature exceeds 99.6°F (37.5°C), shorten the following work period by 1/3 without changing the rest period.
- If, at the next rest period, temperature still exceeds 99.6°F (37.5°C), the worker should not be allowed to continue work until repeated temperature measurements are in the acceptable range (i.e., less than 99.6°F). Do not leave the worker alone during the recovery time. Watch for signs of heat illness and be prepared to implement emergency response as necessary.
- Do not allow a worker to wear impermeable PPE when his/her oral temperature exceeds 100.6°F (38.1°C).

4.8.6 At the start of the workday each Employee's baseline pulse rate (in beats per minute [bpm]) is determined by taking a pulse count for 15 seconds and multiplying the result by four or by using an automated pulse count device. Pulse rates can then be measured at the beginning of each break period and two minutes thereafter to determine if the rest period allows for adequate recovery.

- Take the radial (wrist) pulse as early as possible in the rest period and determine the worker's heart rate in beats per minute. The heart rate is determined by counting the pulse for ten seconds and multiplying the number by 6 to get the beats per minute. Record this as P1.
- Wait 2 minutes and repeat the pulse measurement. Record this as P2.
- If P1 is greater than or equal to 110 beats per minute (bpm) and if (P1 – P2) is less than or equal to 10 bpm (indicating that workers are not recovering adequately), shorten the next work cycle by 1/3 without changing the rest period.
- At the next rest period, if P1 is still equal to or greater than 110 bpm, and if (P1 – P2) is still less than or equal to 10 bpm, shorten the following work cycle by 1/3 without changing the rest period.
- At the third rest period, if P1 is still equal to or greater than 110 bpm and (P1 – P2) is still less than or equal to 10 bpm, the worker should not be allowed to continue work until repeated pulse measurements are in the acceptable range (i.e., P1 is less than 110 bpm and (P1 – P2) is greater than 10 bpm). Do not leave the worker alone during the recovery time. Watch for signs of heat illness and be prepared to implement emergency response as necessary.

4.8.7 Use of an automated or similar blood pressure device will be used to assess each Employee's blood pressure at the beginning and end of each break period to determine if the rest period allows adequate cooling by applying the following criteria:

- If the blood pressure of an Employee is outside of 90/60 to 150/90, then the Employee will not be allowed to begin or resume work; extend the break period by at least five minutes, at the end of which blood pressure rates will be re-measured and the end-of-break criteria again applied.

4.8.8 All physiological monitoring of heat stress will be documented using *S3AM-113-FM1 Heat Stress Monitoring Log.*

4.9 Training

4.9.1 Employees and their Supervisors that may be exposed to the hazard will be trained and oriented to the hazard and the controls prior to work commencing.

4.9.2 Those Employees, including Supervisors, potentially exposed to heat stress will receive training, refer to the *S3AM-003-PR1 SH&E Training* procedure. Training will include, but is not limited to:

- Sources of heat stress (environmental and personal), influence of protective clothing, and importance of acclimatization;
- How the body handles heat and acclimatization;
- Recognition of heat-related illness symptoms;
- Preventative/corrective measures including, but not limited to;
  - Employees will be informed of the harmful effects of excessive alcohol consumption in the prevention of heat stress.
  - All Employees will be informed of the importance of adequate rest and proper diet in the prevention of heat stress.
- First aid procedures for heat stress-related illnesses; and
- Immediate reporting of any heat-related incident (injury, illness, near-miss), refer to the *S3AM-004-PR1 Incident Reporting, Notifications & Investigation* procedure.

5.0 Records

5.1 None

6.0 Attachments

6.1 S3AM-113-ATT1 Temperature Thresholds

6.2 S3AM-113-ATT2 Symptoms & Treatment

6.3 S3AM-113-ATT3 Dehydration Chart

6.4 S3AM-113-FM1 Heat Stress Monitoring Log

Americas

Heat Stress – Temperature Thresholds

S3AM-113-ATT1

1.0 Work-Rest Schedule

The prevention of heat stress is best performed through Supervisor observation of Employees and routine heat stress awareness training activities. However, it is also necessary to implement a work routine that incorporates adequate rest periods to allow Employees to remove protective clothing, drink fluids (vital when extreme sweating is occurring), rest and recover. The frequency and length of work breaks shall be determined by the Supervisor based upon the ambient temperature, amount of sunshine, humidity, the amount of physical labor being performed, the physical condition of the Employees (e.g., acclimated/not), and protective clothing being used.

1.1 Establishing a Work-Rest Schedule:

1.1.1 AECOM permits the use of either of two techniques to initially determine an appropriate daily work-rest schedule. These methods are:

- Wet Bulb Globe Thermometer (WBGT) Method: This method is preferred if a WBGT meter is available.
- Adjusted Temperature Method: This method should be used only if WBGT data is not available.

1.1.2 Either procedure will provide the Supervisor with a recommended routine; however, adjustments to this routine may be required to accommodate the specific daily conditions at the work site.

1.2 WBGT Work-Rest Schedule Guidelines:

1.2.1 If the measured WBGT is less than the action limit value, there is little risk of excessive exposure to heat stress, and work can continue.

- Continue to monitor ambient conditions with the WBGT. However, if there are reports of the symptoms of heat-related disorders, then the analysis of little risk should be reconsidered.
- If the measured WBGT is greater than the values in the following two tables, institute heat stress controls, including the associated work-rest cycle, and perform physiological monitoring as described in *S3AM-113-PR1 Heat Stress*.
- Because of the physiological strain associated with very heavy work among less fit workers regardless of WBGT, values are not provided in Table 1 or 2 for continuous work or 75% work – 25% rest regimen. Physiological monitoring should always be implemented under these conditions.

1.2.2 Table 1, the Non-CPC Activities WBGT Chart, is intended for use where personnel are not utilizing Chemical Protective Clothing (CPC). Where workers are required to utilize CPC, Table 2, the CPC Activities WBGT Chart, will be used.

1.2.3 WBGT readings are compared directly with the values of the applicable WBGT Chart for the applicable work rate (where light work corresponds to minimal physical activity besides standing/watching; very heavy work corresponds to significant, continuous physical labor) to determine the work-rest frequency.

Table 1. Non-CPC Activities WBGT Chart

Work-Rest Regimen	WBGT			
	Light Work	Moderate Work	Heavy Work	Very Heavy Work
Continuous Work	85°F (29.4°C)	81°F (27.2°C)	78°F (25.6°C)	
75% Work – 25% Rest	86°F (30°C)	83°F (28.3°C)	81°F (27.2°C)	
50% Work – 50% Rest	88°F (31.1°C)	85°F (29.4°C)	83°F (28.3°C)	81°F (27.2°C)
25% Work – 75% Rest	90°F (32.2°C)	87°F (30.6°C)	86°F (30°C)	85°F (29.4°C)

Modified from ACGIH's 2014 *Threshold Limit Values for Chemical Substances and Physical Agents*, for acclimatized workers.

Table 2. CPC Activities WBGT Chart

Work-Rest Regimen	WBGT			
	Light Work	Moderate Work	Heavy Work	Very Heavy Work
Continuous Work	74°F (23.3°C)	70°F (21.1°C)	67°F (19.4°C)	
75% Work – 25% Rest	75°F (23.9°C)	72°F (22.2°C)	70°F (21.1°C)	
50% Work – 50% Rest	77°F (25°C)	74°F (23.3°C)	72°F (22.2°C)	70°F (21.1°C)
25% Work – 75% Rest	79°F (26.1°C)	76°F (24.4°C)	75°F (23.9°C)	74°F (23.3°C)

Modified from ACGIH's 2014 *Threshold Limit Values for Chemical Substances and Physical Agents*, for acclimatized workers.

1.3 Humidex Based Work-Rest Schedule Guidelines

1.3.1 The Humidex method is a simplified way of protecting workers from heat stress. It is an equivalent scale intended to express the combined effects of warm temperatures and humidity. Humidex is used as a measure of perceived heat that results from the combined effect of excessive humidity and high temperature.

1.3.2 This method requires only a local air temperature and relative humidity value. Monitoring shall continue throughout the day for changing conditions. Identify a representative location where measurements can be taken. Measurements should be recorded at least hourly when ambient temperatures and 90°F (32°C) for personnel wearing normal permeable work clothes.

- Step 1: On the Humidex table below, look up the temperature on the left (Celsius is located below RH>) and the relative humidity (RH) on the top. Determine the Humidex value.

F	RH>	100%	95%	90%	85%	80%	75%	70%	65%	60%	55%	50%	45%	40%	35%	30%	25%	20%
108	42													55	52	50	48	46
106	41												55	53	51	48	46	44
104	40											55	53	51	49	47	45	43
102	39										55	53	51	49	47	45	43	41
100	38		Step 1 - Determine HUMIDEX VALUE							54	53	51	49	47	45	43	42	40
99	37								54	52	51	49	47	45	44	42	40	38
97	36					57	55	53	52	50	49	47	45	44	42	40	39	37
95	35				56	54	53	51	50	48	47	45	43	42	40	39	37	36
93	34		56	55	53	52	51	49	48	46	45	43	42	40	39	37	36	34
91	33	55	54	53	51	50	48	47	46	44	43	41	40	39	37	36	34	33
90	32	53	51	50	49	48	46	45	44	42	41	40	38	37	36	34	33	32
88	31	50	49	48	47	45	44	43	42	40	39	38	37	35	34	33	32	30
86	30	48	47	46	44	43	42	41	40	39	37	36	35	34	33	31	30	29
84	29	46	45	43	42	41	40	39	38	37	36	35	33	32	31	30	29	28
82	28	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27
81	27	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25
79	26	39	38	37	36	35	34	33	33	32	31	30	29	28	27	26	25	24
77	25	37	36	35	34	33	33	32	31	30	29	28	27	26	26	25	24	23

- Step 2: Place the Humidex value into the Heat Index Adjustment Table below. Determine the applicable adjustments based on the given work or task.

Heat Index Adjustment Table

	Step 2 - Risk Factor Adjustment	
Write in value	What is the HUMIDEX value from the table in Step 1?	
	Radiant Heat	**Adjustment**
	Working in full-sun	Add 2
	Working in ½ or partial sun or weak radiant heat source	Add 1
	Working near very hot equipment surfaces or processes	Add 2
	Clothing: Pick One Only	
	Short/long sleeve shirt and pants – no overalls	None
	Overalls (e.g., Nomex suit)	Add 3
	Double layer overalls	Add 5
Stop	Impermeable clothing	Perform Physiological Monitoring
	Acclimatization	
	Have been working at least 5 of last 7 days in heat stress conditions.	Subtract 4
	Work Load & Miscellaneous Factors	
	Light Work (Standing, slow walking)	Subtract 2
	Medium Work (Walking about with moderate lifting or pushing)	None
	Heavy Work (Shoveling dry sand, carrying 50 lbs)	Add 2
	Very Heavy Work (Shoveling wet sand)	Add 3
	TOTAL – Compare to Heat Index Response Plan	

- Step 3: Compare adjusted Heat Index Total to the Heat Index Response Plan table to obtain guidance for work/rest.

Heat Index Response Plan*

TOTAL NUMBER	Final Step 3 - HEAT INDEX Response
30-33	alert & information & water
34-37	warning & increase water
38-39	75% work - 25% rest & monitor for signs of heat stress
40-41	50% work - 50% rest & monitor for signs of heat stress
42-44	25% work - 75% rest & monitor for signs of heat stress
45+	Perform Physiological Monitoring

*** Percent work and rest/recovery are on a per hour basis. Adjustments and subsequent work/rest cycle recommendations are rough guidelines only. No heat stress prediction scheme can replace monitoring of symptoms or a health care practitioners advice in the case of individuals with special medical conditions or predisposing circumstances for heat related illness. Always pay attention to the way workers are feeling. Recuperate if fatigued, nauseated, dizzy or thirsty,**

1.4 Adjusted Temperature Work-Rest Schedule Guidelines:

This method can be utilized where WBGT data is not available, and requires only that the ambient temperature be known. Adjustment factors are applied to the ambient temperature to account for departures from ideal conditions (sunny conditions, light winds, moderate humidity and a fully acclimated work force). The adjustments will be made by addition or subtraction to the ambient temperature reading, or changes in table position, as indicated in Table 3. Adjustments are independent and cumulative, all applicable adjustments should be applied. The result is the Adjusted Temperature, which can be compared with the values in Table 4 for the applicable work rate (where light work corresponds to minimal physical activity besides standing/watching; very heavy work corresponds to significant, continuous physical labor) to determine the work-rest schedule.

Table 3. Temperature Adjustment Factors

Time of Day	
Before daily temperature peak[1]	+2°F (+1.11°C)
10 am – 2 pm (peak sunshine)	+2°F (+1.11°C)
Sunshine	
No clouds	+1°F (+0.56°C)
Partly Cloudy (3/8 – 5/8 cloud cover)	-3°F (-1.67°C)
Mostly Cloudy (5/8 – 7/8 cloud cover)	-5°F (-2.78°C)
Cloudy (>7/8 cloud cover)	-7°F (-3.89°C)
Indoor or nighttime work	-7°F (-3.89°C)
Wind (*ignore if indoors or wearing CPC*)	
Gusts greater than 5 miles per hour at least once per minute	-1°F (-0.56°C)
Gusts greater than 10 miles per hour at least once per minute	+2°F (+1.11°C)
Sustained greater than 5 miles per hour	-3°F (-1.67°C)
Sustained greater than 10 miles per hour	-5°F (-2.78°C)
Humidity (*ignore if wearing CPC*)	
Relative Humidity greater than 90%	+5°F (+2.78°C)
Relative Humidity greater than 80%	+2°F (+1.11°C)
Relative Humidity less than 50%	-4°F (-2.23°C)
Chemical Protective Clothing (CPC)	
Modified Level D (coveralls, no respirator)	+5°F (+2.78°C)
Level C (coveralls w/o hood, full-face respirator)	+8°F (+4.45°C)
Level C (coveralls with hood, full-face respirator)	+10°F (+5°C)
Level B with airline system (hooded chemical resistant clothing)	+9°F (+5.56°C)
Level B with SCBA (hooded chemical resistant clothing)	+9°F (+5.56°C) and right one column[2]
Level A (totally encapsulating chemical protective suit)	+14°F (+7.78°C) and right one column
Other	Specified in the HASP
Miscellaneous	
Unacclimated work force	+5°F (+2.78°C)
Partially acclimated work force	+2°F (+1.11°C)
Working in shade	-3°F (-1.67°C)
Breaks taken in air conditioned space	-3°F (-1.67°C)

For complete descriptions of Level A through D Protective Clothing refer to Unites States 29 CFR 1910.120 Appendix B

[1] This adjustment accounts for temperature rise during the day. If the temperature has already reached its daytime peak it can be ignored.

[2] Locate the proper column based on work rate, then move one column to the right (next higher work rate) before locating the corresponding adjusted temperature.

Table 4. Work-Rest Schedule Based on Adjusted Temperature

Work-Rest Regimen	Adjusted Temperature			
	Light Work	**Moderate Work**	**Heavy Work**	**Very Heavy Work**
No specified requirements	< 80°F (26.67°C)	< 75 (23.88°C)	< 70 (21.11°C)	< 65 (18.33°C)
15 minute break every 90 minutes of work	80°F – 90°F (26.67°C) - (32.22°C)	75 – 85 (23.88°C) - (29.44°C)	70 – 80 (21.11°C) - (26.67°C)	65 – 75 (18.33°C) - (23.88°C)
15 minute break every 60 minutes of work	>90 – 100 (32.22°C) - (37.77°C)	> 85 – 95 (29.44°C) - (35°C)	>80 – 85 (26.67°C) - (29.44°C)	>75 – 80 (23.88°C) - (26.67°C)
15 minute break every 45 minutes of work	>100 – 110 (37.77°C) - (43.33°C)	>95 – 100 (35°C) - (37.77°C)	>85 – 90 (29.44°C) - (32.22°C)	>80 – 85 (26.67°C) - (29.44°C)
15 minute break every 30 minutes of work	>110 – 115 (43.33°C) - (46.11°C)	>100 – 105 (37.77°C) – (40.55°C)	>90 – 95 (32.22°C) - (35°C)	>85 – 90 (29.44°C) - (32.22°C)
15 minute break every 15 minutes of work	>115 – 120 (46.11°C) - (48.88°C)	>105 – 110 (40.55°C) - (43.33°C)	>95 -100 (35°C) - (37.77°C)	>90 – 95 (32.22°C) - (35°C)
Stop Work	**>120** (48.88°C)	**>110** (43.33°C)	**>100** (37.77°C)	**>95** (35°C)

Note: Time spent performing decontamination or donning/doffing CPC should not be included in calculating work or break time lengths.

Work-rest schedules and water provisioning may be documented using logs such *as S3AM-113-FM2 Daily Heat Illness Prevention Log*.

Americas

Heat Stress – Symptoms & Treatment

S3AM-113-ATT2

1.0 Heat Illness Symptoms

1.1 The following are four stages of heat-related illness:

1.1.1 Heat Rash

Heat rash (prickly heat) may result from continuous exposure to heat or humid air. It appears as red papules (elevated skin lesion), usually in areas where the clothing is restrictive, and gives rise to a prickly sensation, particularly as sweating increases. It occurs in skin that is persistently wetted by un-evaporated sweat. The papules may become infected unless treated.

1.1.2 Heat Cramps

Heat cramps are painful muscle cramps caused by heavy sweating and inadequate electrolyte replacement due to over-exertion in extreme heat. Symtpoms include:

- Muscle spasms; and
- Pain in the hands, feet, and abdomen.

1.1.3 Heat Exhaustion

Heat exhaustion is the next stage. Heat exhaustion occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Symptoms include:

- Cool, moist, pale, flushed or red skin;
- Heavy sweating;
- Headache;
- Nausea or vomiting;
- Dizziness;
- Exhaustion;
- Mood changes (irritable, or confused/can't think straight), and
- Fainting

The key here is that the victim is still sweating, so the cooling system is still working; it's just under severe stress. The body core temperature may be elevated, but not higher than 104ºF (40ºC). It is important to recognize and treat these symptoms as soon as possible, as the transition from heat exhaustion to the very hazardous heat stroke can be quite rapid.

1.1.4 Heat Stroke

Heat exhaustion can sometimes lead to heat stroke, the most serious form of heat stress, which can be fatal and requires emergency treatment. Heat stroke happens when body temperature regulation fails and body temperature continues to rise to critical levels, often to 105 degrees Fahrenheit (°F) (40.5 degrees Celsius [° C]) or higher. Immediate action must be taken to cool the body before serious injury and death occurs. Competent medical help must be obtained. Symptoms of heat stroke:

- Vomiting;
- Decreased alertness level or complete loss of consciousness;
- Slurred speech;
- High body temperature (sometimes as high as 105°F [40.5°C]);
- Red, hot, usually dry skin;
- Lack of or reduced perspiration;
- Skin may still be moist or the victim may stop sweating and the skin may be red, hot, and dry;

- Rapid, weak pulse or rapid, strong pulse;
- Rapid, shallow breathing;
- Nausea;
- Dizziness and confusion; and
- Coma.

2.0 Recommended Treatment for Heat Stress-related Illnesses

2.1 Heat Rash

2.1.1 Treatment for heat rash includes:

- Shower after work, dry off thoroughly, and put on clean, dry underwear and clothes;
- Try to stay in a cool place after work;
- If, in spite of this, you develop heat rash, contact WorkCare.

2.2 Heat Cramps

2.2.1 Treatment for heat cramps includes:

- Gently stretch the cramped muscle and hold the stretch for about 20 seconds, then gently massage the muscle. Repeat these steps if necessary;
- Take more frequent breaks and drink more water;
- Move victim to a cool place;
- Administer drinks of cool water;
- Apply manual pressure to cramped muscles;
- Once spasms disappear, you may return to work;
- Seek medical attention if symptoms are not alleviated or if more serious problems are indicated.

2.3 Heat Exhaustion

2.3.1 Treatment of heat exhaustion includes:

- Get out of the sun to a cool location and drink cool water, a little at a time;
- Remove or loosen tight clothing and elevate the feet;
- If you are nauseated or dizzy, lie down;
- Move the victim to a cool place, administer drinks of cool water and fan to cool;
- Seek medical attention immediately.

2.4 Heat Stroke

2.4.1 Treatment of heat stroke, or if a person's temperature exceeds 102°F (38.9 °C) includes:

- Call for immediate medical help and then try to lower the temperature as quickly as possible:
  - Apply cool (not cold) water the person's whole body, then fan the person;
  - Wrap in wet sheet;
  - If available, use cold packs under arms, neck, and ankles;
  - Body temperature is measured frequently, often constantly. To avoid overcooling, cooling is stopped when the body temperature is reduced to about 102°F (38ºC);
- Do not give aspirin or acetaminophen to reduce the temperature;
- Treat as a true medical emergency. Seek medical help immediately;
- Protect from injury during convulsion;
- Ensure that the person's airway is open;
- Transfer to a medical facility immediately.

Americas

Dehydration Chart

S3AM-113-ATT3

GUIDANCE TOOL FOR MONITORING DEHYDRATION

URINE COLORATION CHART



1 2	3 4	5 6
Target	Dehydration	Severe Dehydration
CONTINUE DRINKING WATER TO MAINTAIN CURRENT HYDRATION LEVELS.	INCREASE WATER CONSUMPTION TO IMPROVE HYDRATION LEVELS, INCREASE BREAKS FREQUENCY, TAKE BREAKS IN A COOL SHADED AREA.	STOP WORK! FIND A SHADED AREA AND BEGIN TO DRINK COOL TO ROOM TEMPERATURE WATER SLOWLY AND STEADILY.

PREVENTING DEHYDRATION

- Start hydrating at least 3 days prior to working in high heat conditions
- Always bring enough water to maintain hydration. CalOSHA requires consuming 1 quart per hour of your work shift - more may be needed

Note: This information is guidance only and should not supersede the recommendation or instruction of a personal physician or medical professional. Contact your physician or medical professional if you have a personal medical condition or take medication for a personal condition which may be adversely affected by dehydration. Urine color can be affected by medications, vitamins and or other personal health conditions.

Americas

Heat Stress Monitoring Log

S3AM-113-FM1

The purpose of this form is to monitor employees for heat illness when applicable. It is the responsibility of the Foreman or Supervisor-in-Charge to ensure that each person completes the required information.

Project Name:			**Foreman/Supervisor:**								**Work/Rest Schedule1:** IN *(min)* OUT *(min)*					
Date:	**Water Provided[1]**		**Acclimated[2]**		**Initial Vitals[3]**	**Vital Signs and Time In/Out[3]**					**Celcius** ☐ / **Farenheit** ☐ (select one)					
Employee Name	Yes	No	Yes	No	**Vitals**	In (P_1)	Out (P_1)	**Vitals**	In (P_1)	Out (P_1)	**Vitals**	In (P_1)	Out (P_1)	**Vitals**	In (P_1)	Out (P_1)
					P			**P**			**P**			**P**		
					BP			**BP**			**BP**			**BP**		
					Temp			**Temp**			**Temp**			**Temp**		
					P			**P**			**P**			**P**		
					BP			**BP**			**BP**			**BP**		
					Temp			**Temp**			**Temp**			**Temp**		
					P			**P**			**P**			**P**		
					BP			**BP**			**BP**			**BP**		
					Temp			**Temp**			**Temp**			**Temp**		
					P			**P**			**P**			**P**		
					BP			**BP**			**BP**			**BP**		
					Temp			**Temp**			**Temp**			**Temp**		
					P			**P**			**P**			**P**		
					BP			**BP**			**BP**			**BP**		
					Temp			**Temp**			**Temp**			**Temp**		
					P			**P**			**P**			**P**		
					BP			**BP**			**BP**			**BP**		
					Temp			**Temp**			**Temp**			**Temp**		

1. Each Employee should be provided a sufficient amount of water or sports drink before entering the hot zone. Drinks such as coffee and cola should be discouraged.
2. Am Employee is “acclimated” if he/she has worked in a hot environment for at least 5 - 7 consecutive days. If an Employee is acclimated, check “Yes.” If an Employee is not acclimated, check “No” and reduce the “Min In” by 50 percent for that Employee until the 5 – 7 -day period is reached.
3. “Vitals” refers to Employee vital signs (e.g., pulse [P], blood pressure [BP], body temperature [Temp], etc.). Initial vitals must be taken and recorded before the start of work and at each break period, or as specified in the Heat Stress Exposure Control Plan.

Heat-Related Illness Prevention

Site/Project Name
Location

Month and Year prepared

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DELETE BEFORE FINALIZING: This is a template intended to provide guidance for the development of site specific Heat Illness Prevention Plans required by the 2015 update to 8 CCR 3395) and should be modified to support site specific operations. This plan is intended to work in conjunction with a Health and Safety Plan (HASP), Safe Work Plan (SWP) or Task Hazard Analysis with an Emergency Action Plan.

Risk for a heat-related illness varies based upon work activities, personal protective equipment (PPE)/clothing selection, geographical locations, personal conditions and weather conditions. To reduce the potential of developing a heat-related illness, AECOM has developed a site-specific procedure incorporating:

- AECOM's SH&E Procedure for Heat Illness Preventions (S3AM-113_PR_Heat Stress),
- California Occupational Safety and Health Administration Heat Illness Prevention Standard (Title 8 of the California Code of Regulations, Section 3395), and
- INSERT SWP, HASP, THA or supporting document

1. Planning

This section may be replaced with an actual forecast or historic data related to location/seasonal temperatures.

The Site Safety Officer (SSO) and Field Supervisor shall verify the risk of heat-related illnesses based on:

- Weather forecasts,
- Planned work activities,
- Planned PPE, and
- Personal risk factors.

The SSO and Project Manager shall also ensure the appropriate equipment and resources are available to employees at risk of a heat- related illness. Examples of necessary equipment may include (but are not limited to):

- Potable water with replenishment supply;
- Drinking cups, insulated water bottles or other small sealable container;
- Sun protection (hats, long sleeves, sunscreen, sunglasses);
- Communication method (cell phone or similar);
- Shade;
- Reliable thermometer (a simple thermometer, like those available at hardware stores, can be used to measure the outdoor "dry bulb" temperature); and
- Cooling devices such as cooling vests or misters.

INSERT HISTORICAL WEATHER DATA OR FORECASTED CONDITIONS FOR DURATION OF PROJECT.

2. Water

2.1 Provision of Water

Employees shall have access to potable drinking water. The frequent drinking of water shall be encouraged by supervisors and field team members.

- Each employee shall be provided with a minimum 2 gallons of water per 8-hour shift, free of charge.

- All water shall be fresh, pure, potable, and cool (cooler than ambient temperature).
- Water will be located as close as possible to the work area.
- Water will be stored in an environment that will ensure a cool temperature and prevent contamination.
- Replenishment Procedures:

Update this section with site specific water replenishment procedures.

  - **Fixed Site:** Replenishment water supply shall be located XXXXXXX. Employees will have access to replenishment during working hours and may be/are required to report the date, time and quantity of water taken from the replenishment supply.
  - **Mobile/Remote Work**: Mobile and remote employees may carry water bottles or smaller sealed container of water with them while they are working, and refill containers at the primary source (cooler or other designated source) during breaks or as needed.

    Containers and refill frequency shall provide for a minimum of 1 quart of water to be consumed per hour while working Water bottles or smaller sealed container do not need to be empty prior to refilling; water should always be immediately available to employees.

2.2 Dehydration Prevention

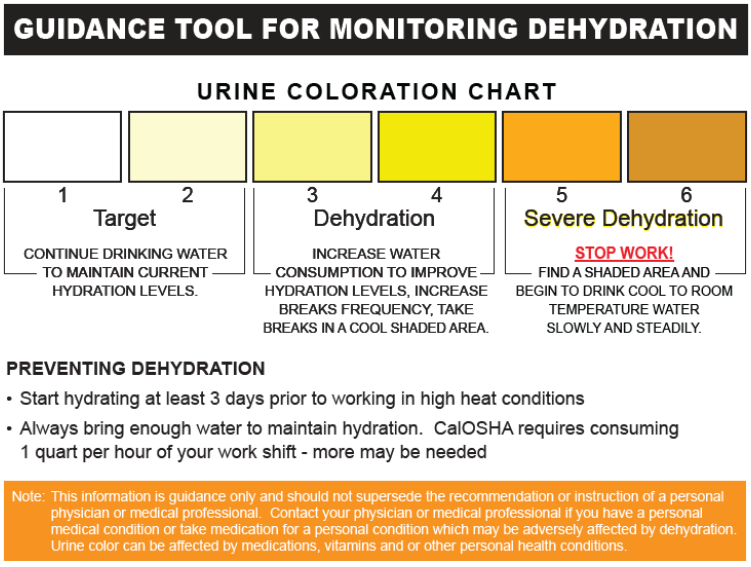
The 2006 Cal/OSHA Heat Illness Case Study showed that, although 90% of the worksites had drinking water at the site, 96% of the employees suffering from heat illnesses were dehydrated.

Dehydration occurs when the body loses too much fluid. This can happen when an employee stops drinking water and can be accelerated by work in hot or dry conditions. Not drinking enough fluids can cause muscle cramps, fainting and shock, which is a life-threatening condition.

Drinking water should increase with activity level. Dehydration can affect the body's ability to recognize thirst, so employees shall drink water on a time schedule.

In hot conditions, it is important that employees drink enough water that urination is required at least every 2 hours. Water is the best hydration fluid. If sports drinks are used, they should be diluted at least 50 percent with water prior to drinking. **Do Not Drink Distilled Water.**

Dehydration can be prevented by monitoring urine color and adjusting water intake accordingly. The following guidance was developed to aid employees in monitoring hydration levels. This tool can be downloaded from: Hydration Chart.



3. Access to Shade

This section may be replaced with a site-specific description of shade structures, locations. A map of these resources can also be included.

When temperatures **do not exceed 80 degrees Fahrenheit (°F) (26°Celsius [°C])**, access to shade for employee will be provided as needed, or as requested by employees. Timely access to shade will be provided upon an employee's request.

Shade is required when the temperature exceeds 80°F (26°C).

One or more shaded areas will be established at all times. Shade may require relocation to accommodate a moving work location.

The shaded area will either open to the air or be provided with ventilation or cooling (such as an air-conditioned vehicle). The amount of shade present shall be at least enough to accommodate the number of employees on a rest/recovery/meal/break period at any given time, so that they can sit in a normal posture fully in the shade without having to be in physical contact with each other.

The shaded area shall be located as close as practicable to the areas where employees are working, but no more than a 2.5-minute walk away. Access must be undeterred (free from obstacles or other barriers such as crossing traffic). The shaded area will be away from portable toilets, and in a clean, dry and otherwise hazard-free environment.

Examples of appropriate access to shade:

- Buildings, canopies, lean-tos, or other partial or temporary structures that are either ventilated or open to air movement.
- Trees and dense vines can provide shade that is superior to artificially provided shade and are accepted as compliant sources of shade as long as branches, thorns and the plant itself does not pose added harm to the employee.
- The interior of a vehicle may only be used to provide shade when the vehicle is air conditioned and the air conditioner is operating.

INSERT FIGURE OF SITE MAP WITH LOCATIONS OF SHADED BREAK AREAS.

4. Work-Rest Cycles and Breaks

It is necessary to implement a work routine that incorporates adequate rest periods to allow employees to remove protective clothing, drink fluids (vital when extreme sweating is occurring), rest and recover.

The frequency and length of work breaks will be determined based on the following considerations:

- Employees are allowed and encouraged to take a preventative cool-down rest in the shade when they feel the need to do so to protect themselves from overheating. The breaks will last for a minimum of 5 minutes and as long as needed to resolve any signs/symptoms of heat illness that are observed.
- The SSO may determine the timing of work breaks based upon the ambient temperature, amount of sunshine, humidity, the amount of physical labor being performed, the physical condition of the employees, and protective clothing being used. The following guidelines shall be used to determine frequency and duration of rest breaks:

4.1 Adjusted Temperature Method

This method requires only that the ambient temperature (in °F [°C]) be known. Adjustment factors are applied to the ambient temperature to account for departures from ideal conditions (sunny conditions, light winds, moderate, humidity and a fully acclimated work force). The adjustments should be made by adding or subtracting the ambient temperature reading, or changes in table position, as indicated in Table 4-1. Adjustments are independent and cumulative; all applicable adjustments should be applied. The result is the *Adjusted Temperature*, which can be compared with the values in Table 4-2 for the applicable work rate (where light work corresponds to minimal physical activity besides standing/watching; very heavy work corresponds to significant, continuous physical labor) to determine the work-rest frequency.

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Table 4-1 Temperature Adjustment Factors

Time of Day	
Before daily temperature peak[1]	+2°F (+1.11°C)
10 a.m. – 2 p.m. (peak sunshine)	+2°F (+1.11°C)
Sunshine	
No clouds	+1°F (+0.56°C)
Partly Cloudy (3/8 – 5/8 cloud cover)	-3°F (-1.67°C)
Mostly Cloudy (5/8 – 7/8 cloud cover)	-5°F (-2.78°C)
Cloudy (>7/8 cloud cover)	-7°F (-3.89°C)
Indoor or nighttime work	-7°F (-3.89°C)
Wind	
Gusts greater than 5 miles per hour at least once per minute	-1°F (-0.56°C)
Gusts greater than 10 miles per hour at least once per minute	+2°F (+1.11°C)
Sustained greater than 5 miles per hour	-3°F (-1.67°C)
Sustained greater than 10 miles per hour	-5°F (-2.78°C)
Humidity	
Relative Humidity greater than 90%	+5°F (+2.78°C)
Relative humidity greater than 80%	+2°F (+1.11°C)
Relative Humidity less than 50%	-4°F (-2.23°C)
Chemical Protective Clothing (CPC)	
Modified Level D (coveralls, no respirator) [2]	+5°F (+1.11°C)
Miscellaneous	
Unacclimated work force	+5°F (+2.78°C)
Partially acclimated work force	+2°F (+1.11°C)
Working in shade	-3°F (-1.67°C)
Breaks taken in air conditioned space	-3°F (-1.67°C)

°F = degrees Fahrenheit; °C = degrees Celsius
[1] This adjustment accounts for temperature rise during the day. If the temperature has already reached its daytime peak, it can be ignored.
[2] Refer to S3AM-113-ATT1 for addition Chemical Protective Clothing (Type C – A)

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Table 4-2 Work-Rest Schedule Based on Adjusted Temperature

Work-Rest Frequency	Adjusted Temperature – ºF (ºC)			
	Light Work	**Moderate Work**	**Heavy Work**	**Very Heavy Work**
No Specified requirements	< 80ºF (26.67ºC)	< 75ºF (23.88ºC)	< 70ºF (21.11ºC)	< 65ºF (18.33ºC)
15-minute break every 90 minutes of work	80–90ºF (26.67–32.2ºC)	75–85ºF (23.88–29.44ºC)	70–80ºF (21.11–26.67ºC)	65–75ºF (18.33–23.88ºC)
15-minute break every 60 minutes of work	> 90–100ºF (32.22–37.77ºC)	> 85–95ºF (29.44–35ºC)	> 80–85ºF (26.67–29.44ºC)	> 75–80ºF (23.88–26.67ºC)
15-minute break every 45 minutes of work	> 100–110ºF (37.77–43.33ºC)	> 95–100ºF (35–37.77ºC)	> 85–90ºF (29.44–32.22ºC)	> 80–85ºF (26.67–29.44ºC)
15-minute break every 30 minutes of work	> 110–115ºF (43.33–46.11ºC)	> 100–105ºF (37.77–40.55ºC)	> 90–95ºF (32.22–35ºC)	> 85–90ºF (29.44–32.22ºC)
15-minute break every 15 minutes of work	> 115–120ºF (46.11–48.88ºC)	> 105–110ºF (40.55–43.33ºC)	> 95–100ºF (35–37.77ºC)	> 90–95ºF (32.2–35ºC)
STOP WORK	**> 120ºF** (48.88ºC)	**> 110ºF** (43.33ºC)	**> 100ºF** (37.77ºC)	**> 95ºF** (35ºC)

ºF = degrees Fahrenheit; ºC = degrees Centigrade

4.2 Procedures for Taking Breaks

- Breaks will be taken in a cool and/or shaded location, in an air-conditioned environment when possible. A shaded break area is required when temperatures are above 80 ºF (26ºC).
- Employees will be monitored by the supervisor or SSO and asked if he or she is experiencing symptoms of heat illness.
- Each employee should self-assess and assess their co-workers for sign/symptoms of a heat-related illness.
- Employees will be encouraged to remain in the shade.
- All breaks will last a minimum of 5 minutes in addition to the time needed to access the shade.
- Employees will not be ordered back to work until any signs or symptoms of heat illness have abated.
- Pulse rate information should be collected to verify the effectiveness of the break and work-rest cycle.
- Water will be available, and consumption encouraged in the break area.
- Manual labor will not be performed during breaks, other than paperwork or similar light tasks.

4.3 Evaluating the Work-Rest Schedule's Effectiveness

Once a work-rest schedule is established, the SSO must continually evaluate its effectiveness through observation of employees for signs/symptoms of heat stress. Measurement of each employee's pulse can provide additional information in determining if the schedule is adequate and is accomplished as follows:
Within the first minute of each rest period, each employee's heart rate (pulse) can be measured and compared to the following:

- Initial heart rate: 110 beats per minute (bpm) (28 beats every 15 seconds).

Each employee's heart rate must be measured again 3 minutes later and compared to the following:

- Recovery heart rate: 80 bpm (20 beats every 15 seconds).
- If both heart rate criteria are met, the subsequent work period may be increased by one-third, provided the temperature remains constant.
- If the initial heart rate is greater than 110 bpm, or the recovery rate is not less than 80 bpm, the subsequent work shift is decreased by one-third.

If cooling devices (e.g., cooling vest) are worn, only physiological monitoring will be used to determine work activity. Measurements for each employee can be recorded and tracked throughout the workday using the Heat Stress Monitoring Log provided in S3AM-113_PR_Heat Stress.

5. Emergency Services

A minimum of two workers trained in cardio-pulmonary resuscitation (CPR) and First Aid will be present on site for all activities that expose employees to temperatures greater than 80ºF (27ºC). This is ideal, but may need to be adjusted for specific working conditions.
Means of contacting Emergency Services shall be validated in areas where cell phone reception is limited, and alternate reliable means will be selected.
Emergency Services will be activated if severe heat illness (such as, but not limited to, decreased level of consciousness, staggering, vomiting, disorientation, irrational behavior or convulsions) is observed or suspected.
An employee that exhibits signs or symptoms of illness shall not be left alone without first aid or medical treatment to resolve symptoms.
Refer the Site-Specific Emergency Action Plan for specific emergency instructions in the Task Hazard Analysis (THAs), Safe Work Plan or Health and Safety Plan.

5.1 Acclimatization

All employees shall be closely observed by a supervisor or designee during a heat wave. For purposes of this section only, "heat wave" means any day in which the predicted high temperature for the day will be at least 80ºF (27ºC) and at least 10 ºF (5 ºC) higher than the average high daily temperature in the preceding 5 days.
An employee who has been newly assigned to a high heat area shall be closely observed by a supervisor or designee for the first 14 days of the employee's employment.

5.2 Training of Employees and Supervisors

All AECOM employees and supervisors shall receive training in the prevention of heat-related illnesses prior to starting work. Training will include:

- Environmental risk factors for heat illness, including added burden of heat load on the body caused by exertion, clothing and PPE;
- Personal Risk Factors for heat illness such as an individual's age, degree of acclimatization, health, water consumption, alcohol consumption, caffeine consumption, and use of prescription medications that affect the body's water retention or other physiological responses to heat;
- AECOM's S3AM-113_PR_Heat Stress and a review of the site-specific procedure in this Safe Work Plan, and associated THAs;
- Signs, symptoms and response measures for different types of heat-related illnesses;
- Procedure for stopping work and reporting signs and symptoms of a heat-related illness in themselves or other people on site;
- First aid measure for managing a case of heat illness;
- AECOM's procedure for responding to heat-related illnesses, including use of AECOM's Corporate Medical Provider (Work Care), and seeking emergency medical services (see the site-specific Emergency Action Plan);

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- Obtaining accurate weather forecast and ambient temperature data;
- Access to potable water, the minimum recommended consumption rate (1 quart per hour), procedure for drinking (small quantities regularly throughout the day, increase intake for higher heat, increased workload or increased sweating);
- Provision of shade required when temperatures are greater than 80ºF (27ºC);
- Acclimatization;
- How to establish a work-rest cycle per S3AM-113_PR_Heat Stress; and
- Specific high heat (95ºF [35ºC]) procedures.

6. High Heat Procedures (>95° F)

The following procedures shall be implemented when the temperature equals or exceeds 95ºF (35ºC). These procedures shall include the following to the extent practicable:

- Ensuring that effective communication by voice, observation, or electronic means is maintained so that employees at the work site can contact a supervisor when necessary. An electronic device, such as a cell phone or text messaging device, may be used for this purpose only if reception in the area is reliable.
- Conduct a pre-shift meeting to review high heat procedures, encourage water consumption, and review the work-rest cycle and supplemental breaks.
- Employees shall be monitored for signs and symptoms through an effective means of observation, which may include:
    - For teams less than 20, monitoring by a supervisor or supervisor designee (SSO).
    - For teams larger than 20, monitoring via the Buddy System.
    - Regular communication through cell phone or radio of a lone worker.

Note: for Lone Worker scenario an alternate means of monitoring the worker must be devised.

- Reminders to drink plenty of water throughout the work shift shall be provided by the SSO or Site Supervisor or from peer to peer.
- Designate an employee that is authorized to call Emergency Services in the event of an emergency

7. Identifying and Responding to Sign and Symptoms

Heat stress can be a significant field site hazard, particularly for non-acclimated personnel working in the desert. Site personnel must be instructed in the identification of heat-stress symptoms of heat-related illnesses. Employees are required to immediately report any signs of symptoms that they may experience or observe in fellow employees. The guidance below in Table 7-1 will be used in identifying and responding to heat-related illness. Any employee exhibiting a sign or symptom of a heat-related illness shall receive appropriate first aid or medical care through the AECOM supervisor, and AECOM's Incident Reporting process.

Table 7-1 Identification and Treatment of Heat-Related Illness

Type of Heat-Related Illness	Description	First Aid
Dehydration	*96% of the employees suffering from heat illnesses were dehydrated.* Dehydration results from in taking less water than your body is using (sweating). Dehydration results in reduced urine output, dark-colored urine, shriveled skin that doesn't "bounce back" when pinched, extreme thirst (not always), sleepiness, lack of sweat, dry skin, headache, constipation.	• Stop work and move employee to shaded rest/break area. • Drink water, slowly and steadily. • Report to SSO, contact Safety Professional/Work Care for guidance on fluid intake and returning to work.
Heat Rash	A heat rash occurs when sweat ducts become clogged and the sweat can't get to the surface of the skin. Instead, it becomes trapped beneath the skin's surface causing a mild inflammation or rash.	Avoid working in hot, humid weather, wear loose clothing made of breathable fabrics like cotton, use air conditioning, and keep the skin clean with frequent baths or showers to prevent sweat glands from becoming clogged. Change clothing that is wet or soiled. Heat rash can be treated by cleaning and cooling the area with cool water and applying an over-the-counter hydrocortisone cream. There is risk of infection from heat rash if sweat glands become infected. The signs of infection include pain, increased swelling, and redness that does not resolve. Pustules may form at the site of the rash. This infection occurs because bacteria have invaded the blocked sweat gland. Antibiotic treatment may be required. Chronic and recurrent heat rash may need to be treated by a health care practitioner or dermatologist (skin specialist).
Mild Heat Strain	The mildest form of heat-related illness. Victims exhibit irritability, lethargy, and significant sweating. The victim may complain of headache or nausea. This is the initial stage of overheating, and prompt action at this point may prevent more severe heat-related illness from occurring.	• Provide the victim with a work break during which he/she may relax, remove any excess protective clothing, and drink cool fluids. • An air-conditioned spot is an ideal break location. • Once the victim shows improvement, he/she may resume working; however, the work pace should be moderated to prevent recurrence of the symptoms.
Heat Exhaustion	Usually begins with muscular weakness and cramping, dizziness, staggering gait, and nausea. The victim will have pale, clammy moist skin and may perspire profusely. The pulse is weak and fast and the victim may faint unless they lie down. The bowels may move involuntarily.	• Immediately remove the victim from the work area to a shady or cool area with good air circulation (*avoid drafts or sudden chilling*). • Remove all protective outerwear. • Call a physician. • Treat the victim for shock. (*Make the victim lie down, raise his or her feet 6–12 inches, and keep him/her cool by loosening all clothing.*) • If the victim is conscious, it may be helpful to give him/her sips of water. • Transport victim to a medical facility as soon as possible.

Type of Heat-Related Illness	Description	First Aid
Heat Stroke	The most serious of heat illness, heat stroke represents the collapse of the body's cooling mechanisms. As a result, body temperature may rise to 104 degrees Fahrenheit or higher. As the victim progresses toward heat stroke, symptoms such as headache, dizziness, and nausea can be noted, and the skin is observed to be dry, red, and hot. Sudden collapse and loss of consciousness follows quickly, and death is imminent if exposure continues. Heat stroke can occur suddenly.	• Immediately evacuate the victim to a cool/shady area. • Remove all protective outerwear and as much personal clothing as decency permits. • Lay the victim on his/her back with the feet slightly elevated. • Apply cold wet towels or ice bags to the head, armpits, and thighs. • Sponge off the bare skin with cool water. • The main objective is to cool without chilling the victim. • Give no stimulants or hot drinks. • Since heat stroke is a severe medical condition requiring professional medical attention, emergency medical help should be summoned immediately to provide on-site treatment of the victim and proper transport to a medical facility.

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Americas

Heavy Equipment

S3AM-309-PR1

1.0 Purpose and Scope

1.1 Outline the safe working requirements for working with and near heavy equipment and heavy equipment operation.

1.2 Military related vehicles and equipment (e.g. tanks) are not covered under this standard.

1.3 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 **Heavy equipment** –All excavating equipment (e.g. scrapers, loaders, crawler or wheel tractors, excavators, backhoes, bulldozers, graders, agricultural and industrial tractors, etc.), cranes, lift trucks, drills, etc. This may include off-highway trucks (e.g. dump truck, heavy haul truck, etc.). For requirements related to crew trucks refer to *S3AM-005-PR1 Driving*.

2.2 **Operator** – Any person who operates the controls while the heavy equipment is in motion or the engine is running.

2.3 **Ground personnel/workers** – Personnel performing work on the ground around heavy equipment (note: operators are considered ground personnel when outside of the equipment cab).

3.0 References

3.1 S3AM-005-PR1 Driving

3.2 S3AM-202-PR1 Competent Person Designation

3.3 S3AM-213-PR1 Subcontractor Management

3.4 S3AM-303-PR1 Excavation

3.5 S3AM-322-PR1 Overhead Lines

3.6 S3AM-325-PR1 Lockout Tagout

3.7 S3AM-331-PR1 Underground Utilities & Subsurface Installation Clearance

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Managers / Supervisors**

- Responsible for confirming all equipment is in good working order and all equipment operators are verified as qualified on the piece of machinery they are assigned.
- As applicable, review as-built drawings.
- Maintain operation manuals at the site for each piece of equipment that is present on the site and in use.
- Maintain a list of operators for the project, and the specific equipment that they are authorized to operate.
- Prohibit equipment from being operated by any personnel who have not been specifically authorized to operate it.

- Confirm an equipment maintenance inventory is maintained, schedules adhered to and appropriate inspections of equipment are conducted.
- Confirm subcontractors are properly pre-qualified in accordance with *S3AM-213-PR1 Subcontractor Management.*
- Require that subcontractor employees follow established safety procedures in operation, inspection, and maintenance of vehicles and equipment.
- Inform AECOM and subcontractor machinery operators about applicable local regulations restricting the consecutive minutes of engine idling time allowed.
- Confirm subcontractor machinery and mechanized equipment is approved for use in accordance with the requirements of *S3AM-309-FM1 Approval of Machinery & Mechanized Equipment*.
- Confirm that all rented equipment bears any required current certification marks and arrives in proper working order with the manufacturer's operating manual before acceptance from the supplier.
- Confirm that AECOM and subcontractor machinery and mechanized equipment is certified, as applicable, in accordance with manufacturer specifications and/or regulatory requirements.
- Visually observe the subcontractors' vehicles and equipment, for any unsafe conditions or practices. Equipment or operation not in compliance with applicable safety standards is prohibited.

4.1.2 **Employees / Ground Personnel**

- Confirm that all rented equipment arrives in proper working order with the manufacturer's operating manual before acceptance from the supplier.
- Ground personnel when working in the vicinity of heavy equipment shall have received training, and comply with the applicable rules of engagement.

4.1.3 **Operators (of heavy equipment)**

- Operate the equipment safely, maintain full control of the equipment, and comply with manufacturer's operation manual and the laws governing the operation of the equipment.
- Inspect equipment and immediately report defects and conditions affecting the safe operation of the equipment to the appropriate Supervisor.
- Trainees may operate equipment in accordance with jurisdictional requirements and under the direct supervision of a trainer.

4.2 Communication

4.2.1 Communication between site Managers / Supervisors, heavy equipment Operators, and site Employees / Ground Personnel is a key method of preventing serious injury or death during heavy equipment operations.

4.2.2 Managers shall confirm the Industrial site or project specific SH&E Plan is developed and communicated to all affected and involved employees. Refer to *S3AM-209-PR1 Risk Assessment & Management*.

4.2.3 Task Hazard Assessments and Daily Tailgate meetings shall be conducted in accordance with *S3AM-209-PR1 Risk Assessment & Management.*

4.2.4 Concerning worksites in which other employers control concurrent operations and SH&E issues related to the worksite, the manager shall coordinate with those conducting concurrent operations to confirm appropriate control measures are in place to protect employees from the hazards associated with activities to be performed.

- Coordination shall occur prior to work commencing, periodically thereafter, and as necessary given changes in scope and/or working conditions.
- Affected employees (including managers and supervisors) shall seek to participate in all site SH&E meetings related to concurrent operations.

4.2.5 The following points outline the communication requirements during heavy equipment operations:

- Site Supervisors/t Managers shall confirm that all operators are notified/informed of when, where, and how many ground personnel will be working on site.
- Site Supervisors/ Managers shall inform all ground personnel before changes are made in the locations of designated work areas.
- Prior to work initiating on site, the Site Supervisor/ Manager is to confirm all operators and ground personnel are trained on the hand signals that will be used to communicate between operators and ground personnel.
- Ground Personnel working around heavy equipment operations are to maintain eye contact with operators to the greatest extent possible (always face equipment). Never approach equipment from a blind spot or angle.
- All heavy equipment whose backup view can be obstructed shall be equipped with reverse warning devices (e.g., backup alarms) that can be significantly heard over equipment and other background noise. Reverse signaling lights shall be in working order.
- When feasible, two-way radios shall be used to verify the location of nearby ground personnel.
- When an operator cannot adequately survey the working or traveling zone, a signal person shall use a standard set of hand signals to provide directions. Flags or other high visibility devices may be used to highlight these signals.

4.3 Ground Personnel

4.3.1 Ground clearance around heavy equipment may significantly reduce hazards posed during heavy equipment operations.

4.3.2 The following points outline the clearance requirements during heavy equipment operations:

- Ground Personnel shall always yield to heavy equipment.
- Ground Personnel shall maintain a suitable “buffer” area of clearance from all active heavy equipment.
- A task hazard assessment that identifies any special precautions shall be completed and communicated to all AECOM personnel associated with or affected by the activity.
- Site Supervisors/ Managers shall designate areas of heavy equipment operation and confirm that all ground personnel are aware of designated areas.
    - Designated areas shall include work zone boundaries and travel routes for heavy equipment.
    - Travel routes shall be set up to reduce crossing of heavy equipment paths and to keep heavy equipment away from ground personnel.
    - Work zone boundaries shall consider line of fire hazards related to the equipment and associated activities. Refer also to *S3AM-309-ATT2 Operator Line of Sight.*
    - If working near heavy equipment, Ground Personnel shall stay clear of loads to be lifted or suspended loads, and out of the travel and swing areas (excavators, all-terrain forklifts, hoists, etc.) of all heavy equipment.
    - During winch use, all swampers or other personnel will remain outside the “whip area” of the winch line or tow cable.

- At a minimum, employees shall maintain a distance of at least two pile lengths from where piles are being cut and dropped, other than in situations where cut piles are being guided to the ground utilizing mechanical means (e.g., pile driver and shackle) to control the direction and speed of fall of the cut pile.

- When feasible, Site Supervisors/ Managers shall set up physical barriers (e.g., caution tape, orange cones, concrete jersey barriers) around designated areas and confirm that unauthorized ground personnel do not enter such areas.
- Operators shall stop work whenever unauthorized personnel or equipment enter the designated area and only resume when the area has been cleared.
- Operators shall only move equipment when aware of the location of all workers and when the travel path is clear.
- Ground Personnel shall never stand between two pieces of operating heavy equipment or other objects (e.g., steel support beams, trees, buildings, etc.).
- Ground Personnel shall never stand directly below heavy equipment located on higher ground unless it can be verified ground stability is not a factor and grade of slope is such that it would not contribute to equipment tip-over.
- Ground Personnel may only enter the swing area, work area or path of travel of any operating equipment when:
  - They have attracted the operator's attention and established eye contact, and
  - The operator has idled the equipment down, placed it in neutral, grounded engaging tools, set brakes and communicated entry is permitted.
- Employees shall keep all extremities, hair, tools, and loose clothing away from pinch points and other moving parts on heavy equipment.
- Employees shall not talk, text, or otherwise use a cell phone while standing or walking on a roadway or other heavy equipment path.

4.3.3 At a minimum, all Ground Personnel and Operators outside of heavy equipment shall wear the following:

- High visibility safety vest (fluorescent background material and retro-reflective striping) meeting jurisdictional requirements that is visible from all angles.
  - Background material: should be fluorescent yellow-green, fluorescent orange-red or fluorescent red.
  - Combined-performance retro-reflective material (e.g. the stripes): should be fluorescent yellow-green, fluorescent orange-red or fluorescent red - and shall be in contrast (that is, have a distinct color difference) to the background material.
  - Hazards may require high visibility garments that cover torso, legs and arms.
  - Confirm that vest is not faded or covered with outer garments, dirt, etc.
- American National Standards Institute/Canadian Standards Association- (ANSI/CSA-) approved hard hat
- ANSI/CSA-approved safety glasses with side shields
- At a minimum, CSA or ASTM approved, high-cut (min. 6"), puncture, impact and compression resistant footwear.
- ANSI/CSA-approved hearing protection as needed
- Appropriate work clothes (e.g., full-length jeans/trousers and a sleeved shirt; no tank, crew tops or other loose clothing permitted).

4.4 Prior to work commencing

4.4.1 All heavy equipment will be inspected pre-shift and then regularly as required with the details of the inspection recorded in a log book.

- Roll-over protection systems (ROPS) and appropriate overhead protection (Fall Object Protection FOP) shall be in place given the specific equipment requirements. Utilize equipment with enclosed cabs where feasible or accessible.
    - Where use of equipment with enclosed cabs is not feasible or said equipment is not accessible, operators shall use any additional personal protective equipment determined as necessary (e.g. goggles, additional hearing protection, etc.).
- Equipment operated in hazardous atmosphere environments shall be equipped with the proper safety equipment (e.g., spark arrestors, positive air shut off, etc.).
- Operation of equipment that has or had cab glass (per the manufacturer's specifications) that is cracked/broken (obstructing the operator's view) or missing is prohibited.
- A locking device shall be provided that will prevent the accidental separation of towed and towing vehicles on every fifth-wheel mechanism and two-bar arrangement.
- Trip handles for tailgates of dump trucks and heavy equipment shall be arranged so that when dumping, the operator will be in the clear.
- The Operator will report defects and conditions affecting the safe operation of the equipment to the Site Supervisor or employer. Any repair or adjustment necessary for the safe operation of the equipment will be made before the equipment is used.
- Exposed moving parts on heavy equipment (belts, gears, shafts, pulleys, sprockets, spindles, drums, fan belts, flywheels, chains, or other reciprocating, rotating or moving parts) which are a hazard to the operator or to other workers will be guarded.
    - If a part will be exposed for proper function it will be guarded as much as is practicable consistent with the intended function of the component.

4.4.2 An approved 4A40BC fire extinguisher shall be present on all heavy equipment. An approved 4A40BC fire extinguisher of appropriate rating shall be present and readily accessible on all heavy equipment.

- Fire extinguishers shall be inspected by the operator prior to heavy equipment operation each shift. Monthly and annual inspections shall be documented.

4.4.3 All Operators shall inspect the area adjacent to the machine prior to starting.

- Evaluate ground conditions, concurrent operations and obstructions to identify approved routes of travel and work areas.
- As applicable, check that there is sufficient swing room and that the outriggers are adequately supported on solid and stable ground

4.4.4 Managers / Supervisors shall inform the operators of the equipment that AECOM employees are in the area and inquire if there are any restricted areas or specific rules or requirements. In some industrial facilities, heavy equipment has the 'right of way'.

4.4.5 Where the Operator will not have a full view of the path of travel, a signal person will be used on the ground that has a full view of the load, the operator, and the path.

4.4.6 All heavy equipment with limited visibility (operator cannot directly or by mirror or other effective device see immediately behind the machine) operated around workers or on a construction site:

- Shall have an audible back-up alarm installed that functions automatically when the vehicle or equipment is put into rear motion.

- All bi-directional equipment shall be equipped with a horn, distinguishable from the surrounding noise level, which shall be operated as needed when the machine is moving in either direction.
- Backing up or movement in both directions for bidirectional equipment shall occur only when a signal person communicates that it is safe to do so if alarms or horns are not feasible.

4.5 Operation

4.5.1 The Operator of heavy equipment is the only worker permitted to ride the equipment unless the equipment is equipped by the manufacturer for passengers. Manufacturer operator's manual shall be complied with.

4.5.2 A person will not operate heavy equipment unless the person has received adequate instruction and training in the safe use of the equipment, and has demonstrated to a qualified supervisor or instructor competency in operating the equipment.

- Oilers, apprentices, and other operators will not be allowed to operate equipment unless authorized by the Manager.

4.5.3 The Operator of heavy equipment will operate the equipment safely, maintain full control of the equipment, and comply with the manufacturer's operator manual and the laws governing the operation of the equipment.

- Operation of company-owned, leased, or rented vehicles or equipment while under the influence of alcohol or illegal drugs or otherwise impaired is prohibited.
- Do not operate any equipment beyond its safe load or operational limits.
- Operator shall not talk on, text, or otherwise use mobile phones while operating heavy equipment.
- Never use bucket teeth or boom for lifting or moving heavy objects.

4.5.4 When heavy equipment is used for lifting or hoisting or similar operations there shall be a permanently affixed notation stating the safe working load capacity of the equipment and the notation shall be kept legible and clearly visible to the operator.

4.5.5 A Supervisor or Manager will not knowingly operate or permit a worker to operate heavy equipment which is, or could create, an undue hazard to the health or safety of any person. Where compliance is refused, the Manager or his or her designate should be notified immediately.

4.5.6 The Operator of heavy equipment will not leave the controls unattended unless the equipment has been secured against inadvertent movement.

- The Operator is not to leave suspended load, machine or part or extension unattended, unless it has been immobilized and secured against inadvertent movement.
- Turn off heavy equipment, place gear in neutral and set parking brake prior to leaving vehicle unattended.
- Buckets and blades are to be placed on the ground and with hydraulic gears in neutral when not in use.
- Brakes shall be set and, as necessary, wheels chocked or equivalent (as applicable) when not in use.

4.5.7 The Operator will maintain the cab, floor and deck of heavy equipment free of material, tools or other objects which could create a tripping hazard, interfere with the operation of controls, or be a hazard to the operator or other occupants in the event of an accident.

4.5.8 If heavy equipment has seat belts required by law or manufacturer's specifications, the Operator and passengers will use the belts whenever the equipment is in motion, or engaged in an operation which could cause the equipment to become unstable.

- Seat belts shall be maintained in functional condition, and replaced when necessary to ensure proper performance.

4.5.9 All vehicles transporting material or equipment on public roads shall comply with local laws pertaining to weight, height, length, and width. Obtain any permits required for these loads.

4.5.10 Never jump on to or off of a piece of heavy equipment, always maintain 3-points of contact at a minimum.

4.5.11 Never exit heavy equipment while it is in motion.

4.5.12 Do not ride with arms or legs outside of the truck body of equipment cab.

- Never ride on the outside of a piece of heavy equipment (e.g. in a standing position on the body, on running boards, or seated on side fenders, cabs, cab shields, rear of truck bed, on the load, bucket, etc.).

4.5.13 Have vehicle headlights on at all times when driving in the area.

4.5.14 Park motor vehicles off the haul roads, or away from the work areas.

4.5.15 Do not wear loose clothing or jewelry where there is a danger of entanglement in rotating equipment.

4.5.16 Do not enter the swing area of machines such as cranes, heavy drill rigs, or excavators, without first making eye contact with the operator, and receiving permission to do so. Refer to *S3AM-309-ATT2 Operator Line of Sight.*

4.5.17 Stay out of the blind areas around heavy equipment and never assume that the equipment operators have seen you or are aware of your presence.

4.5.18 Maintain a distance of at least 2 feet (60 centimeters) between the counterweight of swing machines and the nearest obstacle. If this distance cannot be maintained, a spotter shall observe and be in constant communication with the operator to prevent contact.

4.5.19 Vibrations from moving traffic or heavy equipment can cause excavations or spoil piles to become unstable.

- Excavation activity shall be conducted according to *SOP S3AM-303-PR1 Excavation*.
- Equipment not involved in the excavating activity or not required to be in the vicinity shall keep clear. Equipment that shall operate in the vicinity shall maintain appropriate setback distances from edges of excavations or spoil piles.

4.5.20 All heavy equipment shall be operated in a safe manner that will not endanger persons or property.

- When ascending or descending grades in excess of 5 percent, loaded equipment shall be driven with the load upgrade.
- When operating an electric-powered, remote controlled, hydraulic device used for demolishing concrete structures and refractory linings as well as excavating, refer to the *S3AM-309-ATT1 Brokk 180* for more specifics.

4.5.21 All heavy equipment shall be operated at safe speeds. Do not drive any vehicle at a speed greater than is reasonable and safe for weather conditions, traffic, intersections, width, and character of the roadway, type of motor vehicles, and any other existing condition.

4.5.22 Always move heavy equipment up and down the face of a slope. Never move equipment across the face of a slope.

4.5.23 Slow down and stay as far away as possible while operating near steep slopes, shoulders, ditches, cuts, or excavations.

4.5.24 When feasible, Operators shall travel with the “load trailing”, if the load obstructs the forward view of the operator.

4.5.25 Slow down and sound horn when approaching a blind curve or intersection. Signal people equipped with 2-way radio communications may be required to adequately control traffic.

4.5.26 All haulage equipment / trucks, whose payload is loaded by means of cranes, power shovels, loaders, or similar equipment, shall have a cable shield and/or canopy adequate to protect the operator from shifting or falling material. If protection is not available for the operator, the operator shall leave the vehicle and wait in a designated safe location until it is loaded..

4.5.27 Equipment shall be shut down prior to and during fueling.

- Confirm proper grounding/ bonding between equipment and fuel vehicle prior to fueling operations.
- During fuel operations confirm fuel nozzle remains in contact with the tank.
- Do not smoke, use electrical devices or have an open flame present while fueling.
- Fuel shall not be carried in or on heavy equipment, except in permanent fuel tanks or approved safety cans.

4.5.28 Site vehicles will be parked in a designated parking location away from heavy equipment.

4.5.29 Operators shall never push/pull “stuck” or “broken-down” equipment unless a spotter determines that the area is cleared of all personnel around and underneath the equipment.

4.5.30 If designated for work in contaminated areas/zones, equipment shall be kept in the exclusion zone until work or the shift has been completed. Equipment will be decontaminated within designated decontamination areas.

4.5.31 Equipment left unattended at night adjacent to travelled roadways shall have appropriate lights or reflectors, or barricades equipped with appropriate lights or reflectors, to identify the location of that equipment, and shall not be closer than 6 feet (1.8m) (or the regulatory requirement for the work location) to the active roadway.

4.5.32 Rubber / pneumatic-tired earthmoving haulage equipment shall be equipped with fenders on all wheels. Mud flaps may be used in lieu of fenders whenever motor vehicle equipment is not designed for fenders.

4.5.33 Lift trucks shall have the rated capacity clearly posted on the vehicle, and the ratings are not to be exceeded.

4.5.34 Steering or spinner knobs shall not be attached to steering wheels.

4.5.35 High-lift rider industrial trucks shall be equipped with overhead guards.

4.5.36 All hot surfaces of equipment, including exhaust pipes or other lines, that present a possible injury or fire hazard, shall be guarded or insulated.

4.5.37 All equipment having a charging skip shall be provided with guards on both sides and open end of the skip area to prevent persons from walking under the skip while it is elevated.

4.5.38 Platforms, foot walks, steps, handholds, guardrails, and toeboards shall be designed, constructed, and installed on machinery and equipment to provide safe footing and access ways.

4.5.39 Substantial overhead protection shall be provided for the operators of fork lifts and similar equipment.

4.5.40 In an effort to reduce air emissions, fuel costs, and run-time hours (that can impact equipment warranty), operators shall limit heavy equipment engine idling to not more than five consecutive minutes. Local regulations at the location of the vehicle operation could require less than five consecutive minutes idling time. The idling limit does not apply to:

- Idling when queuing.
- Idling to verify that the vehicle is in safe operating condition.

- Idling for testing, servicing, repairing or diagnostic purposes.
- Idling necessary to accomplish work for which the vehicle was designed (cranes, man-lifts, forklifts, etc.)
- Idling required to bring equipment/vehicle to operating temperature, as specified by the manufacturer. Engine heaters shall be used for cold weather starting to avoid engine idling where feasible.
- Idling necessary to ensure safe operation of the vehicle.
- Idling to keep equipment (including windows) clear of ice and snow.
- Idling to provide air conditioning or heat to ensure the health and safety of the operator, but only when seated inside the equipment or vehicle.

4.6 Utilities

4.6.1 When contacted by heavy equipment, aboveground and underground utilities may cause severe injuries or death as a result of electrocution, explosion, etc. Refer to the *S3AM-322-PR1 Overhead Lines* procedure for more specifics.

4.6.2 The following outline the requirements while performing heavy equipment operations that may lead to contact with aboveground or underground utilities:

- Always be aware of surrounding utilities.
- Confirm all equipment (e.g., dump trailers, loaders, excavators, etc.) is lowered prior to moving underneath aboveground utilities.
- Confirm utilities are cleared and identified prior to beginning any earthmoving operation. Contact the local utility service providers for clearance prior to performing work. Confirm documentation of the contact is made; date, number; contact name, organization, etc. Refer to *SOP S3AM-303-PR1 Excavation* and *S3AM-331-PR1 Underground Utilities & Subsurface Installation Clearance.*

4.7 Training

4.7.1 The Operator or other qualified supervisor will provide all on-site personnel with an orientation to the heavy equipment and its associated hazards and controls.

4.7.2 Only designated, qualified personnel shall operate heavy equipment.

4.7.3 Operators shall have all appropriate jurisdictional licenses or training to operate a designated piece of heavy equipment.

4.7.4 Operators shall be evaluated through documented experience and routine monitoring of activities unless the equipment is operated by an AECOM operator in which case a practical evaluation is required. Operators shall be knowledgeable and competent in the operation of a designated piece of heavy equipment.

4.8 Inspection and Maintenance

4.8.1 Maintenance records for any service, repair or modification which affects the safe performance of the equipment will be maintained and be reasonably available to the operator and maintenance personnel regulatory agencies upon request during work hours.

4.8.2 Maintenance records will be maintained on the site or project for heavy equipment.

4.8.3 Conduct maintenance as prescribed by the manufacturer in the Operation Manual for each piece of equipment.

4.8.4 Servicing, maintenance and repair of heavy equipment will not be done when the equipment is operating.

- Lockout and tagout safety procedures are followed. Refer to *S3AM-325-PR1 Lockout Tagout*.

- Motors are turned off, unless required for performing maintenance or repair.
- All ground-engaging tools are grounded or securely blocked.
- Controls are set in a neutral position and brakes are set.
- Electrically driven equipment is installed with provision for tagging and locking out the controls while under repair.
- Manufacturer's requirements for maintenance and repair are followed.
- If continued operation is essential to the process, a safe means of protection shall be provided.
- Provide and use a safety tire rack, cage, or equivalent protection when inflating, mounting, or dismounting tires installed on split rims, or rims equipped with locking rings or similar devices.

4.8.5 All heavy equipment shall have a documented inspection and if necessary, repaired prior to use.

- Operators shall not operate heavy equipment that has not been cleared for use.
- All machinery and mechanized equipment will be verified to be in safe operating condition (refer to *S3AM-309-FM1 Approval of Machinery & Mechanized Equipment*) by a competent person (refer to *S3AM-202-PR1 Competent Person Designation*) within seven days prior to operation on a new site or project. Clearance is valid for up to one year for the given site or project.
- As applicable, all machinery and mechanized equipment shall be inspected / certified and tested at appropriate intervals as required by the manufacturer and/or regulatory requirements.

4.8.6 All heavy equipment shall be inspected at a minimum to the manufacturer's recommendations prior to each work shift. All defects shall be reported to the Supervisor/ Manager immediately.

- Defective heavy equipment shall be immediately tagged and taken out of service until repaired.
- Inspection, maintenance, service and repair records shall be maintained at the site. If a manufacturer's or company-specific inspection checklist is not provided, use *S3AM-309-FM2 Heavy Machinery Pre-Operation Checklist*.
- Records shall be made available for review upon request. Note: Documents may be electronically stored in the project files.

4.9 Fueling and batteries

4.9.1 A well-ventilated area shall be used for refueling.

4.9.2 Only the type and quality of fuel recommended by the engine manufacturer shall be used.

4.9.3 Fuel tanks shall not be filled while the engine is running. All electrical switches shall be turned off.

4.9.4 If there is potential to spill fuel on hot surfaces, the surfaces shall be permitted to cool down prior to fueling. Any spillage shall be cleaned before starting engine.

4.9.5 Spilled fuel shall be cleaned with cotton rags or cloths and disposed of in the proper receptacle; do not use wool or metallic cloth.

4.9.6 Open flames, lighted smoking materials, sparking equipment or any other type of ignition source shall remain a minimum of 35' (10.7m) from the fueling area and/or fuel source. This clearance shall be increased if required or conditions warrant.

4.9.7 Heaters in carrier cabs shall be turned off when refueling the carrier or the drill rig.

4.9.8 Portable containers to be filled shall be placed directly on the ground or be properly grounded prior to filling to prevent creation of a static charge. Portable fuel containers shall not be filled completely to allow expansion of the fuel during temperature changes.

4.9.9 Control electrostatic hazards.

- Before activating fuel pump, touch some part of vehicle / equipment to de-energize any static electricity that may be present.
- The fuel nozzle shall be kept in contact with the tank being filled to prevent static sparks from igniting the fuel.
- Fuel containers and transfer hoses shall be kept in contact with a metal surface during travel to prevent build-up of a static charge.

4.9.10 Portable fuel containers shall not travel in the vehicle or carrier cab with personnel.

4.9.11 Batteries shall be serviced in a ventilated area while wearing appropriate Personal Protective Equipment.

4.9.12 When a battery is removed from a vehicle or service unit, the battery shall be disconnected ground post first. Consult the SDS applicable to the battery and/or contents for additional information including; handling, precautions, and first aid measures.

- Spilled battery acid shall be immediately flushed off the skin with a continuous supply of water. Battery storage or maintenance areas shall have readily accessible eye wash stations.
- Should battery acid get into the eyes, the eyes shall be flushed immediately with copious amounts of water and medical attention shall be sought immediately.

4.9.13 When installing a battery, the battery shall be connected ground post last.

4.9.14 When charging a battery, cell caps shall be loosened prior to charging to permit gas to escape.

4.9.15 When charging a battery, the power source shall be turned off to the battery before either connecting or disconnecting charger loads to the battery posts.

4.9.16 To avoid battery explosions, the cells shall be filled with electrolytes. A flashlight (not an open flame) shall be used to check water electrolyte levels. Avoid creating sparks around batteries by shorting across a battery terminal. Lighted smoking materials and flames shall be kept at least a minimum of 35 feet (10.7 meters) away from battery-charging stations.

5.0 Records

5.1 Inspection, maintenance, service and repair records shall be maintained with the equipment.

6.0 Attachments

6.1 S3AM-309-ATT1 Brokk180 Safety Card

6.2 S3AM-309-ATT2 Operator Line of Sight

6.3 S3AM-309-FM1 Approval of Machinery & Mechanized Equipment

6.4 S3AM-309-FM2 Heavy Machinery Pre-Operation Checklist

6.5 S3AM-309-FM3 Rubber Tire Backhoe Operator Skill Evaluation

6.6 S3AM-309-FM4 Scraper Operator Skill Evaluation

6.7 S3AM-309-FM5 Bull Dozer Operator Skill Evaluation

6.8 S3AM-309-FM6 Dump Truck Operator Skill Evaluation

6.9 S3AM-309-FM7 Roller Compactor Operator Skill Evaluation

6.10 S3AM-309-FM8 Front End Loader Operator Skill Evaluation

6.11 S3AM-309-FM9 Grader Operator Skill Evaluation

6.12 S3AM-309-FM 10 Excavator Operator Skill Evaluation

6.13 S3AM-309-FM11 Water Truck Operator Skill Evaluation

6.14 S3AM-309-FM12 Heavy Equipment Maintenance Inventory

6.15 S3AM-309-FM13 Heavy Equipment Inspection Report

Americas

Brokk 180

S3AM-309-ATT1

1.0 Objective/Overview

1.1 The Brokk 180 is an electric-powered, remote controlled, hydraulic device used for demolishing concrete structures and refractory linings as well as excavating. This machine includes attachments designed exclusively for demolishing work (e.g., grapple, bucket, hydraulic hammer, etc.). By using the remote control unit, an operator can move the machine and attachments in different directions and speeds from afar.

2.0 Potential Hazards



2.1 Flying debris

2.2 Crush/impact/pinch from extendable boom, tracks, and tipping over

2.3 Struck-by

2.4 Electricity (subsurface utilities when excavating)

2.5 Gas lines (subsurface utilities when excavating)

2.6 Noise

3.0 Safe Operating Guidelines

3.1 Prior to use, complete a pre-operation inspection to determine if the unit is in safe working condition.

3.2 Position the unit to safely perform the intended task, then deploy the outriggers to stabilize the unit.

3.3 Confirm that the operator knows what the lifting capacity is; do not exceed the lifting capacity.

3.4 Complete a subsurface utility clearance prior to excavating.

3.5 Operator should define a swing radius area and exclude workers from the area. Establish a minimum 15-foot (4.5-meter) clearance around the unit while operating.

3.6 Do not allow debris to build up around the unit. Maintain good housekeeping practices.

3.7 Prior to removing debris from under the boom, stop, disengage the unit, and position the boom so that the attachment is at rest on the ground.

3.8 Personnel operating the unit with the remote control device will be properly trained and certified by a competent person.

3.9 The operator will be able to maintain line of sight visual contact with the unit at all times to assess hazards and site security.

3.10 Maintenance in excess of preventive maintenance activities (e.g., lubrication, replenishing fluids, etc.) will be performed by manufacturer personnel ONLY.

3.11 All operations will comply with the manufacturer's recommended policies.

4.0 Training Requirements

4.1 Review of applicable Standard Operating Procedures.

4.2 Complete knowledge and understanding of remote control functions.

4.3 Review and follow manufacturers' recommended policies and practices.

5.0 Personal Protective Equipment

5.1 Class II (minimum) American National Standards Institute/Canadian Safety Association Safety Vest

5.2 Hard Hat

5.3 Safety Toe Boots

5.4 Safety glasses with side shields

5.5 Hearing protection (ear plugs and/or ear muffs)

5.6 Leather gloves

6.0 Other Safety Tips

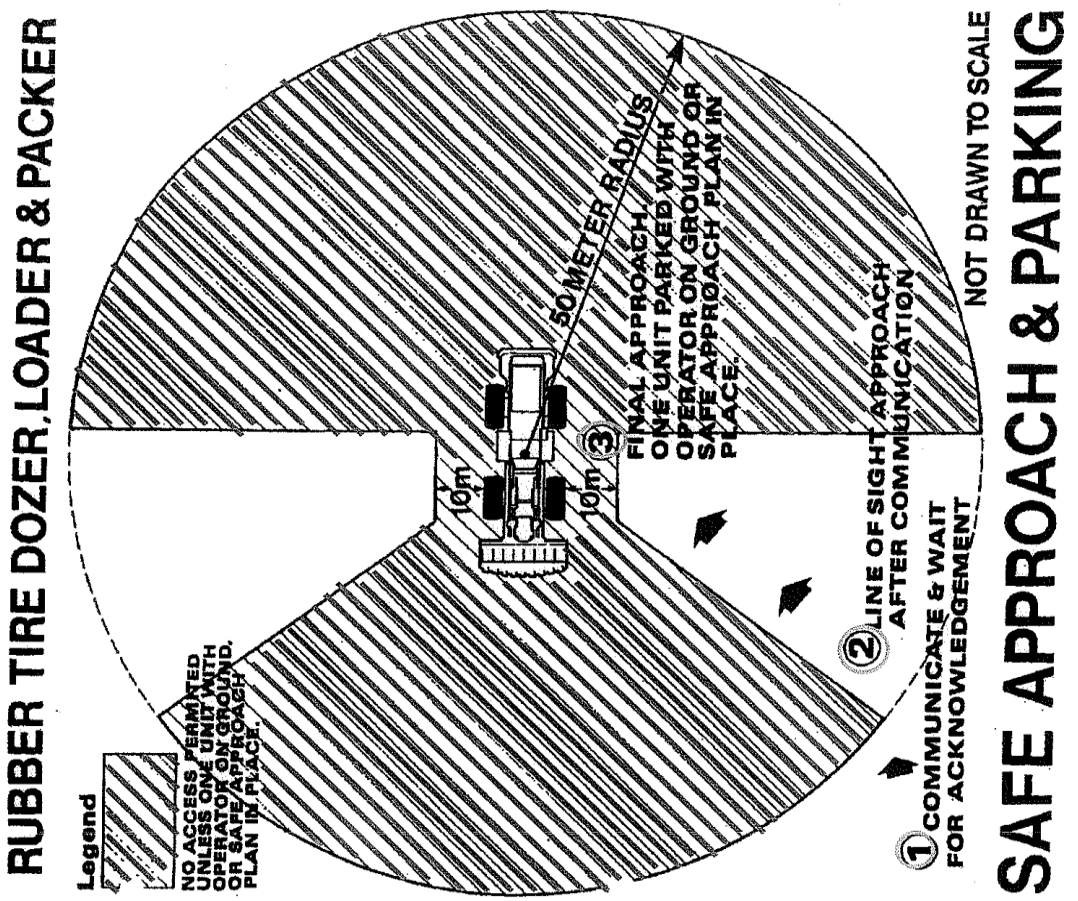
6.1 Never stand under a raised boom.

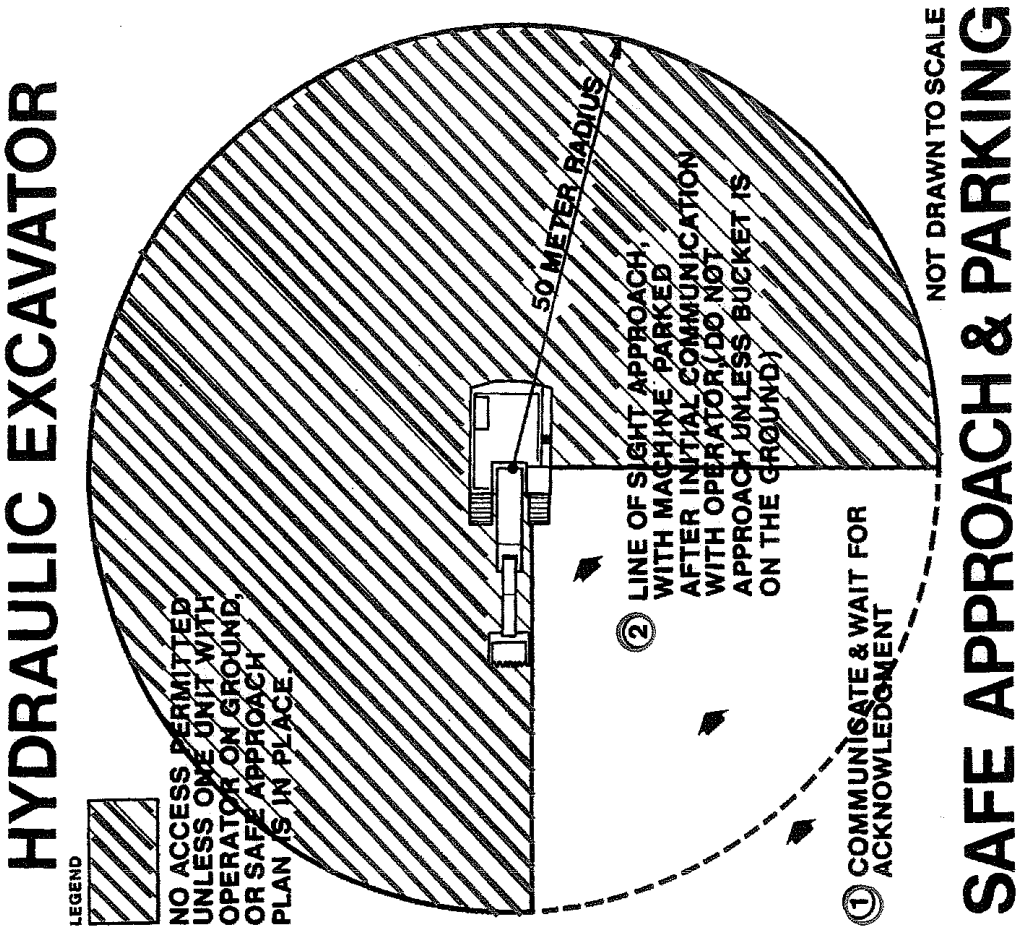
6.2 Pay close attention to power cords for potential tripping hazard and equipment entanglement.

Americas

Operator Line of Sight

S3AM-309-ATT2

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LEGEND
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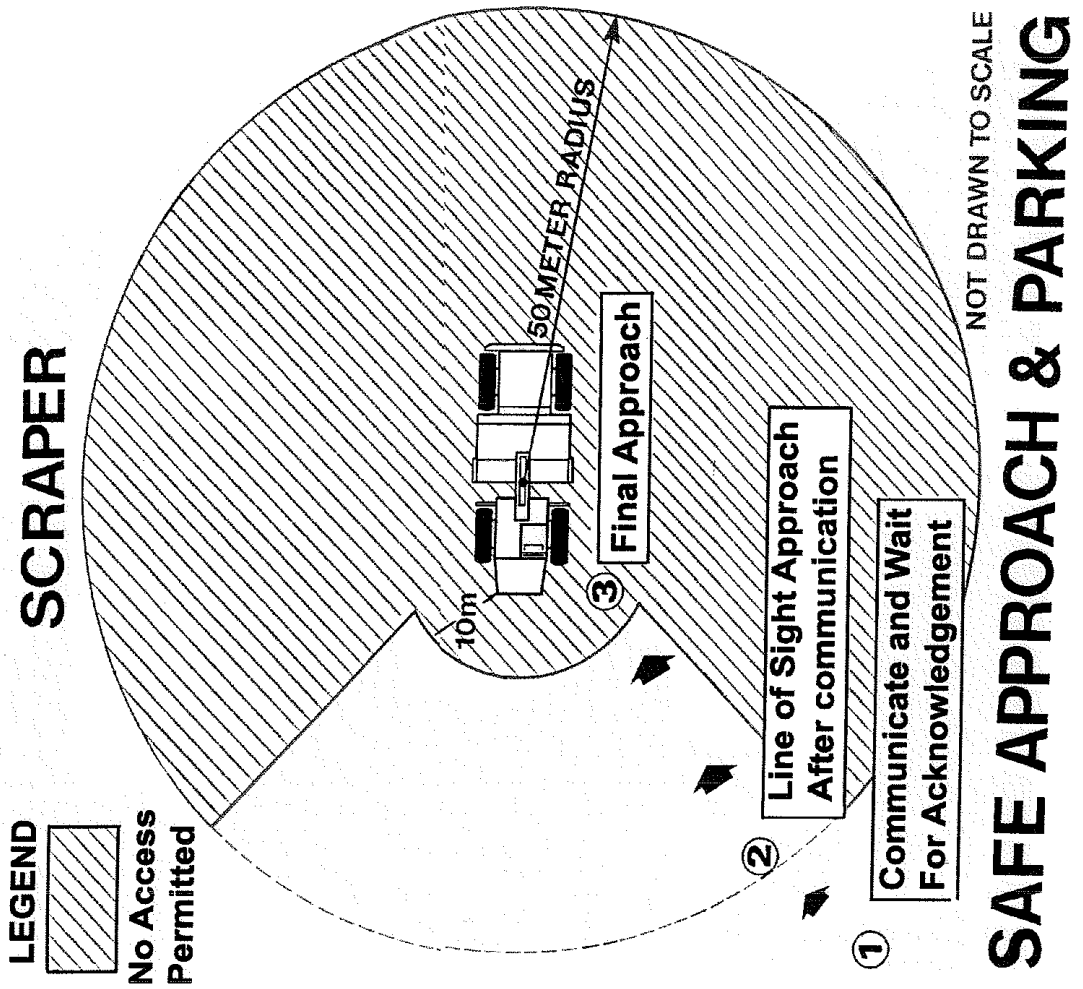
① COMMUNICATE & WAIT FOR ACKNOWLEDGMENT
NOT DRAWN TO SCALE
SAFE APPROACH & PARKING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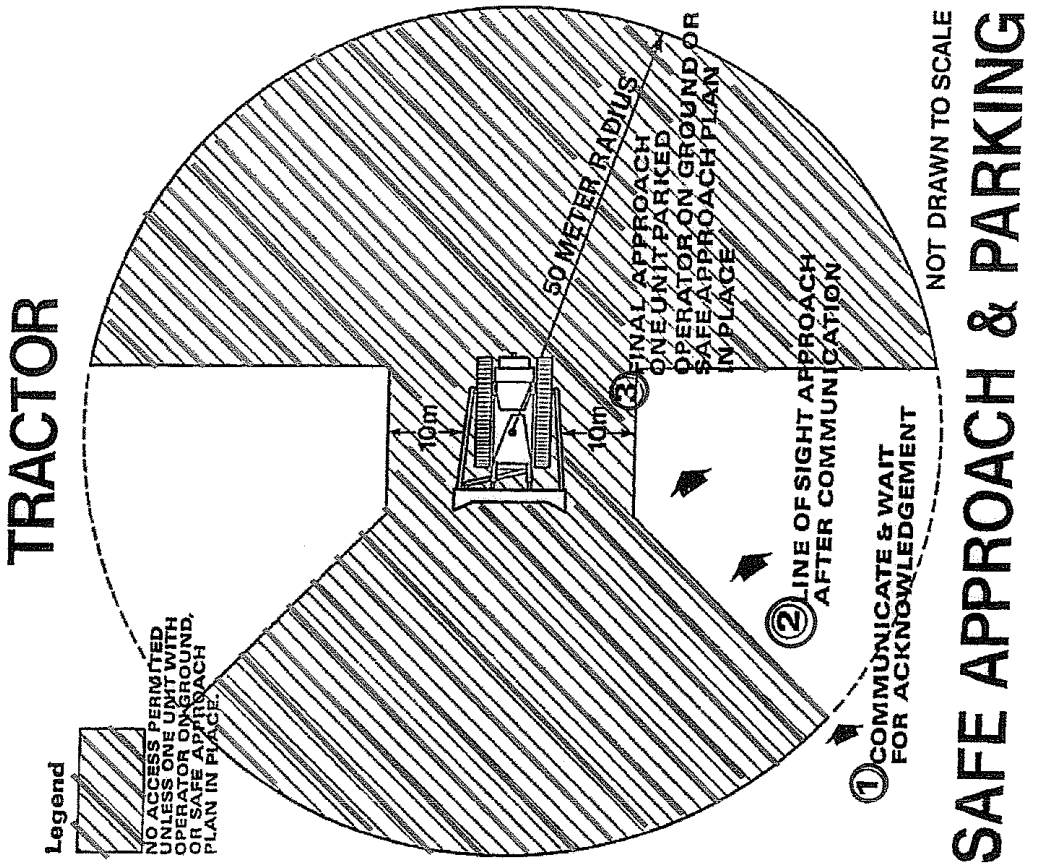
2 Line of Sight Approach After communication
3 Final Approach
LEGEND
No Access Permitted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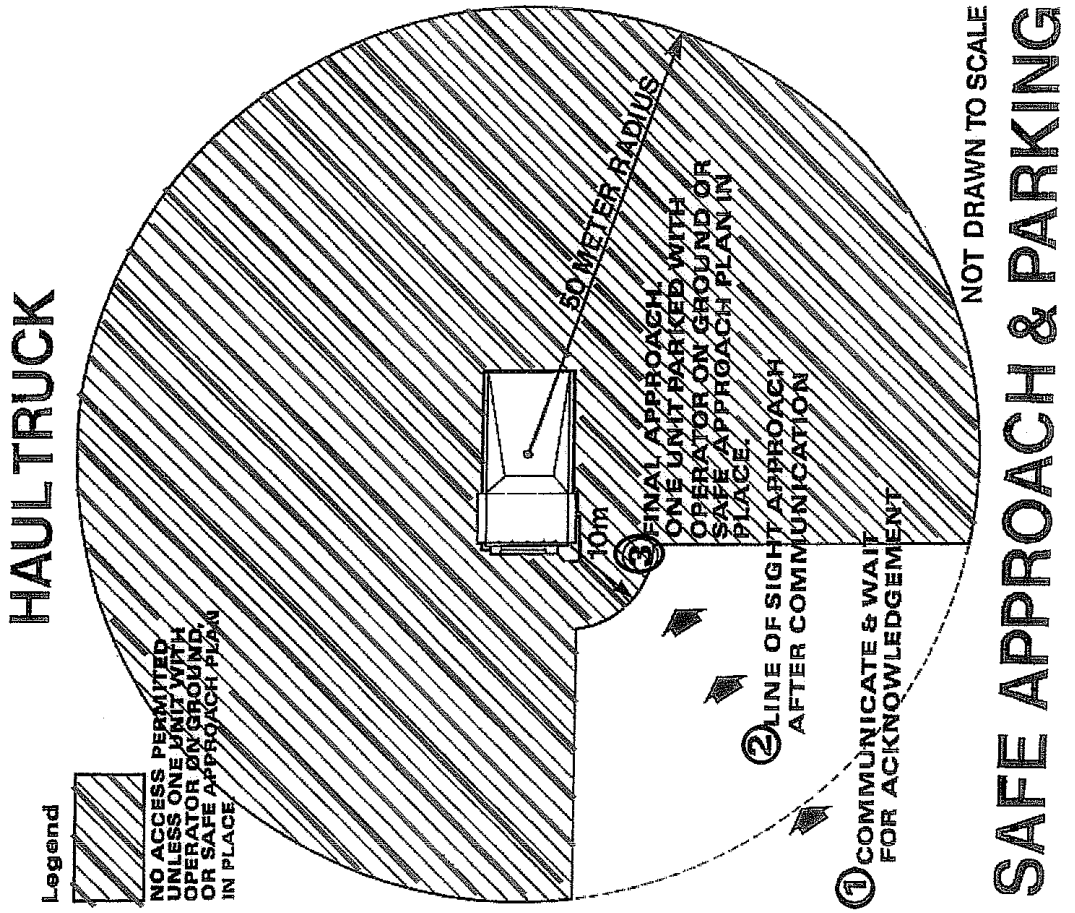
② LINE OF SIGHT APPROACH AFTER COMMUNICATION
① COMMUNICATE & WAIT FOR ACKNOWLEDGEMENT
Legend
NO ACCESS PERMITTED UNLESS ONE UNIT WITH OPERATOR ON GROUND, OR SAFE APPROACH PLAN IN PLACE


HAUL TRUCK
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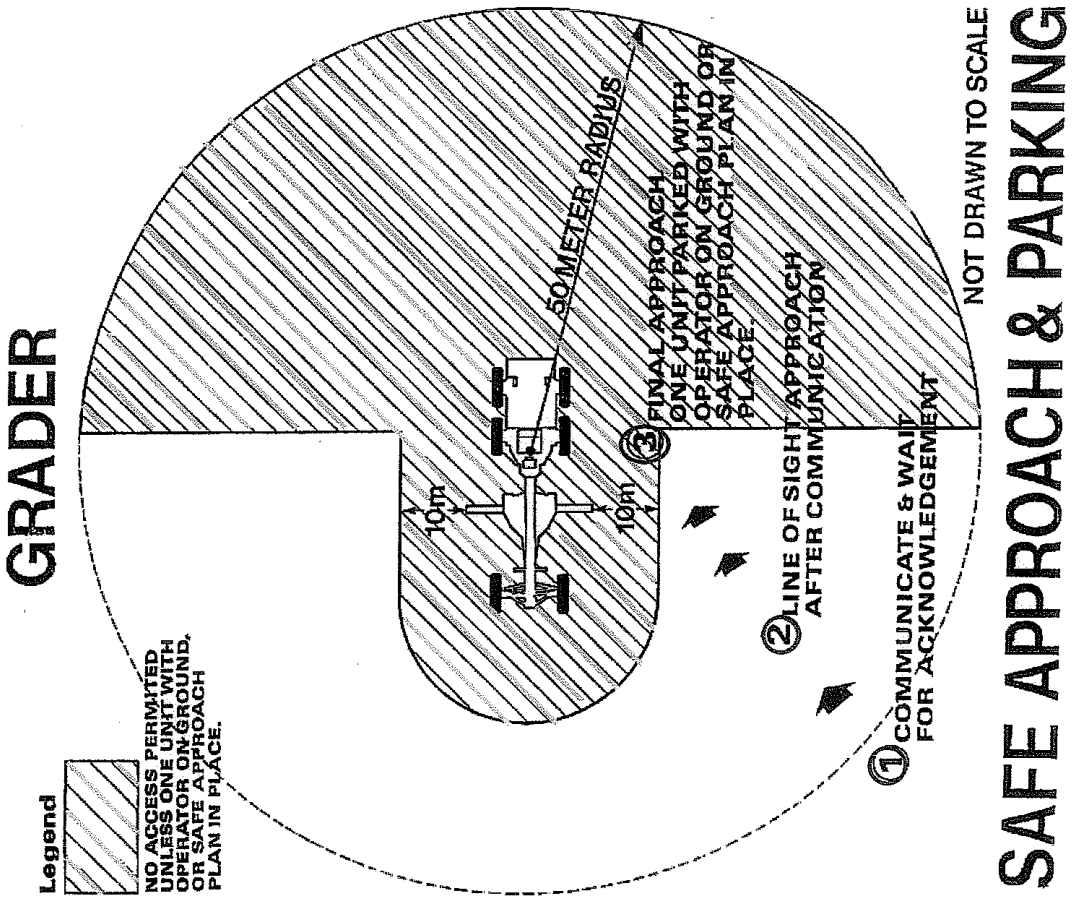
③ FINAL APPROACH, ONE UNIT PARKED WITH OPERATOR ON GROUND OR SAFE APPROACH PLAN IN PLACE.
② LINE OF SIGHT APPROACH AFTER COMMUNICATION
① COMMUNICATE & WAIT FOR ACKNOWLEDGEMENT
NOT DRAWN TO SCALE
SAFE APPROACH & PARKING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① COMMUNICATE & WAIT FOR ACKNOWLEDGEMENT
Legend
NO ACCESS PERMITTED UNLESS ONE UNIT WITH OPERATOR ON GROUND, OR SAFE APPROACH PLAN IN PLACE.

SAFE APPROACH & PARKING

Americas

Approval of Machinery and Mechanized Equipment S3AM-309-FM1

1.0 General Guidelines

1.1 Subcontractor equipment shall comply with all applicable legislative requirements, local, State, Federal, Provincial, Territorial for motor vehicles and material handling heavy equipment.

1.2 Approval shall be obtained for all subcontractor machinery and mechanized equipment within seven calendar days of use on the project site.

1.3 As applicable, all machinery and mechanized equipment must be certified and tested at appropriate intervals as required by the manufacturer and/or regulatory requirements.

1.4 Heavy equipment includes, but is not limited to, drill rigs, front-end loaders, backhoes, trackhoes, bulldozers, forklifts, and similar equipment used for the implementation of the project Statement of Work.

2.0 Equipment Safety Inspections

2.1 The following presents general guidelines for certifying equipment is in safe operating condition before activities commence at the site and during site operations. The following guidelines are not meant to be all-inclusive.

2.1.1 All machinery and mechanized equipment will be approved to be in safe operating condition (using the attached form) by a competent individual within seven calendar days in advance of operation on a new site or project. This approval is valid for one year for the given site or project.

2.1.2 Equipment will be inspected on a daily basis by the owner/operator and daily logs will be maintained. All discrepancies shall be corrected prior to placing the equipment in service.

2.1.3 Inspections shall include, but are not limited to, all hydraulic lines and fittings for wear and damage, all cable systems and pull ropes for damage and proper installation, exhaust systems, brake systems, and drill controls, etc.

2.1.4 Drill rigs and related support equipment and vehicles shall be inspected by the driller in charge on a daily basis. These inspections shall be recorded on the Daily Drill Rig Checklist or on equivalent subcontractor forms.

2.1.5 Preventive maintenance shall be conducted for all equipment according to manufacturer recommendations and/or the subcontractor's internal policies, schedules, and equipment Standard Operating Procedures.

2.1.6 Only designated qualified persons shall operate and inspect machinery and mechanized equipment.

2.1.7 The contractor shall maintain records of tests and inspections at the site and shall make the records available upon request of the designated authority; the records shall become part of the official project file.

2.1.8 Equipment found to not be in safe operating condition or to have a deficiency that affects the safe operation of the equipment shall immediately be tagged, taken out of service, and its use prohibited until deficiencies have been corrected to a safe condition.

2.1.9 All equipment shall be kept in the exclusion zone until decontaminated within designated decontamination areas.

2.1.10 Equipment with an obstructed rear view must have an audible alarm that sounds when equipment is moving in reverse.

TO: AECOM

DATE:

FROM:

Project Name: Project Number:

Project Location:

1. This form provides approval of machinery and mechanized equipment to be used on the referenced project for the following work:

Description of equipment work:	
Project site:	
Subcontractor providing equipment: Address:	
Dates (duration) of equipment work:	

2. Inspection and approval of machinery and mechanized equipment, as required by AECOM, has been made within seven calendar days in advance of use on the project site. This approval process shall be repeated for equipment that is used on the project or site for more than one year.

Identification of equipment (make, model, serial no.)		Date of Certification
1		
2		
3		

3. The above listed equipment has been inspected and tested as indicated on this form, and is DECLARED TO BE IN SAFE OPERATING CONDITION BY THE FOLLOWING COMPETENT INDIVIDUAL:

Name		Title
Company		
Signature		Date

4. If there are any questions regarding this certification, please contact the following AECOM representative:

Americas

Heavy Equipment Pre-Operation Checklist

S3AM-309-FM2

Project Name/Location:										**Project #:**					
Equipment # / Name:			**Make/Model:**							**Annual Insp/Cert. Date:**					
Hour meter reading:															
Operator Name/Date															
✓ = Satisfactory; in working order **X** = Unsatisfactory; not in working order/damaged **N/A** = Not Applicable															
Check the following as appropriate	✓	X	N/A	✓	X	N/A	✓	X	N/A	✓	X	N/A	✓	X	N/A
Side Shields/Screens/Grab Handles															
Overhead Guard (ROPS, FOP)															
Horn / Backup Alarm															
Lights															
Gauges / Temperature															
Parking Brake / Service Brakes															
Steering / Controls															
Hydraulic System (full, no leaks)															
Other Fluids (radiator, washer, etc.)															
Blast Shields															
Attachment (bucket, forks, compactor, jib)															
Lift-arm Device															
Tires / Tracks / Treads (visual)															
Seat belt / Operator Seat Bar															
Windows / Mirrors / Wipers															
Exhaust Components															
Fuel System (lines secure/no leaks)															
Electrical Lines															
Fire Extinguisher															
Spark arrestor / Positive air shutoff															
Safety signs															
General condition (exterior clean/intact)															
General condition (interior clean/tidy)															
Quantity of Fuel Added															
Quantity of Oil Added															
Operator Signature															

Comments (including any corrections):

Americas

Rubber Tire Backhoe Operator Skill Evaluation

S3AM-309-FM3

Date _____ Employee Name _____ Evaluator _____

Description:

This equipment is used for primarily for excavation, although it may occasionally be used for other miscellaneous tasks for which crane or stick type equipment is required.

STEPS KEYPOINTS	SATISFACTORY
1) Demonstrated abilities b) Pre-shift inspection check list (*S3AM-309-FM2 Heavy Machinery Pre-Operation Checklist* or equivalent) i) Check equipment for loose bolts, leaks; oil, hydraulic and water ii) Make sure area around the equipment is clear of people and other equipment iii) Check for fire extinguisher iv) Make sure that the following equipment is operational a) Brakes b) Lights c) Back-up alarms d) Hand rails & ladders e) Seat belts f) Tires if applicable g) Glass, wipers h) Gauges, including temperature, oil, and fuel i) Wheel chocks v) Notify supervision of any equipment that is not operational vi) The operator can park a piece of equipment that is unsafe to operate if it poses a danger or hazard to employees or property c) Maintain three points of contact while entering and exiting the equipment	☐ Yes ☐ No
2) Identification of equipment controls	☐ Yes ☐ No
3) Excavating techniques a) Benching, sloping b) Spoil removal from side wall c) Back filling operations d) Aware of surroundings and personnel near the swing radius of boom	☐ Yes ☐ No
4) Can arrange controls and boom for travel	☐ Yes ☐ No
5) Speed in relation to terrain (controlled speed)	☐ Yes ☐ No
6) Stock piling with front end bucket	☐ Yes ☐ No
7) Loading truck bed with bucket	☐ Yes ☐ No
8) Parking and shut down procedures a) Equipment line-up i) Straight line ii) Allow easy access for maintenance and servicing b) Turn off all accessories c) Set all park brakes d) Lower bucket to ground e) Place and position wheel chocks f) Perform a general walk around looking for items for maintenance	☐ Yes ☐ No

Any items checked 'No' require additional training of operator and the skill evaluation to be repeated until the operator successfully achieves a satisfactory status in all skill identified.

Americas

Scraper Operator Skill Evaluation

S3AM-309-FM4

Date _____ Employee Name _____ Evaluator _____

Description:

Drives a tractor to pull a steel bowl-like or box-like scoop (scraper), mounted on wheels, which scrapes up earth and transports it to a designated place; manipulates a series of levers to lower cutting edge of scraper into the ground, to raise cutting edge when scraper is full, to empty scraper

STEPS KEYPOINTS	SATISFACTORY
1. Demonstrated abilities a) Pre-shift inspection check list (*S3AM-309-FM2 Heavy Machinery Pre-Operation Checklist* or equivalent) i) Check equipment for loose bolts and leaks; check oil, air, hydraulic fluids and water ii) Make sure area around the equipment is clear of people and other equipment iii) Check for fire extinguisher iv) Make sure that the following equipment is operational a) Brakes b) Lights c) Back-up alarms d) Hand rails & ladders e) Seat belts f) Tires g) Glass, wipers h) Gauges, including temperature, oil, air and fuel i) Wheel chocks v) Notify supervision of any equipment that is not operational vi) The operator can park a piece of equipment that is unsafe to operate if it poses a danger or hazard to employees or property b) Maintain three points of contact while entering and exiting the equipment	☐ Yes ☐ No
2. Identification of equipment controls	☐ Yes ☐ No
3. Loading techniques a) Use of apron b) Use of cutting edge c) Push loading d) Push/pull loading e) Use of ejector	☐ Yes ☐ No
4. Shifting and hauling	☐ Yes ☐ No
5. Rough cut and fill	☐ Yes ☐ No
6. Spreading material	☐ Yes ☐ No
7. Fine grading	☐ Yes ☐ No
8. Obtaining compaction	☐ Yes ☐ No
9. Parking and shut down procedures a) Equipment line-up i) Straight line ii) Allow easy access for maintenance and servicing b) Turn off all accessories c) Lower apron d) Lower bowl to the ground e) Place and position wheel chocks f) Perform a general walk around looking for maintenance items	☐ Yes ☐ No

Any items checked 'No' require additional training of operator and the skill evaluation to be repeated until the operator successfully achieves a satisfactory status in all skill identified.

Americas

Bull Dozer Operator Skill Evaluation

S3AM-309-FM5

Date _____ Employee Name _____ Evaluator _____

Description:

Operates a large tractor with a concave steel blade or push block mounted in front of the chassis to level, distribute and push earth. This equipment may be used to push earth carrying equipment. A ripper attachment may be used for ripping the earth prior to loading the scraper. Operator regulates height of blade or push block from ground and may help in adjustments to equipment as needed

STEPS KEYPOINTS	SATISFACTORY
1) Demonstrated abilities a) Pre-shift inspection check list (*S3AM-309-FM2 Heavy Machinery Pre-Operation Checklist* or equivalent) i) Check equipment for loose bolts and leaks; check oil, air, hydraulic fluid and water ii) Make sure area around the equipment is clear of people and other equipment iii) Check for fire extinguisher iv) Make sure that the following equipment is operational a) Brakes b) Lights c) Back-up alarms d) Hand rails & ladders e) Seat belts f) Tracks g) Glass, wipers h) Gauges, including temperature, oil, air and fuel i) Audible horn v) Notify supervision of any equipment that is not operational vi) The operator can park a piece of equipment that is unsafe to operate if it poses a danger or hazard to employees or property b) Maintain three points of contact while entering and exiting the equipment	☐ Yes ☐ No
2) Identification of equipment controls	☐ Yes ☐ No
3) Pushing techniques a) Use of push blade b) Loading of push load equipment	☐ Yes ☐ No
4) Use of ripper shanks	☐ Yes ☐ No
5) Rough cut and fill	☐ Yes ☐ No
6) Spreading material	☐ Yes ☐ No
7) Fine grading	☐ Yes ☐ No
8) Obtaining compaction by tracking in material	☐ Yes ☐ No
9) Parking and shut down procedures a) Equipment line-up i) Straight line ii) Allow easy access for maintenance and servicing b) Turn off all accessories c) Lower rippers d) Lower blade to the ground e) Perform a general walk around looking for maintenance items	☐ Yes ☐ No

Any items checked 'No' require additional training of operator and the skill evaluation to be repeated until the operator successfully achieves a satisfactory status in all skill identified.

Americas

Dump Truck Operator Skill Evaluation

S3AM-309-FM6

Date _____ Employee Name _____ Evaluator _____

Description:

Drives a heavy-duty gasoline or diesel-powered truck used in hauling material to fill areas or dump sites. Truck is either tandem rear axle type, or tractor truck, single or tandem axle, pulling a trailer, articulated or fixed axle haul truck. May service and make necessary adjustments for proper operation of equipment.

STEPS KEYPOINTS	SATISFACTORY
1) Demonstrated abilities a) Pre-shift inspection (*S3AM-309-FM2 Heavy Machinery Pre-Operation Checklist* or equivalent) i) Check equipment for loose bolts and leaks; check oil, air, hydraulic fluid and water ii) Make sure area around the equipment is clear of people and other equipment iii) Check for fire extinguisher iv) Make sure that the following equipment is operational (1) Brakes (2) Lights (3) Back-up alarms (4) Hand rails & ladders (5) Seat belts (6) Tires (7) Glass, wipers (8) Gauges, including temperature, oil, air and fuel (9) Wheel chocks v) Notify supervision of any equipment that is not operational vi) The operator can park or side line a piece of equipment that is unsafe to operate if it poses a danger or hazard to employees or property b) Maintain three points of contact while entering and exiting the equipment	☐ Yes ☐ No
2) Identification of equipment controls	☐ Yes ☐ No
3) Truck Weighing a) Tare weights b) Gross Weights	☐ Yes ☐ No
4) Loading Techniques a) Parking into load patterns b) Bed preparation for material c) Remains in cab in loading area and while being loaded	☐ Yes ☐ No
5) Shifting and Hauling	☐ Yes ☐ No
6) Stockpiling	☐ Yes ☐ No
7) Backing with the use of mirrors	☐ Yes ☐ No
8) Dumping/Spreading Material a) Fill material b) Base course material c) Surface materials d) Asphalt e) Lowers truck bed (dump trucks) or dump chutes (belly dumps) f) Follows spotters directions (when applicable)	☐ Yes ☐ No
9) Parking and shut down procedures a) Equipment line-up i) Straight line ii) Allow easy access for maintenance and servicing b) Turn off all accessories c) Use park brake d) Place and position wheel chocks e) Perform a general walk around looking for maintenance items	☐ Yes ☐ No

Any items checked 'No' require additional training of operator and the skill evaluation to be repeated until the operator successfully achieves a satisfactory status in all skill identified.

Americas

Roller / Compactor Operator Skill Evaluation

S3AM-309-FM7

Date _____ Employee Name _____ Evaluator _____

Description:

Operates a self-propelled gasoline or diesel machine, which has pneumatic tires, steel wheels/drums used to compact earth fills, flexible bases and all types of materials. Rollers are also used for compaction to achieve a desired or specified density. Rides on the machine platform and moves lever and pedals or throttles to control and guide machine.

STEPS KEYPOINTS	SATISFACTORY
1) Demonstrated abilities a) Pre-shift inspection check list (*S3AM-309-FM2 Heavy Machinery Pre-Operation Checklist* or equivalent) i) Check equipment for loose bolts and leaks; check oil, air, hydraulic fluid and water ii) Make sure area around the equipment is clear of people and other equipment iii) Check for fire extinguisher iv) Make sure that the following equipment is operational a) Brakes b) Lights c) Back-up alarms d) Hand rails & ladders e) Seat belts f) Tires, if applicable g) Glass, wipers h) Gauges, including temperature, oil, air and fuel i) Wheel chocks v) Notify supervision of any equipment that is not operational vi) The operator can park a piece of equipment that is unsafe to operate if it poses a danger or hazard to employees or property b) Maintain three points of contact while entering and exiting the equipment	☐ Yes ☐ No
2) Identification of equipment controls	☐ Yes ☐ No
3) Rolling techniques to obtain compaction a) Use of controls b) Vibratory controls c) Turns and maneuvers d) Aware of surroundings	☐ Yes ☐ No
4) Rolling patterns a) Staggered patterns with other rollers	☐ Yes ☐ No
5) Parking and shut down procedures a) Equipment line-up i) Straight line ii) Allow easy access for maintenance and servicing b) Turn off all accessories c) Place and position wheel chocks d) Perform a general walk around looking for maintenance items	☐ Yes ☐ No

Any items checked 'No' require additional training of operator and the skill evaluation to be repeated until the operator successfully achieves a satisfactory status in all skill identified.

Americas

Front End Loader Operator Skill Evaluation

S3AM-309-FM8

Date _____ Employee Name _____ Evaluator _____

Description:

Operates rubber tire or crawler type tractor with attached bucket on front end. Moves lever to raise, lower and dump contents of bucket. Machine used to load materials from stockpiles, excavation, loading trucks.

STEPS KEYPOINTS	SATISFACTORY
1) Demonstrated abilities a) Pre-shift inspection check list (*S3AM-309-FM2 Heavy Machinery Pre-Operation Checklist* or equivalent) i) Check equipment for loose bolts and leaks; check oil, air, hydraulic fluid and water ii) Make sure area around the equipment is clear of people and other equipment iii) Check for fire extinguisher iv) Make sure that the following equipment is operational a) Brakes b) Lights c) Back-up alarms d) Hand rails & ladders e) Seat belts f) Tires g) Glass, wipers h) Gauges, including temperature, oil, air and fuel i) Wheel chocks v) Notify supervision of any equipment that is not operational vi) The operator can park a piece of equipment that is unsafe to operate if it poses a danger or hazard to employees or property b) Maintain three points of contact while entering and exiting the equipment	☐ Yes ☐ No
2) Identification of equipment controls	☐ Yes ☐ No
3) Loading techniques a) Use of bucket and controls b) Crowding the pile c) Pump loading, etc. d) Loading patterns e) Loading trucks f) Loading scrapers	☐ Yes ☐ No
4) Control handling of soils	☐ Yes ☐ No
5) Shifting and hauling	☐ Yes ☐ No
6) Stockpiling	☐ Yes ☐ No
7) Mixing and moisture conditioning	☐ Yes ☐ No
8) Feeding crusher	☐ Yes ☐ No
9) Rough cut and fill	☐ Yes ☐ No
10) Spreading material	☐ Yes ☐ No
11) Parking and shut down procedures a) Equipment line-up i) Straight line ii) Allow easy access for maintenance and servicing b) Turn off all accessories c) Lower bucket to the ground d) Place and position wheel chocks e) Perform a general walk around looking for maintenance items	☐ Yes ☐ No

Any items checked 'No' require additional training of operator and the skill evaluation to be repeated until the operator successfully achieves a satisfactory status in all skill identified.

Americas

Grader Operator Skill Evaluation

S3AM-309-FM9

Date _____ Employee Name _____ Evaluator _____

Description:

Rides in cab of grader and moves levers and steering wheel to guide machine and regulate the scraper blade or ripper. Blade is mounted on a carrying and turning circle at the front of the machine. Equipment is used to level or mix soils and aggregates to grade and to lay asphalt and flexible base materials and clean haul roads.

STEPS KEYPOINTS	SATISFACTORY
1) Demonstrated abilities a) Pre-shift inspection check list (*S3AM-309-FM2 Heavy Machinery Pre-Operation Checklist* or equivalent) i) Check equipment for loose bolts and leaks; check oil, air, hydraulic fluid and water ii) Make sure area around the equipment is clear of people and other equipment iii) Check for fire extinguisher iv) Make sure that the following equipment is operational a) Brakes b) Lights c) Back-up alarms d) Hand rails & ladders e) Seat belts f) Tires g) Glass, wipers h) Gauges, including temperature, oil, air and fuel v) Notify supervision of any equipment that is not operational vi) Wheel chocks vii) The operator can park a piece of equipment that is unsafe to operate if it poses a danger or hazard to employees or property b) Maintain three points of contact while entering and exiting the equipment	☐ Yes ☐ No
2) Identification of equipment controls	☐ Yes ☐ No
3) Leveling and scraping techniques a) Use of levers b) Use of cutting edge c) Controlling front wheel tilt d) Controlling crab motion e) Use of ripper	☐ Yes ☐ No
4) Shifting and traveling with loaded moe board	☐ Yes ☐ No
5) Rough cut and fill	☐ Yes ☐ No
6) Spreading material	☐ Yes ☐ No
7) Fine grading	☐ Yes ☐ No
8) Parking and shut down procedures a) Equipment line-up i) Straight line ii) Allow easy access for maintenance and servicing b) Turn off all accessories c) Lower moldboard to the ground d) Place and position wheel chocks e) Perform a general walk around looking for maintenance items	☐ Yes ☐ No

Any items checked 'No' require additional training of operator and the skill evaluation to be repeated until the operator successfully achieves a satisfactory status in all skill identified.

Americas

Excavator Operator Skill Evaluation

S3AM-309-FM10

Date _____ Employee Name _____ Evaluator _____

Description:

Operates a rubber tire or crawler type tractor with an attached bucket on front end. Moves a lever to raise and lower and dump contents of bucket. Machine is used to load materials from stockpiles, excavation, loading trucks.

STEPS KEYPOINTS	SATISFACTORY
1) Demonstrated abilities a) Pre-shift inspection check list (*S3AM-309-FM2 Heavy Machinery Pre-Operation Checklist* or equivalent) i) Check equipment for loose bolts and leaks; check oil, air, hydraulic fluid and water ii) Make sure area around the equipment is clear of people and other equipment iii) Check for fire extinguisher iv) Make sure that the following equipment is operational a) Brakes b) Lights c) Back-up alarms d) Hand rails & ladders e) Seat belts f) Tires g) Glass, wipers h) Gauges, including temperature, oil, air and fuel i) Wheel chocks (for rubber tire type excavators) v) Notify supervision of any equipment that is not operational vi) The operator can park a piece of equipment that is unsafe to operate if it poses a danger or hazard to employees or property b) Maintain three points of contact while entering and exiting the equipment	☐ Yes ☐ No
2) Identification of equipment controls	☐ Yes ☐ No
3) Loading techniques a) Use of bucket and controls b) Crowding the pile c) Pump loading, etc. d) Loading patterns e) Loading trucks f) Loading scrapers	☐ Yes ☐ No
4) Control handling of soils	☐ Yes ☐ No
5) Shifting and hauling	☐ Yes ☐ No
6) Stockpiling	☐ Yes ☐ No
7) Mixing and moisture conditioning	☐ Yes ☐ No
8) Feeding crusher	☐ Yes ☐ No
9) Rough cut and fill	☐ Yes ☐ No
10) Spreading material	☐ Yes ☐ No
11) Parking and shut down procedures a) Equipment line-up i) Straight line ii) Allow easy access for maintenance and servicing b) Turn off all accessories c) Lower bucket to the ground d) Place and position wheel chocks (rubber tire type excavator) e) Perform a general walk around looking for maintenance items	☐ Yes ☐ No

Any items checked 'No' require additional training of operator and the skill evaluation to be repeated until the operator successfully achieves a satisfactory status in all skill identified.

Americas

Water Truck Operator Skill Evaluation

S3AM-309-FM11

Date _____ Employee Name _____ Evaluator _____

Description:

Drives articulated, pull type, single and two axle type water trucks. Waters roads, fills, and cut areas to suppress dust.

STEPS KEYPOINTS	SATISFACTORY
1) Demonstrated abilities a) Pre-shift inspection check list (*S3AM-309-FM2 Heavy Machinery Pre-Operation Checklist* or equivalent or DOT daily inspection if applicable) i) Check equipment for loose bolts and leaks; check oil, air, hydraulic fluid and water ii) Make sure area around the equipment is clear of people and other equipment iii) Check for fire extinguisher iv) Make sure that the following equipment is operational a) Brakes b) Lights c) Back-up alarms d) Hand rails & ladders e) Seat belts f) Tires g) Glass, wipers h) Gauges, including temperature, oil, air and fuel i) Wheel chocks v) Notify supervision of any equipment that is not operational vi) The operator can park a piece of equipment that is unsafe to operate if it poses a danger or hazard to employees or property b) Maintain three points of contact while entering and exiting the equipment	☐ Yes ☐ No
2) Identification of equipment controls	☐ Yes ☐ No
3) Loading Techniques a) Minimizes spillage b) Uses chocks or turns into berm	☐ Yes ☐ No
4) Shifting and Hauling	☐ Yes ☐ No
5) Properly applies water to ramps/corners	☐ Yes ☐ No
6) Backing with the use of mirrors	☐ Yes ☐ No
11) Parking and shut down procedures a) Equipment line-up i) Straight line ii) Allow easy access for maintenance and servicing b) Turn off all accessories c) Use park break d) Place and position wheel chocks e) Perform a general walk around looking for maintenance items	☐ Yes ☐ No

Any items checked 'No' require additional training of operator and the skill evaluation to be repeated until the operator successfully achieves a satisfactory status in all skill identified.

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Heavy Equipment Maintenance Inventory

S3AM-309-FM12

Equipment (*Make, Model, Serial #*)	Equipment Owner	Equipment Status (*On Hire, Active, Decommissioned*)	Frequency of service	Service Type	Manufacturer's Standards	Industry Standards	Legislated Requirements	Location of Equipment

Americas

Heavy Equipment Inspection Report

S3AM-309-FM13

TOOL	DATE	INSPECTED BY	RESULTS	ACTION REQUIRED	ACTION COMPLETED (DATE)

Protective Devices for Temporary Traffic Control (TCC)

S3AM-306-ATT1

1. Temporary Traffic Control Devices (TCC) - alphabetical

Protective Device	Common Applications	General Guidance (refer to jurisdictional requirements and guidance for further detail)
Arrow Boards	There are a variety of arrow board application: low-speed urban streets, intermediate speed facilities and for maintenance or mobile operations on high-speed roadways, high-volume motor vehicle traffic control projects, or those intended only for use on vehicles authorized by the state or local agency.	An arrow board should be used in combination with appropriate signs, channelizing devices, or other TTC devices. An arrow board should be placed on the shoulder of the roadway or, if practical, farther from the traveled lane. An arrow board should be delineated with retroreflective TTC devices. When an arrow board is not being used, it should be removed; if not removed, it should be shielded; or if the previous two options are not feasible, it should be delineated with retroreflective TTC devices.
Attenuator Vehicles	Conditions which require or recommend the use of an attenuator vehicle are generally specified in jurisdictional requirements and guidance. Other scenarios (bridge inspections, debris removal) may warrant the use of an attenuator vehicle. Attenuator vehicles are best suited for situations when workers or a hazard are confined to a limited area rather than spread over a longer distance.	It is good construction practice to place an attenuator truck or trailer (minimum) an appropriate distance and immediately in advance of workers in a work zone to protect workers from vehicle intrusions and to warn approaching drivers that the shoulder or traveled lane is occupied by work activities. The attenuator vehicle should be placed a sufficient distance to protect the work zone but avoid creating so much distance that a vehicle can travel around the attenuator vehicle and re-enter the lane ahead of the protected work. The tires should be placed so that if the vehicle is struck, it turns away from workers. Attenuator vehicles shall be equipped with flashing arrows, changeable message signs, and/or high-intensity rotating, flashing, oscillating or strobe lights to warn approaching motorists. Specific requirements for markings may be specified in jurisdictional requirements and guidance.
Automated Flagger Assistance Devices	These devices are designed to be remotely operated either by a single flag person at one end of the temporary traffic control zone or at a central location, or by separate flag persons near each device's location.	Automated Flagger Assistance Devices (AFADs) shall only be used in situations where there is only one lane of approaching traffic in the direction to be controlled.
Channelizing Devices	The function of channelizing devices is to warn road users of conditions created by work activities in or near the roadway and to guide road users. Channelizing devices include cones, tubular markers, vertical panels, drums, barricades, and longitudinal channelizing devices.	Channelizing devices should be placed to provide for smooth and gradual vehicular traffic flow from one lane to another, onto a bypass or detour, or into a narrower traveled way. Channelizing devices should be used to channelize vehicular traffic away from the work space, pavement drop-offs, pedestrian or shared-use paths, or opposing directions of vehicular traffic.

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Protective Device	Common Applications	General Guidance (refer to jurisdictional requirements and guidance for further detail)
		Channelizing devices should be selected and placed in work zones in accordance with jurisdictional requirements and guidance. Devices that are damaged or have lost a significant amount of their retro-reflectivity and effectiveness shall be replaced. Devices should be secured against tipping, particularly by wind generated by moving traffic (or other). Tubular markers are less visible and should only be selected where space restrictions prevent the use of other markers.
Crash Cushions	Crash cushions are systems that mitigate the effects of errant vehicles that strike obstacles either by smoothly decelerating the vehicle to a stop when hit head on or by redirecting the errant vehicle. Crash cushions include concrete barriers, ballast-filled barriers, and moveable concrete barriers, as well as shadow vehicles with truck-mounted attenuators, and vehicle arresting systems that prevent road users from entering a closed section of roadway.	Stationary crash cushions selected for use in a temporary traffic control zone must be crashworthy, designed for the application they are selected, periodically inspected, and promptly repaired or replaced to maintain their effectiveness. Specific information on the use of crash cushions can be found in jurisdictional requirements and guidance.
Flag Person	A flag person is a trained/qualified position used in conjunction with other TTC measures to facilitate the movement of vehicles away from the work zone. Flag persons also monitor the work zone for intrusions and give warnings to workers.	Flag persons shall stand in a safe position, be clearly visible, and have an unobstructed view of approaching traffic. Flag persons must remain visible to other road users. Flag persons shall be positioned a suitable distance away from the work area (a distance permitting vehicles to slow down or stop before reaching the work area). Distances are defined in local jurisdictional requirements and guidance. Flag person stations must be located such that an errant vehicle has additional space to stop without entering the work zone. Flag persons must have an escape route that can be used to avoid an errant vehicle. The Traffic Control Plan should include advanced warning signage notifying drivers of the presence of a flag person. “Flag Person Ahead" (or similar) signs shall be posted in advance of each flag person's station. Such signs shall be removed promptly when the flagging operation terminates. Specification for size, color, and proper use of the “Flag Person Ahead” sign is prescribed in jurisdictional requirements and guidance. Flag persons should use STOP/SLOW signs or paddles. Specification for size, color, and proper use of the STOP/SLOW paddles is prescribed in jurisdictional requirements and guidance. Flag person stations should be illuminated at night. Refer to S3AM306-FM5 Safe Practices for Night Work in Work Zones. Flag persons and others providing temporary traffic control shall wear high visibility retro-reflective clothing in compliance with jurisdiction requirements and guidance.

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Protective Device	Common Applications	General Guidance (refer to jurisdictional requirements and guidance for further detail)
		Class III is typically the minimum requirement for normal conditions. Flag persons shall be provided with sufficient breaks, shade, water, and a rest area away from the roadway. Flag persons shall not be distracted, wear head phones, use a cell phone or mobile device, or engage in multitasking or other conversations while flagging. Flay persons should stand away from other workers, vehicles, and equipment but should be periodically monitored by the site supervisor or site safety officer to assure they are maintaining alertness, taking breaks, and performing duties as prescribed. If railroad tracks are adjacent to the work zone, the flag station should be positioned so that vehicles are stopped in advance of the railroad tracks and the work zone.
Law Enforcement	Local law enforcement agencies can be useful in enforcing and supporting safe work zones, especially in areas where fines for speeding and other traffic violations exist, during nighttime operations, short-term and mobile operations with minimal controls, and around schools and other sensitive locations.	Use of local law enforcement agencies shall be coordinated in advance and frequent meetings shall be held to establish communication procedures.
Portable Changeable Message Signs	Portable changeable message signs have a wide variety of applications in TTC zones, including roadway, lane, or ramp closures; incident management; width restriction information; speed control or reductions; advisories on work scheduling; road user management and diversion; warning of adverse conditions or special events; and other operational control. The primary purpose of portable changeable message signs in TTC zones is to advise the road user of unexpected situations. Portable changeable message signs are particularly useful as they are capable of: A. Conveying complex messages, B. Displaying real time information about conditions ahead, and C. Providing information to assist road users in making decisions prior to the point where actions must be taken.	When portable changeable message signs are used for route diversion, they should be placed far enough in advance of the diversion to allow road users ample opportunity to perform necessary lane changes, to adjust their speed, or to exit the affected highway.
Rolling Closures	A rolling closure is the use of police	In such cases, these very short duration operations can be

Protective Device	Common Applications	General Guidance (refer to jurisdictional requirements and guidance for further detail)
	car(s), crash truck(s), and/or sign truck(s) to control the speed and restrain vehicles upstream of a construction site, so as to create a time window (usually 5 to 15 minutes) when the road downstream of the lead vehicles is effectively clear of vehicles, which creates an unhindered opportunity for workers to do work and/or make traffic control changes at the work site clear of live traffic. Example situations of where rolling closures may be a good method of traffic control include: Changing a lane closure on a freeway from a right lane closure to a left lane closure, or vice versa. Removing large debris from a roadway.	safely and efficiently carried out if traffic is temporarily prevented from entering the work zone. It is the decision of the road authority to use rolling closures. Paid-duty police officers and coordination and approval from local jurisdictions are required for freeway rolling closures due to increased hazard levels to the general public. Other road closures shall be coordinated with the road authority and executed in accordance with jurisdictional requirements and guidance. Prior to initiating a rolling closure, all parties shall have verbal communication to establish procedures, signals, and sequencing of the closure. Communication should be direct and verbal, or otherwise distinguishable from other roadways sounds (horns, sirens, etc.).
Rumble Strips	Transverse rumble strips consist of intermittent, narrow, transverse areas or rough texture or slightly raised or depressed road surface that extends across the travel lane. Transverse rumble strips alert drivers to unusual traffic conditions through noise and vibration. Longitudinal rumble strips alert drivers they are leaving a lane.	Design, placement, and use of rumble strips must be in accordance with jurisdictional requirements and guidance, and with approved Traffic Control Plan.
Shadow Vehicles	Shadow vehicles can be selected to provide greater warning to drivers and protection to the work zone, particularly in short duration scenarios where other TTC devices in use are lightweight/ mobile.	Shadow vehicles without an attenuator can cause increased injuries to the occupants of the shadow vehicle as well as the errant vehicle. Generally, shadow vehicles should be unoccupied when serving as protection from traffic. However, some mobile or short duration activities may require a driver to remain in the vehicle. If a driver remains in the vehicle, the driver's seatbelt and vehicle safety features must be used at all times. When used, shadow vehicles shall be equipment with flashing arrows, changeable message signs, and/or high-intensity rotating, flashing, oscillating, or strobe lights to warn approaching motorists. Specific requirements for markings may be specified in jurisdictional requirements and guidance. Roadway workers must maintain a buffer zone (minimum 50 feet) from shadow vehicles in the event the shadow vehicle is struck. Jurisdictional requirements and guidance for the design specification and use of shadow vehicles shall be followed.

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Protective Device	Common Applications	General Guidance (refer to jurisdictional requirements and guidance for further detail)
Spotters	Spotters shall be used to facilitate the safe movement of equipment and vehicles within a work zone or construction site. Spotters shall be assigned to monitor traffic when a task prevents a worker from effectively monitoring traffic, or when road configuration prevents a worker from having visibility of traffic approaching the work area. Spotters can monitor traffic flow, backing vehicles, pedestrian access/egress, driveways, and parking activity.	Spotters are not to serve as flag persons unless they are trained and designated in a dual role by the project manager and duties are performed separately. Spotters are responsible for maintaining visibility by operators when performing their duties. Spotters must utilize the agreed upon and trained method of communicating (hand signals or other) with operators. Spotters shall not be distracted, wear head phones, use a cell phone or mobile device, or engage in multitasking or other conversations while spotting.
Warning Signs	Warning signs call attention to unexpected conditions on or adjacent to a highway or street and to situations that might not be readily apparent to road users. Warning signs alert road user to conditions that might call for reduction in speed or an action in the interest of safety. Warning signs internal to a construction zone may perform the same/similar function. Additional signage may be used to call attention to designated areas, paths of travel, restrictions, and appropriate use of certain areas.	The use of warning signs shall be selected by the traffic control engineer based on study or engineering judgement. Placement of signs in or near a work zone shall be determined based on driver perception, identification, emotion, and volition time. Generally, this is considered 6 seconds or more for high speed scenarios. Signs should not be placed so far in advanced distance that drivers may forget the warning and fail to respond. The location of driveways, parking, and similar locations between the warning sign and the work area should considered in placing signs and providing warning to potential drivers of parked vehicles. Signage shall be of acceptable standards, in good condition, clean, legible, suited to the purpose, and meeting local legislation requirements. Signage shall be secured or weighted. Routinely inspect signage for placement, cleanliness, and physical damage. Cover road traffic control signage when no activity is present. Provide appropriate instructional signage such as: EVACUATION ROUTE; DO NOT ENTER; REDUCED SPEED AHEAD; ROAD CLOSED; WORKERS AHEAD; and NO OUTLET.

2. Change Log

List the change history pertaining to this document including if it was identified differently throughout its life-cycle:

Rev #	Change Date	Description of Change	Location of Change
0	Nov 13, 2019	New Instruction attached to S3AM-306-PR1 Highway and Road Work	New Document

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Short and Long Duration Work Zones

S3AM-306-ATT2

1. Short-Term Traffic Protection

Short-term work zones are defined in jurisdictional requirements and guidance. In general, the following categories may apply:

- Mobile operations: move intermittently or continuously, such as litter and debris removal, pothole patching, utility operations.
- Very Short or Short Duration operations: occur for less than 1 hour (some jurisdictions are as low as 30 minutes). Roadside assistance, incident response, surveying, or other data collection may fall into this category.
- Short Duration, stationary: occurs for more than 1 hour (some jurisdictions are as low as 30 minutes) but less than one daylight period. Examples include maintenance and utility operations.

1.1 General

1.1.1 Most guidance allows for less permanent barriers and active devices (such as flashing arrow boards) to be used for short duration or mobile work tasks in order to reduce the amount of time that a worker is exposed to moving traffic.

1.1.2 When calculating the work duration, the time required to set up and take down traffic control should be included.

1.1.3 Personal protective equipment as defined in the SH&E Plan / Task Hazard Assessment (THA) shall be worn.

1.2 Safe Work Practices for Short Duration Work Zones

1.2.1 Consider timing of heaviest traffic flow on the specified roadway, and plan work to avoid roadway impact during high flow events such as morning and evening rush hours; holiday weekends; and notable community events such as fairs, parades, and entertainment venue events.

1.2.2 Minimize time for set-up and removal of traffic control devices:

- Plan the number and placement of devices in advance to assure maximum protection with minimal number of devices.
- Eliminate unnecessary steps from work or identify tasks that can be performed outside the work zone and locate those tasks in a fully protected area.
- Substitute portable signage with vehicle-mounted signs that do not require additional time on the roadside to deploy.
- Use lightweight portable signs.
- Use a work vehicle to place devices.

1.2.3 Unexpected and emergency work:

- Use high-intensity rotating, flashing, oscillating, or strobe lights on appropriately colored or marked vehicles.

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- Arrow panels and portable changeable message signs can be used for advanced notifications and messaging to drivers.
- Law enforcement officers are often available in unexpected or emergency situations to assist with increasing visibility of the work zone.

1.2.4 Mobile operations (continuous movement at slow speeds with some short stops):

- Utilize vehicle-mounted devices (arrow boards, portable changeable message boards).
- Shadow and attenuator vehicles may be utilized to follow the work vehicle, especially in high speed or high-volume situations.

1.2.5 Managing intersections, driveways, and parking:

- Identify potential access points in pre-planning.
- Use flag persons or route diversion where needed to communicate the presence of the work zone.
- Consider law enforcement officers to assist with traffic control in complicated or high traffic flow intersections.
- Coordinate closures with owners/operators in advance of closing.
- Parking lane closures should include the use of channelizing devices in a manner that prevents vehicles from using or departing spaces and provide adequate buffer space for worker protection.

1.2.6 Accommodating non-motorized users and transit:

- Identify non-motorized facility user needs in and near the work area during pre-planning.
- Notify affected agencies.
- Incorporate non-motorized user and transit needs into Traffic Control Plan.
- Use temporary traffic control, including warning devices to alert users of changes and closures.
- Presence of transit facilities (rail) can increase work zone length or require additional flag persons and spotters.

1.2.7 Aerial Lift Trucks and other Work Vehicles:

- Never extend lifts over traffic lanes.
- Lane closures may be required for any lane over which a bucket will be extended.
- Use a shadow truck or attenuator vehicle when aerial lifts or other special purpose equipment is in use.
- Rolling stops, law enforcement, and other supporting jurisdictional services are required.
- Refer to *S3AM-323-Aerial Work Platforms* for further information.

2. Long-Term Traffic Protection

Long-term work zones are defined in jurisdictional requirements and guidance. In general, the following categories may apply:

- Intermediate-term stationary: more than one daylight period, up to 3 days or nighttime work lasting 1 hour.
- Long-term stationary: lasts more than 3 days in one location.

2.1.1 Traffic Control Plans may be extensive and require coordination with the supporting jurisdiction.

2.1.2 Traffic Protection Plans are required to facilitate the safe movement of vehicles and equipment within the work zone. These plans should include:

- Safe access and egress to and from the work zone;
- Location of light stands, generators, cranes, bins, and other supporting features of the work;
- Location of restrooms/handwashing, break areas; and
- Parking.

2.1.3 Temporary Traffic Control devices should be selected so provide maximum separation of work zone from traffic using detours or through positive protection (Portable Concrete Barriers, Movable Concrete Barriers, Ballast-Filled Barriers, Shadow Vehicles, and Vehicle Arrestor Systems, or similar).

2.1.4 Personal protective equipment as defined in the SH&E Plan / Task Hazard Assessment (THA) shall be worn.

2.1.5 For long duration work zones, traffic accommodation shall be provided BEFORE the work starts and shall be maintained until the work is completed.

3. Change Log

List the change history pertaining to this document including if it was identified differently throughout its life-cycle:

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0	Nov 13, 2019	New Instruction attached to S3AM-306-PR1 Highway and Road Work	New Document

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Safe Work Practices for Roadway Workers

S3AM-306-ATT3

1. Safe Work Practices

Roadway workers shall abide by the following safe work practices:

- Roadway workers shall be fit-for-duty; refer to *S3AM-008-PR1 –Fitness for Duty*.
- All roadway workers shall be trained on how to work next to motor vehicle traffic in a way that eliminates or minimizes their exposure. Refer to *S3AM-003-PR1 SH&E Training*.
- All SH&E Plans, Traffic Control Plans, Traffic Management Plans (if applicable), and Task Hazard Assessments shall be reviewed and acknowledged by signature by each roadway worker prior to starting work.
- Roadway workers shall work distraction free. Use of cell phones, earphones/ear buds, or headsets or other distractions are prohibited while working within the work zone.
- Photography, videography, note, or measurement taking should be done with the use of a spotter to monitor traffic while engaged in immersive tasks.
- Seatbelts shall be worn, even when work vehicles are parked within a work zone.
- Vehicles should be positioned so that access and egress to and from vehicles are protected from traffic either by barriers or by entering and exiting the vehicle from the non-traffic exposed side of the vehicle.
- Roadway workers should maintain a body position that allows for visual monitoring of traffic; if such a position cannot be achieved or the assigned task prohibits a roadway worker from monitoring traffic, then a spotter(s) should be assigned.
- Crossing active lanes of traffic should be avoided. Crossing active lanes can be avoided by using short duration work zones, rolling closures, and parking in designated parking areas within lane closures.
- If accessing active lanes cannot be avoided due to a necessary work function (such as incident management, debris removal), then a spotter or warning signage to divert traffic should be deployed. Workers that enter lanes as a necessary work function shall be trained and evaluated on a method to assess vehicle speed and other risk factors for this task. Roadway workers shall notify their supervisors, or equivalent, prior to entering lanes and when they return from lanes.
- Roadway workers should maintain a body position that prevents them from being caught between two pieces of equipment, equipment and structures, or other crush points.

2. Change Log

List the change history pertaining to this document including if it was identified differently throughout its life-cycle:

Rev #	Change Date	Description of Change	Location of Change
0	Nov 13, 2019	New Instruction attached to S3AM-306-PR1 Highway and Road Work	New Document

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Safe Work Practices for Night Work

S3AM-306-ATT4

1. Safe Work Practices

- Shifting work to nighttime hours could provide an advantage in areas where traditional daytime traffic controls cannot achieve an acceptable balance between worker and public safety and traffic/community impact.
- Night work poses the increased risks of reduced visibility in darkness, potentially higher speeds on roads with fewer vehicles, and more impaired drivers especially on weekends and holidays.
- Night work on roadways should not be done unless there is sufficient justification that safety and community impact can be effectively balanced.
- A records review of impairment-related incidents can be completed to determine the risk level and appropriate levels of protection required.
- Local law enforcement should be used to calm traffic, monitor and enforce speed limits, identify and remove impaired motorists, and improve overall site security.
- Temporary traffic control devices may be larger and have increased reflectivity for night work.
- Spacing can be reduced between channelizing devices to discourage intrusions; in some settings (intersections, ramps), the channelizing device spacing should be reduced to half the normal tangent spacing or less to provide enhanced guidance through these critical areas.
- Reflectivity of surfaces on equipment, signs, and channelizing devices can be increased by adding reflective material.
- Attenuator vehicles and shadow vehicles are good choices for lane closures that occur at night and should be used for middle lane closures that occur at night, on highway, or where high speed traffic is present or possible.
- All reflective surfaces shall be cleaned as required so that the reflectivity of the material is not degraded. Any areas of reflective surface that are damaged or obscured shall be replaced.
- Personnel working at night shall have reflective tape on their hardhats and shall wear retroreflective ensembles that meet the jurisdictional requirements and guidance for night work. Refer to *S3AM-208-PR Personal Protective Equipment* and ANSI/ISEA 107-2015 for selection guidance.
- Additional measures, such as white coveralls, reflective bands, and personal battery-operated strobe lights may be used when practical. All devices should be planned to increase visibility by motorists as well as motorist ability to differentiate a worker from the background.
- Increasing the use of fluorescent materials during dawn or dusk may have a greater protective effect than reflectivity where light sources are low.

2. Illumination

- A lighting plan must be developed for long duration work zones that will have night work to assure proper lighting and support resources are provided.
- Whenever feasible and practical, light plants shall be used to illuminate the work area. Balloon or diffuse lighting portable light towers should be used along highways and where possible to provide glare-free illumination.
- On mobile operations, additional lighting such as spot lights, lights worn by workers and or lights added to equipment may be used to illuminate the work area.
- Lighting for workers on foot and equipment operators is to be at least 5 foot candles (54 Lux) or greater.

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- All equipment shall have working lights and, at a minimum, have working strobe or warning beacon lights.
- All flag persons shall be placed in illuminated areas only.
- All lighting must be checked after setup to confirm that it is not interfering with approaching traffic and other equipment in the work zone and meets the jurisdictional requirements and guidance.

3. Change Log

List the change history pertaining to this document including if it was identified differently throughout its life-cycle:

Rev #	Change Date	Description of Change	Location of Change
0	Nov 13, 2019	New Instruction attached to S3AM-306-PR1 Highway and Road Work	New Document

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Highway and Road Work

S3AM-306-PR1

1. Purpose and Scope

To address potential hazards that may occur while working on public or private roadways or within the right-of-way of a public or private roadway.

- This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.
- This procedure is designed to assure that work on highway and roads meets the requirements established in federal, state, provincial, territorial, and local department of transportation laws, regulations, and guidance (jurisdictional requirements and guidance). If discrepancies exist between this procedure and other applicable materials, the most stringent option shall be selected.

2. Procedure

2.1 Planning Work in a Highway or Road Setting

2.1.1 The Project Manager will prepare an SH&E Plan consistent with *S3AM-209-PR1 Risk Assessment & Management* and include a thorough assessment of all hazards. Priority shall be placed on eliminating the need to place workers on an active roadway, followed by using barriers to physically separate workers from traffic. PPE and other warning devices that do not offer substantial protection from moving vehicles and equipment will be selected and used in combination with more advanced controls.

2.1.2 For work that occurs in the right-of-way (area that includes the traveled way, shoulders, and clear zone) or may otherwise expose workers to the motoring public, a Traffic Control Plan shall be developed and incorporated directly into the SH&E Plan or included as a separate Plan by attachment or reference. This applies to both long and short duration activities in/or adjacent to roadways even when not required by a local jurisdiction.

2.1.3 For work within a worksite that involves the movement of vehicles or equipment, a Traffic Protection Plan shall be developed and incorporated directly into the SH&E Plan by or included as a separate Plan by attachment.

2.1.4 Applicable jurisdictional requirements and guidance as well as industry standards and best practices shall be consulted during plan development and appropriate control measures established. These include the Occupational Health and Safety regulations and associated standards or guidebooks, and local jurisdictional manuals on the uniformity of traffic control devices in temporary construction, maintenance, and utility work zones.

2.1.5 Additional risk-specific plans may be necessary for specialized work. Examples include fall protection, respiratory protection, work over water, confined spaces, hazardous materials/waste, tunneling/blasting, heat/cold stress, excavation, heavy equipment operation, aerial lifts, and hearing conservation.

2.1.6 Emergency response plans specific to roadway emergencies that take into account limited access/egress areas such as bridges will be developed and included in the SH&E Plan. Refer to *S3AM-010-PR1 Emergency Response Planning – Americas*.

2.1.7 A system for checking workers in and out at a worksite and the work zone should be included in the SH&E Plan.

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2.1.8 PPE requirements shall be designated on a task hazard assessment for each task performed on a project (surveying, inspection, environmental, management, equipment operation). Refer to *S3AM-208-PR1 Personal Protective Equipment*.

2.1.9 Where several projects occur simultaneously, the coordination of vehicle routes and communication between contractors shall occur to reduce vehicular struck-by and backing incidents.

2.1.10 A Traffic Control Plan shall be prepared by or reviewed by a Competent Person with credentials, certifications, and experience required by jurisdictional requirements and guidance.

2.1.11 A Traffic Protection Plan shall be prepared by a Competent Person with credentials, certifications, and experience required by jurisdictional requirements and guidance.

- For long-term duration work activities that are performed at construction projects, the constructor of the project is required to develop a Traffic Protection Plan.
- If AECOM has assumed the role of constructor for the project, the Traffic Protection Plan shall be developed and implemented prior to the commencement of work activities at the project.
- If AECOM is not the constructor for the project, the Traffic Protection Plan for the project shall be developed by our client or a constructor designated by the client.
- The Traffic Protection Plan should be reviewed with AECOM employees during orientation to the project.

2.2 Selecting Protective Measures

Protective measures for traffic control and worker protection shall be selected in accordance with work conditions and prevailing requirement of jurisdictional requirements and guidance. Additionally, the Project Manager, Traffic Control Engineer (if applicable), and/or Competent Person shall reduce risk to Roadway Workers by employing the Hierarchy of Controls as described in *S3AM-209-PR1 Risk Assessment & Management*. Below are examples:

- Elimination: Completely eliminate public traffic from the work area and construction traffic. This can occur by locating survey monuments and other data gathering points outside of roadways, utilizing alternative data collection methods, constructing detours and alternate routes, or otherwise isolating the work zone.
- Substitution: Substitute the use of an exposed worker with an alternate method to perform the work such as aerial photography, remote sensing, and remote control such as Automated Flagger Assistance Devices (AFADs).



- Engineering Controls: Use prescribed temporary traffic control devices and layouts to effectively control traffic, through a work zone, permitting public traffic and construction to interact without the use of Flag Persons or other exposed workers. Positive protection, or devices that contain and redirect vehicles preventing their intrusion into the work zone. Please also refer to *S3AM-306-ATT1 Protective Devices for Temporary Traffic Control* and *S3AM-306-ATT2 Short and Long Duration Work Zones*.
- Administrative Controls: Schedule the work at times when traffic volume is low, reducing the exposure to traffic. This may also include requiring workers to perform work in a prescribed way such as facing traffic or using a Spotter. Training and emergency procedures are also considered administrative controls. Please also refer to *S3AM-306-ATT4 Safe Work Practices for Roadway Workers*.

- Personal protective equipment: Traffic vests, safety glasses, and high visibility clothing should always be worn to increase visibility but rarely, if ever, solely relied upon as a protective measure for moving traffic.

3. Responsibilities

3.1 Manager or Supervisor

- Verify development and administration of the procedures, communication methods, and the measures and configuration of the temporary traffic control zone in accordance with specifications for workers, motorists, and pedestrians, and the protection of AECOM employees. Please also refer to *S3AM-306-ATT1 Protective Devices for Temporary Traffic Control*.
- Confirm the SH&E Plan, Traffic Control Plan, and as applicable, the Traffic Protection Plan are developed and communicated to all involved and affected employees.
- Confirm compliance with the SH&E Plan, Traffic Control Plan, Traffic Protection Plan (if applicable), and this procedure.
- Confirm compliance with jurisdictional requirements and guidance governing highway and road work.
- Confirm site-specific or client-required safety training is completed and documented for all assigned Roadway Workers.
- Confirm employees assigned to work zones are trained in safe work practices and the use of traffic control systems, communication systems, and PPE. Please also refer to *S3AM-306-ATT3 Safe Work Practices for Roadway Workers.*
- Lead inspections or investigations, as appropriate.
- Identify the Competent Person and, as applicable, Traffic Control Engineer for the project.

3.2 Flag Person

- Comply with the applicable SH&E Plan, Traffic Control Plan, and Traffic Protection Plan (if applicable), and with communication requirements.
- Maintain training and competency in traffic control and flagging procedures.
- Receive and communicate specific instructions clearly, firmly, and courteously to other Roadway Workers and the public.
- Maintain alertness at their points of duty until relieved. Report to work “Fit-for-Duty” and able to move and maneuver quickly in order to avoid danger from errant vehicles.
- Properly use signaling devices (such as paddles and flags) in order to provide clear and positive guidance to drivers.
- Properly use PPE and communication devices and signals.
- Monitor work area for new and changing conditions and effectively communicate information to other Roadway Workers and Supervisors, including emergency or rapidly changing situations.
- Test and verify emergency procedures within a work zone.

3.3 SH&E Representative/Site Safety Officer

- Assist the Project Manager with implementation of SH&E Plan, Traffic Protection Plan (if applicable), and Traffic Control Plans at the work zone.
- Coordinate safety on the specified project to include traffic and non-traffic hazards.
- Conduct hazard assessments, inspections, and safety observations.

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- Develop mitigating strategies, and review and monitor their implementation.
- Conduct worksite inspections including the use of traffic control devices as required, make recommendations for improvement, and coordinate changes with the Project Manager and, as applicable, the Traffic Control Engineer.
- Coordinate the modification of traffic control devices with the Project Manager and Traffic Control Engineer (if applicable), Flag Person, and Competent Person in order to provide mobility and positive guidance to road users and Roadway Workers.
- Stop work in the event of an unsafe act or condition.

3.4 Spotter

- Comply with the applicable SH&E Plan, Traffic Control Plan, and Traffic Protection Plan (if applicable), and with communication requirements.
- Facilitate the safe movement of equipment and vehicles within and between work zones.
- Spotters are not permitted to act as a Flag Person.
- Monitor surrounding areas for moving vehicles and provide warning to workers.
- Maintain training and competency in spotting procedures.
- Receive and communicate specific instructions clearly, firmly, and courteously to other workers and the public.
- Maintain alertness at their points of duty until relieved. Report to work “Fit-for-Duty” and able to move and maneuver quickly in order to avoid danger from moving vehicles.
- Properly use PPE, and communication devices and signals.
- Maintain a position that is visible to moving equipment and vehicles.
- Monitor work area for new and changing conditions and effectively communicate information to other workers and Supervisors, including emergency or rapidly changing situations.

3.5 Traffic Control Engineer

- Maintain certifications and credentials to perform duties.
- Maintain knowledge on current traffic control devices and methods.
- Perform engineering studies to evaluate best methods for traffic control and protection.
- Develop traffic protection and control strategies consistent with local jurisdiction guidance and requirements.
- Incorporate best practices and more conservative safety measures when they provide increased protection for workers and/or the public.
- Monitor effectiveness of traffic control strategies.

3.6 Competent Person, Traffic Control

- Maintain knowledge and experience in traffic control consistent with the work environment assigned.
- Determine communication methods (hand signals, warning alarms) to be used within a worksite.
- Provide training to workers on communication methods.
- Perform inspections of traffic control devices, make recommendations for improvement, and coordinate changes with the Project Manager and Traffic Control Engineer.
- Stop work in the event of an unsafe act or condition.

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4. Help & Training

- All Roadway Workers shall be trained on how to work next to motor vehicle traffic in a way that eliminates or minimizes their exposure. Refer to *S3AM-003-PR1 SH&E Training* and *S3AM-306-ATT3 Safe Work Practices for Roadway Workers.*
- Individuals that oversee work occurring on highways and roads shall receive appropriate training per jurisdictional requirements and guidance.
- Workers with specific responsibilities and duties (Competent Person, Flag Person, Spotter, Supervisor) shall have additional training, experience, and authorization to perform assigned duties.
- All Roadway Workers shall receive a site-specific orientation to the hazards and controls, including as applicable, Traffic Protection Plan, Traffic Control Plan, and communication requirements for the site(s) to which they are assigned. No personnel shall be allowed onto the site without first reviewing the project-specific Traffic Control Plan and/or Traffic Protection Plan. Additional orientation topics are specified in the SH&E Plan.
- Only persons designated by the Project Manager, with appropriate training and experience will serve as a Flag Person (traffic control). Flag Person training shall comply with jurisdictional requirements and guidance, which may vary between work locations.
- Flag Persons and Spotters shall be instructed by the Competent Person on the specific project Traffic Protection Plan (if applicable) and Traffic Control Plan.
- Flag Persons shall be trained / certified in signaling methods. Training shall comply with jurisdictional requirements and guidance (American Traffic Safety Services Association or equivalent).
- Roadway Workers, Equipment Operators, and Drivers in internal work zones shall be trained to their respective tasks and know the routes of construction vehicles. Where AECOM is not a controlling contractor at the site, training should be provided by the controlling contractor or owner.
- Equipment Operators and Spotters shall know the hand signals to be used, and the communication methods and requirements applicable to the worksite.
- Equipment Operators, Spotters, and Roadway Workers shall be trained on the visibility limits and the "blind spots" for each vehicle on site.
- Roadway Workers shall be trained on the hazards associated with shift work and night work. Please also refer to *S3AM-306-ATT4 Safe Work Practices for Night Work*.

5. Terms and Definitions

a.	Channeling Device	devices to warn road users of conditions created by work activities in or near the roadway and to guide road users. Channelizing devices include cones, tubular markers, vertical panels, drums, barricades, and longitudinal channelizing devices.
b.	Clear Zone	the total roadside border area, starting at the edge of the traveled way that is available for an errant driver to stop or regain control of a vehicle. This area might consist of a shoulder, a recoverable slope, and/or a non-recoverable, traversable slope with a clear run-out area at its toe. See Figure 1.
c.	Competent Person	those who are knowledgeable about the fundamental principles of temporary traffic control and the work activities to be performed, and who have the authority to propose and implement corrective measures to eliminate hazardous situations associated with temporary traffic control.
d.	Flag Person	a person who actively controls the flow of vehicle traffic into and/or through a temporary traffic control zone using hand-signaling devices or an Automated Flagger Assistance Device (AFAD).

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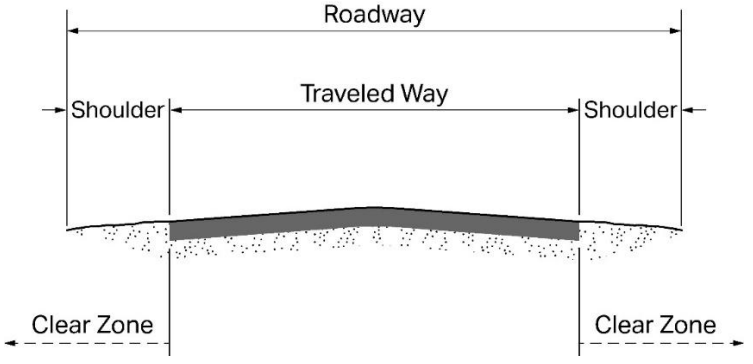
e.	Highway	a general term for denoting a public way for purposes of vehicular travel, including the entire area within the right-of-way.
f.	Personal Protective Equipment (PPE)	safety clothing and equipment worn by workers in traffic areas to provide protection and heightened visibility from physical hazards, including moving vehicles and construction equipment.
g.	Right-of-Way	a general term for denoting the traveled way, and adjacent clear zone, berms, shoulders, and sidewalks that encompass public space potentially impacted by construction, maintenance, or other activities.
h.	Roadway	that portion of a highway improved, designed, or ordinarily used for vehicular travel and parking lanes. Excludes the sidewalk, berm, or areas used solely by persons riding bicycles or other human-powered vehicles. See Figure 1.
i.	Roadway Worker	a person on foot whose duties place him or her within the right-of-way.
j.	Temporary Traffic Control Zone	an area of a highway where road user conditions are changed because of temporary traffic control devices, flag persons, uniformed law enforcement officers, or other authorized personnel.
k.	Temporary Traffic Control Device	a sign, signal, marking, or other device used to regulate, warn, or guide traffic, placed on, over, or adjacent to a street, highway, private road open to public travel, pedestrian facility, or shared-use path by authority of a public agency or official having jurisdiction, or, in the case of a private road open to public travel, by authority of the private owner or private official having jurisdiction.
l.	Traffic Control Engineer	a person who by qualification, experience, and certification is licensed and authorized to perform the duties associated with the design of traffic control systems, including temporary traffic control.
m.	Traffic Protection Plan	a detailed plan for the protection of workers within a work zone. The plan shall contain a written description of the traffic hazards to which workers may be exposed within the confines of a work zone. Traffic Protection Plans are commonly referred to as Internal Traffic Control Plans.
n.	Traffic Control Plan	a detailed plan for the control of traffic (public) during construction, maintenance, or utility operations on a highway/road, taking into account the organized, systematic, safe conduct of the project, including, as applicable, detours, staging sequences, work vehicle access and egress from worksites, temporary barriers, removal of old pavement markings, and selection and planned implementation of appropriate typical layouts for traffic control. Plan shall be written to meet jurisdictional requirements and guidance. Traffic Control Plans are commonly referred to as Traffic Management Plans.
o.	Traveled Way	the portion of the roadway for the movement of vehicles, exclusive of the shoulders, berms, sidewalks, and parking lanes. See Figure 1.
p.	Work Zone	a controlled access area due to the presence of construction, maintenance, or operational activity.

Figure 1. Depiction of Traveled Way, Roadway, Shoulder, Clear Zone



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6. References

List other procedures or external standards/regulations that apply to carrying out the process in this document. List using 'Alpha List' option from the AECOM Procedure List dropdown on the Home tab.

a. S3AM-003-PR1 SH&E Training

b. S3AM-208-PR1 Personal Protective Equipment

c. S3AM-209-PR1 Risk Assessment & Management

d. S3AM-202-PR1 Competent Person Designation

e. S3AM-008-PR1 Fitness for Duty

f. S3AM-008-PR1 Emergency Response Planning – Americas

7. Records

Traffic Protection Plans, Traffic Control Plans, and completed Equipment Checklists shall be maintained in project files.

8. Appendices

a. S3AM-306-FM1 Equipment Checklist

b. S3AM-306-ATT1 Protective Devices for Temporary Traffic Control (TCC)

c. S3AM-306-ATT2 Short and Long Term Work Zones

d. S3AM-306-ATT3 Safe Work Practices for Roadway Workers

e. S3AM-306-ATT4 Safe Work Practices for Night Operations in Work Zones

9. Change Log

List the change history pertaining to this document including if it was identified differently throughout its life-cycle:

Rev #	Change Date	Description of Change	Location of Change
2	Mar 1, 2016	AECOM URS integration of legacy documents	
3	Dec 15, 2016	See Level III Americas Revision Summary - December 15, 2016	Various locations
4	Jul 31, 2019	See Level III Americas Revision Summary – July 31, 2019	Scope & Purpose
5	Nov 13, 2019	Complete rewrite & formatting – tracked changes document on file	Comprehensive changes

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Americas

Highway and Road Work Equipment Checklist

S3AM-306-FM1

Name of Contractor (or N/A): _____ Project Name: _____

Location: _____ Project #: _____

Date: _____ Time: _____ Weather: _____

Person Conducting Inspection _____ Title: _____

*Note: As you conduct your inspection you should be able to answer each question with a **YES**. If the answer to any question is **NO,** this deficiency should be corrected as soon as possible.*

	YES	NO	Deficiency Corrected? OK	N/A
Is an approved traffic control/protection plan on site?	☐	☐	☐	☐
Are accident prevention signs, tags clearly visible?	☐	☐	☐	☐
Are danger signs used where immediate hazards exist?	☐	☐	☐	☐
Are caution signs used to warn against potential hazards or to caution against unsafe practices?	☐	☐	☐	☐
Are exit signs posted at all exit locations?	☐	☐	☐	☐
Are proper visual warning signs posted prior to (in advance of) the work area?	☐	☐	☐	☐
Are flaggers provided with signs, signals, and barricades to provide the necessary protection?	☐	☐	☐	☐
Are flaggers using red lights when signaling during periods of darkness?	☐	☐	☐	☐
Are flaggers wearing highly visible warning garments?	☐	☐	☐	☐
Are the flaggers trained in proper flagging procedures?	☐	☐	☐	☐
Are all workers trained in working in proximity to motor vehicle traffic?	☐	☐	☐	☐
Are warning garments worn at night reflectorized?	☐	☐	☐	☐
Are highly visible flags used by the flaggers at least 18 inches (45 centimeters) square?	☐	☐	☐	☐
Are barricades used to totally obstruct the passage of people and vehicles to protect the work area?	☐	☐	☐	☐
Do barricades meet the requirements set forth in the Manual of Uniform Traffic Control Devices?	☐	☐	☐	☐
Has effectiveness of the traffic control/protection plan been evaluated?	☐	☐	☐	☐

COMMENTS:

Americas

Approval of Machinery and Mechanized Equipment S3AM-309-FM1

1.0 General Guidelines

1.1 Subcontractor equipment shall comply with all applicable legislative requirements, local, State, Federal, Provincial, Territorial for motor vehicles and material handling heavy equipment.

1.2 Approval shall be obtained for all subcontractor machinery and mechanized equipment within seven calendar days of use on the project site.

1.3 As applicable, all machinery and mechanized equipment must be certified and tested at appropriate intervals as required by the manufacturer and/or regulatory requirements.

1.4 Heavy equipment includes, but is not limited to, drill rigs, front-end loaders, backhoes, trackhoes, bulldozers, forklifts, and similar equipment used for the implementation of the project Statement of Work.

2.0 Equipment Safety Inspections

2.1 The following presents general guidelines for certifying equipment is in safe operating condition before activities commence at the site and during site operations. The following guidelines are not meant to be all-inclusive.

2.1.1 All machinery and mechanized equipment will be approved to be in safe operating condition (using the attached form) by a competent individual within seven calendar days in advance of operation on a new site or project. This approval is valid for one year for the given site or project.

2.1.2 Equipment will be inspected on a daily basis by the owner/operator and daily logs will be maintained. All discrepancies shall be corrected prior to placing the equipment in service.

2.1.3 Inspections shall include, but are not limited to, all hydraulic lines and fittings for wear and damage, all cable systems and pull ropes for damage and proper installation, exhaust systems, brake systems, and drill controls, etc.

2.1.4 Drill rigs and related support equipment and vehicles shall be inspected by the driller in charge on a daily basis. These inspections shall be recorded on the Daily Drill Rig Checklist or on equivalent subcontractor forms.

2.1.5 Preventive maintenance shall be conducted for all equipment according to manufacturer recommendations and/or the subcontractor's internal policies, schedules, and equipment Standard Operating Procedures.

2.1.6 Only designated qualified persons shall operate and inspect machinery and mechanized equipment.

2.1.7 The contractor shall maintain records of tests and inspections at the site and shall make the records available upon request of the designated authority; the records shall become part of the official project file.

2.1.8 Equipment found to not be in safe operating condition or to have a deficiency that affects the safe operation of the equipment shall immediately be tagged, taken out of service, and its use prohibited until deficiencies have been corrected to a safe condition.

2.1.9 All equipment shall be kept in the exclusion zone until decontaminated within designated decontamination areas.

2.1.10 Equipment with an obstructed rear view must have an audible alarm that sounds when equipment is moving in reverse.

TO: AECOM

DATE:

FROM:

Project Name: Project Number:

Project Location:

1. This form provides approval of machinery and mechanized equipment to be used on the referenced project for the following work:

Description of equipment work:	
Project site:	
Subcontractor providing equipment: Address:	
Dates (duration) of equipment work:	

2. Inspection and approval of machinery and mechanized equipment, as required by AECOM, has been made within seven calendar days in advance of use on the project site. This approval process shall be repeated for equipment that is used on the project or site for more than one year.

Identification of equipment (make, model, serial no.)		Date of Certification
1		
2		
3		

3. The above listed equipment has been inspected and tested as indicated on this form, and is DECLARED TO BE IN SAFE OPERATING CONDITION BY THE FOLLOWING COMPETENT INDIVIDUAL:

Name		Title
Company		
Signature		Date

4. If there are any questions regarding this certification, please contact the following AECOM representative:

DCS Americas

Subcontracting Temporary Traffic Control

S4[DCS]AM-306-ATT1

1. Purpose and Scope

Contractors providing temporary traffic control (TTC) for work in roadways are a critical part of ensuring safety for all workers conducting lane closure activities.

TTC workers have an increased level of risk due to their exposure to active traffic and increasingly unpredictable behavior of drivers. The following requirements and guidelines have been developed to supplement *S3AM-306-PR1 Highway and Road Work* to further address this risk.

2. Requirements and Guidelines

Project Managers shall examine the full hierarchy of controls to determine and verify exposure to live traffic cannot be eliminated through other means (elimination, substitution).

Safety requirements and expectations should be communicated to traffic control contractors through coordination with AECOM Procurement. The Project Manager-prepared scope of work (request for proposal) and the subcontract's terms and conditions must include the following at a minimum:

- TTC contractor should conduct a site visit to develop the site-specific Traffic Control Plan. Positive protection (such as portable, movable, ballast filled barriers, shadow trucks, attenuators) and speed reductions should be included whenever possible, with approval from local jurisdiction.
- Supervisors provided by TTC contractor should have the following qualifications:
  - (2) years' TTC supervisor experience in a non-highway settings and
  - (5) years' TTC supervisor experience in a highway setting
- Workers provided by the TTC contractor should have verifiable training recognized by American Traffic Safety Services Association (ATSSA) or other equivalent certifying organization acceptable for the given jurisdiction.
- If a TTC contractor provides a worker(s) with less than six (6) months experience, the contractor shall assign a safety mentor consistent with AECOM's Newly Hired/Transferred Employee Program (e.g., Green Hat). TTC teams should not exceed one (1) newly hired employee per five (5) team members.
- In advance of work the TTC contractor shall submit risk assessment documents (Task Hazard Assessment) for the following tasks (at a minimum:)
  - TTC scene set up
  - Flagging and directing traffic
  - TTC scene termination and retrieval

AECOM Project Manager shall conduct project safety orientations/kick-off within one (1) week of field work and include a management or supervisory representative from the TCC contractor in the orientation.

- TCC contractor's workers shall be included in each subsequent daily tailgate safety meeting and attendance shall be documented.

AECOM Field Supervisors shall receive advanced training from ATSSA or equivalent certifying organization so they can provide effective spot checks of TCC contractor performance.

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1. Change Log

List the change history pertaining to this document including if it was identified differently throughout its life-cycle:

Rev #	Change Date	Description of Change	Location of Change
0	April 28, 2020	New Document	

Americas

Material Storage

S3AM-316-PR1

1.0 Purpose and Scope

1.1 This procedure applies to all AECOM Americas-based employees and operations, and any other entity and its personnel contractually required to comply with this document's content, where materials are stored and used. Note that this standard does not address manual material handling (e.g., manual lifting, lowering, pushing, pulling, carrying, holding, or restraining). Information on manual material handling can be found in *S3AM-014-PR1 Manual Lifting*.

1.2 The purpose of this standard is to ensure the safety of AECOM personnel during the storage of materials.

2.0 Terms and Definitions

2.1 None

3.0 References

3.1 S3AM-014-PR1 Manual Lifting

3.2 S3AM-115-PR1 Hazardous Materials Communication

4.0 Procedure

4.1 Implementation of this standard is the responsibility of the Manager directing activities of the facility, site, or project location.

4.2 Employees shall be properly trained and follow the established procedures applicable to the material stored.

4.3 General

4.3.1 Consult additional applicable jurisdictional requirements and AECOM procedures for specific tasks, materials, and equipment involved in material storage operations.

4.3.2 Storage areas should be specifically designated and be clearly marked. Aisles should be clearly marked, be of ample width for the type of storage, and be kept free from obstacles and trash.

4.3.3 Store materials in a manner that prevents damage or deterioration to the material and in a configuration that is safe and provides for the optimal and efficient use of storage space.

4.3.4 Material must not be stacked within 18 inches of the sprinkler heads Material should be kept well clear of light fittings, heating pipes and ceilings.

4.3.5 Ensure that stacks are stable and self-supporting.

- Stack symmetrically.
- Base areas and heights of stacks should be kept as small as circumstances permit. The ratio of height to base dimensions of large stacks should be correctly proportioned so that failure of part or whole of the stack does not occur.
- Experience has shown that the height to base ratio of an unsupported stack should not exceed 3 to 1.
- As most stacks are erected by visual alignment, a slight error in calculation near the base can easily result in a barely noticeable overhang, with a resultant loss of stability.

- Where effective banding and shrink wrapping can be achieved, the ratio of height to base can be safely increased to 4 to 1.
- Stable construction of the stack is entirely dependent upon the following factors:
  - Safe relation of height to dimension of base;
  - Sound interlocking of the material;
  - Contents of the cartons;
  - Shape of articles

4.3.6 Post maximum safe loads for all floors above grade in pounds per square foot.

4.3.7 As applicable, stack, rack, block, interlock, band or shrink-wrap, or otherwise secure all materials to be stored in tiers to prevent sliding, falling, or collapse.

4.3.8 De-stacking is largely the reverse process of stacking. Most accidents involving the collapse of stacked materials occur during de-stacking. The prime cause of this is haphazard removal. All stacking and de-stacking should be carried out under competent supervision. Basic rules for breaking down stacks are:

- One person should be responsible for the manner in which the stack is reduced;
- The stack should be taken down tier by tier and;
- As there is a high tripping hazard in the working area of a stack, tidiness and systematic work methods are essential.

4.3.9 Keep aisles, passageways, and other access ways clear to provide for the free and safe movement of material-handling equipment or employees. Mark all permanent aisles.

4.3.10 Segregate and label non-compatible materials. Refer to *S3AM-117-PR1 Hazardous Materials Communication*.

4.3.11 When loads swing freely, confirm non-compatible materials are segregated. Do not lift loads or swing over the heads of persons; it is not permitted to walk under a load. Wear hardhats in these areas.

4.3.12 Do not place material stored inside buildings under construction within 6 feet (1.8 meters) of any hoistway or inside floor openings, or within 10 feet (3 meters) of any exterior wall lower than the top of the material stored.

4.3.13 Pallets should be of sound construction, and be of adequate strength for the loads and conditions under which they are used. Where pallet loads are stacked tier on tier, the unit loads must be able to support the weight above.

4.3.14 Stacks, shelving and other fixtures for holding or storing materials should be so laid out and designed that there is sufficient access for safe loading and unloading by either manual or mechanical means

4.4 Stacking Frames

4.4.1 Conduct a visual inspection of the stacking frames prior to loading for damage (e.g., bent, twisted, broken or excessive rust). Remove from service any stacking frames that fall into any of these categories.

4.4.2 Several pallets can be loaded on a stacking frame provided they are stable and will not fall.

4.4.3 If more than one (1) pallet is placed on a stacking frame and materials are unstable or appear to be capable of falling, the pallets will be shrink-wrapped or banded together or stored in another storage location.

4.4.4 Do not exceed the maximum load of the stacking frame. Be sure to include the weight of the stacking frame in the maximum load calculation.

4.4.5 Material on a stacking frame will not extend above the top rail if another stacking frame is to be placed on top of the lower frame.

- The highest or top stacking frame may have material that extends above the top rails, but the pallet itself must be below the top rails and the material secured.

4.4.6 Stacking frames will only be stacked high enough for forklift forks to be able to reach and remove one (1) frame at a time. At no time will they be stacked higher than five (5) high regardless of the dimensions of the stacking frame. Material placed on the top rack will be banded or shrink wrapped (if applicable).

4.4.7 Do not mix stacking frames manufactured by different companies (e.g., a UNICOR with a Nestainer or other manufacturer).

- Stacking frames of different colors can be intermingled but will be of the same dimensions and manufacturer (e.g., UNICOR to UNICOR, Nestainer to Nestainer).

4.4.8 The 1st (lowest) stacking frame will have the greatest amount of weight. The subsequent frames will, if possible, have less weight than the frame immediately below it. This is to avoid top heaviness.

4.4.9 When picking up a stacking frame, ensure the MHE forks are securely seated into the two (2) stirrups of the frame. When traveling, maintain a clear field of vision and travel in reverse if vision is obstructed by the load. Sound your horn at all intersections and blind spots.

4.4.10 Transport one (1) loaded stacking frame at a time.

4.4.11 When traveling with a pallet, keep load as low as possible. Do not bulldoze pallets or stacking frames.

4.5 Bagged Materials

4.5.1 Provide bags of cement and lime stacked over ten bags high with restraining walls of appropriate strength.

4.5.2 Stack cement, lime, and similar materials in bags so that the mouths of the outside bags are facing the center of the stack.

4.5.3 During un-stacking, keep the entire top of the stack nearly level, and maintain the necessary setback.

4.5.4 Warn employees handling cement or lime about skin burns, and ensure that goggles, gloves, and clothing that fits snugly about the neck and wrists are worn.

4.5.5 Lime must be stored to prevent a premature slaking action that may cause fire.

4.6 Bricks and Blocks

4.6.1 Brick stacks must not exceed 7 feet (2.1 meters), and they should be tapered back starting at 4 feet (1.2 meters).

4.6.2 Always stack bricks on planks, asphalt, or concrete, and never on uneven or soft surfaces.

4.6.3 Keep the top of brick stacks level and maintain the taper during un-stacking operations.

4.6.4 Stack blocks in tiers on solid, level surfaces, and taper back over the 6-foot (1.8-meter) level.

4.7 Lumber

4.7.1 When stacking lumber, place cross strips on stacks more than 4 feet (1.2 meters) high.

4.7.2 Remove all nails from used lumber before stacking, unless the lumber is to be burned or hauled away without further handling.

4.7.3 Stack lumber on level and solidly supported sills to be stable and self-supporting.

4.7.4 Do not stack lumber more than 16 feet (4.9 meters) high.

4.8 Reinforcing and Structural Steel

4.8.1 Store steel rods in separate stacks according to length and size.

4.8.2 Carefully stack structural steel to prevent the danger of members sliding off, or the stack toppling over.

4.8.3 Never store “I” beams with the webs vertical.

4.9 Foundation Bolts

4.9.1 Stack bolts in separate stacks according to length and size.

4.10 Corrugated and Flat Iron

4.10.1 Stack corrugated and flat iron flat, and not more than 4 feet (1.2 meters) high.

4.10.2 Place spacing strips between bundles.

4.11 Pipes, Poles, and other Cylindrical Material

4.11.1 Stack and block cylindrical material in such a way to keep the material from spreading or toppling.

4.11.2 Do not stack pipes higher than 5 feet (1.5 meters) unless racked.

4.11.3 When removing pipe or other material larger than 2 inches (5 centimeters) in diameter from storage, and where stacked pipe runs in one direction and is more than one pipe high, employees will be instructed to approach the stack from the ends, not from the sides.

4.12 Sand, Gravel, and Crushed Stone

4.12.1 While removing sand, gravel, and crushed stone from stockpiles, ensure there are no overhanging or vertical faces at any time.

4.12.2 Do not store material dumped against walls or partitions to a height that will endanger the stability or exceed the resisting strength of such walls and partitions.

5.0 Records

5.1 No documentation maintenance is required.

6.0 Attachments

6.1 None

Americas

Respiratory Protection

S3AM-123-PR1

1.0 Purpose and Scope

1.1 This procedure establishes a written respiratory protection program with the required elements and work site-specific procedures for respirator selection, use, and maintenance for any workplace where respirators are necessary to protect the health of an Employee.

1.2 The primary objective shall be to prevent exposure to atmospheric contaminants as far as feasible by accepted engineering control measures (e.g. enclosure or confinement of the operation, general and local exhaust ventilation [LEV], and substitution of less toxic materials). If respiratory hazards remain, suitable administrative controls and respiratory protective equipment requirements shall be established.

1.3 This procedure applies to all AECOM Americas-based employees and operations, and any other entity and its personnel contractually required to comply with this document's content, except where local or governmental regulations are more stringent**.**

2.0 Terms and Definitions

2.1 **Action Level (AL)** – An airborne concentration of a potentially toxic or hazardous substance, measured in parts per million by volume (ppm), microgram per cubic meter (µg/m3) milligram per cubic meter (mg/m3) or fibres per cubic centimetre (f/cc), that triggers certain provisions as required by the applicable jurisdictional legislation. In many cases the action level is 50% of the established exposure limit.

2.2 **Air-purifying respirator** – A respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.

2.3 **Approved** – Equipment tested and listed by the Bureau of Mines, jointly by the Mining Enforcement and Safety Administration (MESA), and the National Institute for Occupational Safety and Health (NIOSH), or jointly by the Mine Safety and Health Administration (MSHA) and NIOSH. Please note Canadian Standards Association (CSA) bases respirator selection on NIOSH criteria for the testing and certification of respirators.

2.4 **Assigned protection factor (APF)** – The ratio of the ambient concentration of an airborne substance (outside the respirator) to the concentration of the substance inside the respirator.

2.5 **Atmosphere-supplying respirator** – A respirator that supplies the user with breathing air from a source independent of the ambient atmosphere, including supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units.

2.6 **Breakthrough** – The first perception of an odor, taste or irritation experienced while wearing an air-purifying respirator. Breakthrough is generally an indication that the cartridges are saturated and are no longer filtering out the contaminant. Breakthrough can also be an indication of an improperly functioning respirator.

2.7 **Established Exposure Limit** – The maximum regulatory exposure concentration to which an individual may be exposed to for an 8- hour time weighted average (TWA).

- This limit is referred to by different terminology depending upon the given jurisdiction (e.g. Permissible Exposure Limit (PEL), Contamination Limit, Occupational Exposure Limit (OEL), Threshold Limit Value (TLV), etc.).
- Acceptable methods of adjusting this limit to correspond to a different exposure period (e.g. 10 hours) vary by jurisdiction and substance.

2.8 **Filtering facepiece (dust mask)** – A negative pressure particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium.

2.9 **Fit factor** – A quantitative estimate of the fit of a particular respirator to a specific individual, typically estimating the ratio of the concentration of a substance in ambient air to its concentration inside the respirator when worn.

2.10 **Fit test** – The use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual. (See also Qualitative fit test [QLFT] and Quantitative fit test [QNFT].)

2.11 **Hazardous atmosphere** – Any atmosphere, either immediately or not immediately dangerous to life or health, that is oxygen-deficient or that contains a toxic or disease-producing contaminant exceeding the legally established permissible exposure limit or, where applicable, the Threshold Limit Value established by the American Conference of Governmental Industrial Hygienists.

2.12 **Immediately dangerous to life or health (IDLH)** – An atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere.

2.13 **Maximum use concentration (MUC)** – The maximum concentration of an airborne contaminant from which an employee is expected to be protected when wearing a respirator, determined by the assigned protection factor of the respirator or class of respirators and the occupational exposure limit for that contaminant. The MUC is usually determined mathematically by multiplying the assigned protection factor (APF) specified for a respirator by the established exposure limit, which can include a short-term exposure limit and a ceiling limit or any other exposure limit used for that chemical agent, as defined by the authority having jurisdiction.

MUC = APF x established exposure limit

2.14 **Negative pressure respirator (tight fitting)** – A respirator in which the air pressure inside the facepiece is negative during inhalation with respect to the ambient air pressure outside the respirator.

2.15 **Oxygen-deficient atmosphere –** An atmosphere with oxygen content below 19.5 percent by volume.

2.16 **Physician or other licensed health care professional (PLHCP)** – An individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide or be delegated the responsibility to provide some or all of the health care services required by local or governmental respiratory protection standards.

2.17 **Positive pressure respirator** – A respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.

2.18 **Powered air-purifying respirator (PAPR)** – An air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.

2.19 **Pressure demand respirator** – A positive pressure atmosphere-supplying respirator that admits breathing air to the facepiece when the positive pressure is reduced inside the facepiece by inhalation.

2.20 **Qualitative fit test (QLFT)** – A pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent.

2.21 **Quantitative fit test (QNFT)** – An assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.

2.22 **Self-contained breathing apparatus (SCBA)** – An atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

2.23 **Supplied-air respirator (SAR) or airline respirator** – An atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.

2.24 **Tight-fitting facepiece** – A respiratory inlet covering that forms a complete seal with the face.

2.25 **User seal check** – An action conducted by the respirator user to determine if the respirator is properly sealed to the face.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-114-PR1 Compressed Gases

3.3 S3AM-128-PR1 Medical Screening & Surveillance

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Respiratory Protection Program Administrator**

The Respiratory Protection Program Administrator will be established at each project/location where employees are required to wear respirators. The Respiratory Protection Program Administrator will:

- Verify full compliance with this procedure.
- Assist with the arranging of any required medical evaluations or any other additional medical attention related to the use of a respirator.
- Perform or arrange suitable providers to perform the program evaluations described in this procedure.
- Maintain required inspections and testing/certifications of SCBA units

4.1.2 **Manager /Supervisor**

- Verify compliance with the respiratory protection program set forth in this procedure.
- Verify that only those employees who are medically qualified, properly trained, and fit tested are assigned to respirator work.
- Verify that respirators are provided, repaired, or replaced as may be required due to wear and deterioration.
- Confirm that the emergency rescue service is available to respond prior to any employees entering the IDLH area.

4.1.3 **SH&E Manager (or designee)**

- Monitor compliance with the various aspects of this program.
- Provide technical assistance regarding respirator selection and use, evaluate the effectiveness of this program, and support respirator training and fit testing (e.g. determine cartridge change out schedule for negative air respirators).
- Audit company compliance with this procedure.

4.1.4 **Employee**

- Use respiratory protection in accordance with instructions and training received.
- Maintain the respirator in accordance with this procedure and the manufacturer's instructions.
- Immediately report any malfunction of the respirator to the Supervisor or Manager or other responsible person.
- For employees who wish to wear respirators on a voluntary basis when not required to by AECOM or a regulatory agency, the employee shall complete *S3AM-123-FM2 – Voluntary Use of Respirators* or an equivalent form.

4.2 Training

4.2.1 Employees who wear respiratory protection shall receive training before they are assigned to a task that requires the use of respiratory protection.

4.2.2 Employees that may be exposed to a respiratory hazard will be instructed on the hazard and the controls prior to beginning work.

4.2.3 Atmospheric testing will be carried out by qualified personnel trained in the use, calibration, and interpretation of the test equipment.

4.2.4 Retraining shall be administered annually, and when the following situations occur:

- Changes in the workplace or the type of respirator render previous training obsolete;
- Inadequacies in the Employee's knowledge or use of the respirator indicate that the Employee has not retained the requisite understanding or skill; or
- Any other situation arises in which retraining appears necessary to verify safe respirator use.

4.2.5 Basic Respirator Training Program

Respirator training classes will include, at a minimum, the following**:**

- Instruction in the nature of the respiratory hazards, whether acute, chronic, or both, and a description of potential health effects if the respirators are not used;
- Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator;
- The limitations and capabilities of the respirator;
- Proper fitting, including demonstrations and practice in wearing, adjusting, determining the fit of, and performing a user seal check each time respirator is donned. Refer to *S3AM-123-ATT1 Fit Testing Protocol*, *S3AM-123-FM1 Respiratory Equipment Fit Test* and *S3AM-123-ATT2 User Seal Check*;
- How to inspect, put on, use and remove the respirator;
- How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions;
- The procedures for maintenance and storage of the respirator;
- How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators; and
- The general requirements of local or governmental Respiratory Protection Standards.

4.3 Medical Surveillance

4.3.1 No Employee shall be assigned to a task that requires the use of a respirator unless it has been determined that he/she is physically able to perform the work while using the required respirator.

4.3.2 Prior to wearing a respirator and in accordance with the applicable jurisdictional requirements, Employees shall complete medical screening to identify any relevant psychological or physiological impediments to respiratory protection use. Screening may require an initial baseline medical surveillance examination, based on jurisdictional requirements or screening results, performed by a PLHCP in accordance with the requirements of *S3AM-128-PR1 Medical Screening & Surveillance Program.*

4.3.3 Additional medical examinations will be provided to employees who wear respirators when:

- An Employee reports medical signs or symptoms that are related to ability to use a respirator;
- A PLHCP, Supervisor, or the Respiratory Protection Program Administrator determines that an Employee needs to be reevaluated;
- Information from the Respiratory Protection Program, including observations made during fit testing and program evaluation, indicates a need for Employee reevaluation; or

- A change occurs in workplace conditions (e.g., physical work effort, protective clothing, temperature, etc.) that may result in a substantial increase in the physiological burden placed on an Employee.

4.3.4 All medical surveillance examinations shall be at no cost to the employee and occur during normal working hours; shall be convenient, understandable, and confidential; and the Employee will be given the chance to discuss results with examining physician.

4.4 Respirator Selection

4.4.1 The location or project specific SH&E Plan shall identify applicable respiratory hazards and develop appropriate controls, which may include respiratory protection. If respiratory protection is necessary the SH&E Plan shall detail the requirements.

4.4.2 SH&E Managers or his/her designated representative shall select and provide an appropriate respirator based on:

- The respiratory hazard(s) to which the employee may be exposed, including oxygen deficiency. Identify potential contaminants, concentrations, and the physical state of airborne contaminants:
    - Particulates (dust, fibers, micro-organisms, smoke, fumes).
        - Indicate the presence of any oil in particulate hazards. (may be produced by motor vehicles, air compressor systems using oil lubricators) If unknown, oil shall be assumed to be present.
    - Vapor and gases
        - Gases which may produce an oxygen deficiency (i.e. helium, argon, carbon monoxide and nitrogen).
        - Gases which are acids or produce acids when in contact with moisture (i.e. sulphur oxides, carbon dioxide, hydrogen chloride).
        - Gases which are alkaline or produce alkalis in reaction with moisture (i.e. ammonia, amines, phosphine).
        - True gases or vapors from evaporation of organic liquids (i.e. acetone, toluene, benzene).
        - Metal reacted with an organic compound (i.e. tetra-ethyl lead: was used in leaded fuel and still in aviation fuel, organic phosphates).
        - Mercury vapor.
        - Radon.
- The eye and face hazards to which the employee may be exposed (absorption, irritant, impact).
- Workplace or user factors that may affect respirator performance and reliability.

4.4.3 SH&E Managers or his/her designated representative shall identify and evaluate the respiratory hazard(s) in the workplace. Evaluations shall include a reasonable estimate of employee exposures to respiratory hazard(s) and an identification of the contaminant's chemical state and physical form.

4.4.4 Respiratory protection is required for those operations in which engineering controls or work practice controls are not feasible to reduce toxic or hazardous substance exposure at or below the AL (or if applicable, established exposure limit).

4.4.5 Where the employee exposure cannot be identified or reasonably estimated, the atmosphere shall be considered IDLH.

4.4.6 Only approved respirators shall be selected and they shall be used in compliance with the conditions of their certification.

4.4.7 Respirators shall be selected from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user.

4.5 Fit Testing Procedures

4.5.1 After the medical assessment is complete, employees using a tight-fitting respirator shall pass an appropriate QLFT or QNFT prior to initial use of the respirator, whenever a different respirator facepiece (size, style, model or make) is used, and at least annually (or as required by the applicable jurisdiction) thereafter. Refer to *S3AM-123-ATT1 Fit Testing Protocol*.

4.5.2 Fit testing shall be performed using the same make, model, style and size of respirator the user would be expected to use.

4.5.3 Should the fit test fail, alternative makes, models, styles and sizes shall be tested to find a correct fit for the user.

4.5.4 Respiratory protective equipment shall not be used unless a satisfactory fit test has been achieved for that particular equipment.

4.5.5 Fit testing shall also verify user competency in donning, doffing, inspecting and performing of seal checks.

4.5.6 Additional fit tests will be performed:

- Whenever there is an indication that changes in the Employee's physical condition might have an effect on respirator fit (such conditions include, but are not limited to, facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight);
- If the Employee notifies his/her Supervisor or SH&E Manager that the fit of his/her respirator is unacceptable.

4.6 Interference with Facepiece Seal

4.6.1 AECOM shall not permit respirators with tight-fitting facepieces to be worn by Employees who have:

- Facial hair that comes between the sealing surface of the facepiece and the face or that interferes with valve function; or
- Any condition that interferes with the face-to-facepiece seal or valve function.

4.6.2 If an employee wears corrective glasses or goggles or other personal protective equipment, the Supervisor or Manager shall confirm that such equipment is worn in a manner that does not interfere with the seal of the facepiece to the face of the user.

4.6.3 Employees shall perform a user seal check each time they don the respirator. Refer to *S3AM-123-ATT2 User Seal Check Procedures*.

4.7 Specification of Proper Level of Respiratory Protection

4.7.1 The SH&E Manager or his/her designated and qualified representative shall provide guidance on the proper selection and use of all respiratory protective devices, including half-face and full-face air purifying respirators, airline respirators, and self-contained breathing apparatus. This information is generally specified as part of the written site-specific SH&E plan and Task Hazard Assessment (THA).

4.7.2 Employees engaged in activities not covered by a THA or SH&E plan shall stop work and consult with the SH&E Manager or his/her designated representative to determine the proper equipment to use prior to resuming activities. Whenever appropriate, exposure levels will be measured to verify that the actual use conditions are within the limitations of the approvals specified by NIOSH/MSHA for the selected respirator.

4.8 Cartridges

4.8.1 NIOSH certifies three classes of filters*:

Three categories of resistance to filter efficiency degradation:	Three levels of filter efficiency:
N (**N**ot resistant to oil)	95% (called “95”)
R (**R**esistant to oil)	99% (called “99”)
P (oil **P**roof)	99.97% (called “100”)

*Filters are available in any combination of the above.

4.8.2 Generally cartridge color denotes the type of contaminant the cartridge was designed to filter:

Olive:	Multi-contaminant
White:	Acid gas
Black:	Organic vapors
Green:	Ammonia gas
Yellow:	Acid gas and organic vapors
Blue:	Carbon Monoxide
Purple (Magenta):	Radioactive material, except tritium & noble gases
Purple:	Any particulates - P100
Orange:	Any particulates - P95, P99, R95, R99, R100
Teal:	Any particulates free of oil - N95, N99, or N100

Please note; this is only a basic listing and should only be used as a reference. Combinations, deviations or additional types may be encountered. To ensure proper cartridge selection consult the cartridge supplier to ensure applicability to the contaminant(s) anticipated

4.8.3 Filter cartridges shall be changed out whenever an increase in breathing resistance is detected by the user.

4.8.4 When available, chemical cartridges that are equipped with end-of-service life indicators (ESLI) shall be utilized. In those cases, cartridges should be changed when indicated by the ESLI. A buddy system should be used so coworkers can monitor each other’s cartridge color condition.

4.8.5 In the absence of cartridges equipped with an ESLI, employees shall change chemical cartridges on the following schedule:

- Immediately if breakthrough is perceived or if resistance to breathing is detected by the user; and
- In accordance with the change out schedule based upon the anticipated contaminant concentration, environmental conditions, employee work rate, and the specific data provided by manufacturer.

4.8.6 When PAPRs are worn, the same rules apply with the exception that filter cartridges should be changed when airflow through the filter elements decreases to an unacceptable level, as indicated by the manufacturer’s test device.

4.9 Air-Supplying Respirator Use

4.9.1 Air-supplying respirators will be specified for use when it has been determined that any of the following conditions exist:

- The oxygen concentration is less than 19.5 percent;
- The contaminant is unknown or its concentration cannot be quantified;
- The airborne contaminant concentration is above its IDLH;
- An air-purifying respirator canister or cartridge that removes the contaminant is not available;
- The contaminant concentration is above the concentration for which an air-purifying canister or cartridge is approved; or
- The contaminant concentration is above the MUC of a full-face air-purifying respirator.

4.9.2 No Employee may engage in an operation requiring the use of an air-supplied respirator unless the SH&E Manager or his/her designated representative has reviewed the operation and approved its use.

4.9.3 The determination of the type of air-supplying respirator (i.e., SCBA, airline, demand, pressure demand, etc.) appropriate for the job, outside standby persons, communication, proper training and equipment, notification procedures, and necessary action should be part of the THA or SH&E Plan. Mandatory equipment including SCBA or SAR with auxiliary air supply and emergency appropriate retrieval equipment or equivalent rescue means shall be made by the SH&E Manager or his/her designated representative at the time of the THA or SH&E Plan review. The need for any additional precautions (i.e., equipment specific training, on-site health and safety support, etc.) shall also be determined by the SH&E Manager or his/her designated representative.

4.10 Minimum Procedures for IDLH Atmospheres

4.10.1 One Employee or, when needed, more than one Employee shall be located outside the IDLH atmosphere. This employee shall be responsible for communicating with the Employees in the IDLH atmosphere, alerting rescue services if needed, and restricting entrance to the IDLH area by untrained and unapproved persons.

4.10.2 Visual, voice, or signal line communication shall be maintained between the Employee(s) in the IDLH atmosphere and the employee(s) located outside the IDLH atmosphere.

4.10.3 The Employee(s) located outside the IDLH atmosphere shall be trained and equipped to provide effective emergency rescue or to initiate on-site rescue services.

4.10.4 If on-site rescue services are to be used, the Manager or Supervisor shall confirm that the service is available to respond prior to any employees entering the IDLH area.

4.10.5 Employee(s) located outside the IDLH area and/or on-site rescue services shall be equipped with:

- Pressure demand or other positive pressure SCBAs, or a pressure demand or other positive pressure supplied-air respirator with auxiliary SCBA; and either
- Appropriate retrieval equipment for removing the employee(s) who enter(s) these hazardous atmospheres where retrieval equipment would contribute to the rescue of the employee(s) and would not increase the overall risk resulting from entry; or
- Equivalent means for rescue where retrieval equipment would create a hazard to the Employees in the IDLH area.

4.11 Breathing Air

4.11.1 Compressed air used for respiration shall be of high purity and shall meet, as a minimum, the requirements of the specification for Grade D breathing air as described in Compressed Gas Association Specification G-7.1 (ANSI Z86.1).

4.11.2 Oxygen shall NOT be used as a source of breathing air at any time in open-circuit SCBAs or airline respirators.

4.11.3 Compressor Supplied Breathing Air

- All compressors used for filling SCBA air cylinders or for supplying airline respirators shall be equipped with the following safety and standby devices:
    - The compressor intake shall be located to verify that only respirable (uncontaminated) air is admitted. This requires attention to the location of the compressor intake with respect to compressor engine exhaust, chemical storage or use areas, and suitable intake screening or filtration.
    - Alarms to indicate compressor failure (such as low-pressure air horns, etc.) shall be installed in the system.
    - A receiver of sufficient capacity to enable the respirator wearer to exit from a contaminated atmosphere shall be provided.
- If an oil-lubricated compressor is used to supply breathing air, it shall be equipped with both of the following devices:
    - A continuous reading carbon monoxide monitoring system set to alarm should the carbon monoxide concentration exceed 10 parts per million; and,
    - A high temperature alarm which will activate when the discharge air exceeds 110 percent of the normal operating temperature in degrees Fahrenheit.
- An in-line purifying filter assembly to remove oil, condensed water, particulates, odors, and organic vapors shall be used in conjunction with the air compressor.

4.11.4 Compressed Air Cylinder Systems for Airline Respirators

- Compressed air cylinders shall meet the requirements of *S3AM-114-PR1 Compressed Gases*.
- Compressed air cylinder systems used to supply airline respirators shall be equipped with low pressure warning bells (e.g., Scott Pak-Alarm) or similar warning devices to indicate air pressure in the manifold below 500 pounds per square inch (psi). When such systems are used, one employee shall be assigned as safety standby within audible range of the low pressure alarm.
- Airline hose couplings shall be incompatible with outlets for other gas systems to prevent inadvertently supplying airline respirators with non-respirable gases or oxygen.
- The air pressure at the hose connection to airline respiratory equipment shall be within the range specified in the approval of the equipment by the manufacturer.
- Routine inspection and maintenance of the air compressor shall be performed.

4.11.5 Compressed Air Cylinder Systems for Recharging SCBAs

- When a cascade system is used to recharge SCBA air cylinders, it shall be equipped with a high-pressure supply hose and coupling rated at a capacity of at least 3,000 psi.

4.11.6 Escape/Egress Units

- Escape/egress unit respirators are intended for use in areas where escape with a short-term (minimum 5 minutes) air supply is necessary. It is important that escape bottle size be provided that will allow the employee to get to a safe location considering breathing rate and distance.
- Escape bottles are required on air-line respirators used in IDLH and high hazard work conditions.
- They may be used as adjuncts to airline pressure demand respirators as a backup air supply or as independent emergency devices in areas where respiratory protection is not normally required.

- Appropriate training shall be conducted and documented prior to assigning Employees to tasks or locations subject to the use of these respirators.
- Escape/egress units (minimum 5 minutes) shall never be used to enter a hazardous atmosphere or as primary standby respirators for confined space entry.

4.12 Respirator Inspection, Cleaning, Maintenance, and Storage

When respirator use is required, only properly cleaned and maintained NIOSH/MSHA approved respirators shall be used.

4.12.1 Inspection

- Respirators should be inspected before and after use using *S3AM-123-FM3 Respiratory Equipment Inspection*, or equivalent. The respirator should not be used and removed and marked out of service if any item on the checklist fails inspection.
- Respirators for emergency use should be inspected once per month.
- Defects shall be reported to their Supervisor or Manager. No defective respirator shall be issued or worn.

4.12.2 Cleaning and Maintenance

- Respirator facepiece assemblies shall be cleaned and sanitized minimally after each day of use in accordance with the requirements specified in *S3AM-123-ATT3 Respirator Cleaning*.
- The respirator should also be inspected for any damaged parts (repair should only be done by trained personnel with the proper tools).
- Respiratory equipment shall not be passed from one person to another until it has been cleaned and sanitized.
- Respiratory equipment shall be maintained according to manufacturer's instructions.
- In field situations, a pre-moistened towelette (e.g., baby wipes) can be used. The mask should then be rinsed with clean warm water and dried. Towelettes or wipes shall be compatible with the respirator materials.
- Alcohol should never be used to clean masks as it can damage the facepieces and rubber parts.
- Where respirators are assigned to individual employees, management shall verify compliance with cleaning and maintenance requirements by periodic inspection and field audits of respiratory equipment.

4.12.3 Storage

- Store clean respirators so that they are protected from dust, excessive moisture, damaging chemicals, temperature extremes and direct sunlight or UV light. They should be placed in a sealed plastic bag and stored in the original box or similar container which blocks light.

4.13 Hygiene

4.13.1 Employees shall leave the work area to wash, change cartridges, or if they detect breakthrough or resistance.

4.14 Costs

4.14.1 The costs for training, medical examinations, fit testing, respirators, spectacle kits, and cleaning materials should be considered as operational costs.

4.15 Program Evaluation

4.15.1 The SH&E Manager or his/her designated representative shall conduct evaluations of the workplace as necessary to verify that the provisions of the current written program are being effectively implemented and that it continues to be effective.

4.15.2 The SH&E Manager shall regularly (i.e., during annual training) consult Employees required to use respirators to assess their views on program effectiveness and to identify any problems. Any problems that are identified during this assessment shall be corrected. Factors to be assessed include but are not limited to:

- Respirator fit (including the ability to use the respirator without interfering with effective workplace performance);
- Appropriate respirator selection for the hazards to which the Employee is exposed;
- Proper respirator use under the workplace conditions the Employee encounters; and
- Proper respirator maintenance.

5.0 Records

5.1 Medical records under this section shall be maintained at a minimum in accordance with *S3AM-128-PR1 Medical Screening & Surveillance.*

5.2 Fit Test Records shall be maintained in the Employee's health and safety records. *S3AM-123-FM1 Respiratory Equipment Fit Test*, or equivalent, will be used to document each fit test.

5.3 Training Records shall be maintained in accordance with *S3AM-003-PR1 SH&E Training***.**

6.0 Attachments

6.1 S3AM-123-ATT1 Fit Testing Protocol

6.2 S3AM-123-ATT2 User Seal Check

6.3 S3AM-123-ATT3 Respirator Cleaning

6.4 S3AM-123-FM1 Respiratory Equipment Fit Test

6.5 S3AM-123-FM2 Voluntary Use of Respirators

6.6 S3AM-123-FM3 Respiratory Equipment Inspection

Americas

Underground Utilities

S3AM-331-PR1

1.0 Purpose and Scope

1.1 Provides procedures designed to help prevent injuries to personnel working on the location and pedestrians, property damage, and adverse environmental impact as a result of potential hazards associated with encountering underground utilities, subsurface installations, and potential overhead hazards.

1.2 Provides the minimum requirements to be followed for underground work (e.g., excavations, drilling, boring, and probing work) to ensure that underground installations, and subsurface structures, are identified properly before work commences.

1.3 This procedure applies to all Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

1.4 The Manager is responsible for meeting all the requirements in this procedure.

1.5 AECOM's clients may have specific procedures which shall be followed to identify and map utility and subsurface structures on their properties or facilities. Provided the client's procedures meet or exceed those of AECOM, approval shall be obtained from the Manager and the SH&E Manager to follow the client's procedures.

2.0 Terms and Definitions

2.1 **Underground Utilities –** All utility systems located beneath grade level, including, but not limited to, gas, electrical, water, compressed air, sewage, signaling and communications, etc.

2.2 **Clearance** – includes the following:

- The positive locating of underground utilities or subsurface installations in or near the work area.
- A signed statement by an appropriate representative attesting to the location of underground utilities and/or the positive de-energizing (including lockout) and testing of electrical utilities.

2.3 **Ground Disturbance (GD) –** Any indentation, interruption, intrusion, excavation, construction, or other activity in the earth's surface as a result of work that results in the penetration of the ground.

2.4 **Hand Clearance Zone –** The area on either side of the locate marks of a utility that shall be maintained in order to expose the utility through the use of non-destructive ground disturbance techniques acceptable to the owner of the buried utility. Visual exposure is required before mechanical excavation equipment may be used.

2.5 **Intrusive Activities –** Examples: Excavation of soil borings, installations of monitoring wells, installation of soil gas sampling probes, excavation of test pits/trenches or other man-made cuts, cavity, trench or depression in an earth surface formed by earth removal.

2.6 **Non-Destructive Ground Disturbance Technique –** A safe and acceptable excavation method that is used to visually expose an underground utility without causing damage. Non-destructive ground disturbance techniques may include, but are not limited to:

- Hand digging.
- Use of non-conductive tools.
- Hydro-vacuum.

2.7 **Subsurface Installation –** Examples: Subterranean tunnels, underground parking garages and other structures beneath the surface.

2.8 **Utility Strikes –** Unplanned contact with utilities resulting in damage to the utility or its protective coating.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-303-PR1 Excavation

3.3 S3AM-321-PR1 Drilling, Boring & Direct-Push Probing

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager**

- Administer this procedure and the development of the SH&E Plan.
- Confirm the appropriate equipment and materials are available to conduct the underground utility and/or subsurface installation clearance.
- Confirm all employees involved and affected by the task review the SH&E Plan and Task Hazard Assessment (THA) prior to work commencing
- Authorize work to proceed using the *S3AM-331-FM1 Underground Utility & Subsurface Installation Clearance Checklist*.
- Confirm that employees conducting underground utilities and subsurface clearance processes possess all required training, registrations or certifications.
- Provide authorization (with the concurrence of the Site Supervisor and SH&E Manager) for work to resume if interrupted due to unexpected conditions or events.

4.1.2 **Safety, Health & Environment (SH&E) Manager**

- Assist AECOM management as needed by providing guidance and clarification as to issues that may arise.
- Review the SH&E Plan to confirm compliance with jurisdictional regulations. Provide technical guidance as needed when a variance is pursued related to this procedure.

4.1.3 **Employees**

- Maintain training as appropriate to the work to be completed (e.g. ground disturbance, lockout tagout, equipment operation, etc.). Refer to *S3AM-003-PR1 SH&E Training*.
- Review the SH&E Plan and Task Hazard Assessment (THA) prior to work commencing.
- As appropriate to the anticipated or encountered hazards and as addressed in the applicable planning documentation, utilize appropriate personal protective equipment (PPE) and applicable training, practices and operating procedures.
- Immediately notify the Manager of any unanticipated conditions or events. If assigned equipment, perform appropriate inspections and confirmations of maintenance and/or repairs.

4.2 Training

4.2.1 All on-site employees involved with the underground utility and subsurface identification and associated clearance process shall be trained, at a minimum, in these procedures.

4.2.2 Employees shall complete all required training associated with their tasks in accordance with the SH&E Training Matrix and any training assessments developed at the business group.

- Refer to *S3AM-003-PR1 SH&E Training.*
- This training may include, but is not limited to, Excavation / Trenching (Ground Disturbance), HAZWOPER, Petroleum Safety Training (or Construction Safety Training), and H2S Alive as appropriate.

4.2.3 As applicable, employees shall receive client-required training.

4.3 Planning

4.3.1 Health and Safety Plan – At a minimum, a SH&E Plan and task hazard assessments (THAs) shall be prepared prior to any underground utilities and subsurface installations clearance activities.

- The SH&E Plan will address any required environmental monitoring including gas monitoring, dust, noise, metals, radiation or other monitoring as may be appropriate for site conditions.
- Employees shall comply with all SH&E Plan requirements.
- The location specific emergency response plan shall be in place, contain procedures applicable to the potential emergencies presented by the operations, and be reviewed with all personnel potentially affected.

4.3.2 *S3AM-331-ATT2 Underground Utilities & Subsurface Installation Clearance Flow Chart* provides a summary of the key requirements addressed in this procedure.

4.3.3 Underground utilities and subsurface installations shall be investigated as being present, including the following, but not limited to:

- Steam, gas and electric.
- Sewer and water.
- Subterranean tunnels.
- Fibre optics (note: routine geophysical surveys will not identify fibre optic cables).
- Traffic control cables.

4.3.4 Location of underground utilities and subsurface installations will be confirmed by cross-referencing available information:

- Maps, as-built drawings and issued for construction (IFC) drawings.
- Plot plans, permits, crossing/encroachment agreements.
- One-Call information, locator and provided surveys.
- Private utility information, locator and provided surveys (e.g. ground penetrating radar (GPR), electromagnetic, etc.).
- Owner supplied documentation.
- Site walks.

4.3.5 As applicable, emergency shut-off locations of utilities shall be verified before work activities commence.

4.3.6 Jurisdictional, land owner, client and utility owner requirements shall be consulted to determine the minimum search zone dimensions and appropriate clearance distances.

4.3.7 As necessary and if possible, adjust locations of excavations or intrusive subsurface work away from subsurface utilities and installations

4.3.8 Prior to any excavation or intrusive subsurface work, the *S3AM-331-FM1 Underground Utility & Subsurface Installation Clearance Checklist* shall be completed. The form shall be reviewed and signed by the Manager.

- If the answer to any question in Part 1 of the checklist is “No” or “N/A”, no ground disturbance may take place without review by the Manager, in consultation with SH&E Manager, of the circumstances related to the particular item. The Manager shall initial beside each “No” or “N/A” item to indicate review and authorization.

4.4 Permits, Notifications and Access Agreements

4.4.1 Any required notifications shall be provided within the appropriate timeframe to the applicable organization (e.g. owner, utility company, agency, governing body, etc.).

4.4.2 All applicable permits (e.g. client, government, working near rail road, etc.) will be identified, obtained, and adhered to.

4.4.3 All access agreements will be obtained and adhered to.

4.5 Locating Underground Utilities and Subsurface Installations

4.5.1 Utilize the appropriate call/click-before-you-dig provider. Refer to *S3AM-331-ATT1 One-Call System*.

4.5.2 Federal/State/Provincial/Territorial and other “One Call” providers shall be contacted at least two working days and no more than ten working days prior to commencing the ground disturbance. Jurisdictional requirements shall be consulted to verify the appropriate advance notice. (e.g. 24 hours, two full working days, three to ten business days, etc.).

4.5.3 If the location of proposed excavation or intrusive subsurface work cannot be clearly and adequately identified, the route and/or area of the proposed ground disturbance shall be identified using white flags, paint or stakes prior to the arrival of the locator. Consult jurisdictional requirements as white-lining may be a mandatory requirement on all ground disturbances.

4.5.4 One Call providers shall appropriately identify and mark the subsurface utilities or installations, or otherwise provide written notification they do not have any facilities near the proposed subsurface/intrusive locations.

4.5.5 Confirm all circuits were on during subsurface checks if the checks were for identifying energized lines (e.g. circuits on timers or light sensing switches).

4.5.6 Areas that have a high density of sub-surface facilities may require a secondary locate by another independent locator to verify locations identified by the first locator.

4.6 Private Utility Locating

4.6.1 One Call services may not be available in various non-urban locations. Private utility locating companies shall be utilized to identify and located any underground utilities or subsurface installations.

4.6.2 Be aware urban areas (e.g. city or town) may have subsurface installations (e.g. underground garages) and utilities (e.g. public water, sewer, and gas pipelines) that are not covered by one-call systems.

- These subsurface installations and utilities require additional investigation and diligence beyond the one-call system.
- Additional investigation and diligence beyond the one-call system is also recommended for non-urban areas.

4.6.3 In urban areas, private utility locating companies shall be called to identify and locate, through geophysical surveys and other means, the presence of private utilities installed by the property owner (e.g. irrigation systems) and to verify the presence of public utilities on the properties.

- Hand clearing is required in urban areas.

4.6.4 Hand clearing is also recommended for non-urban areas and may be required by the given jurisdiction.

4.6.5 Warning tape, pea gravel, sand, non-indigenous material, bentonite, red concrete (indicative of electrical duct banks) and any departure from native soil or backfill may be evidence of the presence of subsurface installations and utilities.

4.7 Surface Markings

4.7.1 Once the underground installation has been identified, proper surface markings shall be made in accordance with the guidelines from the One-Call System (refer to S3AM-331-ATT1), guidance contained in this procedure or as contract-specified.

4.7.2 Color-coded surface marks (paints or similar coatings) shall be used to indicate the type, location, and route of buried installations. Additionally, to increase visibility, color-coded vertical markers (temporary stakes or flags) shall supplement surface marks.

4.7.3 All marks and markers shall indicate the name, initials, or logo of the company that owns or operates the installation and the width of the installation if it is greater than 2 inches.

4.7.4 If the surface over the buried installation is to be removed, supplemental offset marking shall be used. Offset markings shall be on a uniform alignment and shall clearly indicate that the actual installation is a specific distance away.

4.7.5 Locate marks shall be re-verified as per jurisdictional requirements or no later than 14 days after the previous locate was completed, whichever interval is shorter. These locate time intervals shall be maintained for the duration of the ground disturbance.

- If the work is interrupted during the determined lifespan or work does not commence during the applicable lifespan, a new locate shall be performed.
- Jurisdictional provisions may allow for an extension to the lifespan of the locate marks, however certain conditions may need to be met. (e.g. activities uninterrupted)
- If locate marks are moved or destroyed the location of the buried facilities shall be re-established.

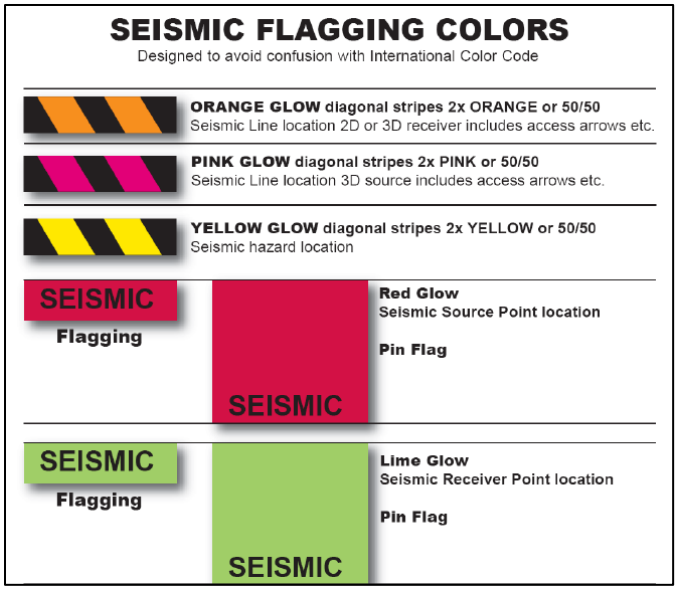
4.8 Uniform Color Coding

4.8.1 The colors and corresponding installation type are as follows unless otherwise contract-specified:

AMERICAN PUBLIC WORKS ASSOCIATION – APWA
Color Coding for Marking of Buried Facilities

White	Proposed Ground Disturbance Area
Pink	Temporary Survey Markings
Red	Electric Power Lines, Cables, Conduit and Lighting Cables
Yellow	Gas, Oil, Steam, Petroleum Lines or Gaseous Materials
Orange	Conduit, Cable, Communication, Alarm or Signal Lines
Blue	Potable Water
Green	Sewer, Storm Sewer and Drain Lines
Purple	Reclaimed Water, Irrigation and Slurry Lines (non-potable)

Canadian Association of Geophysical Contractors



4.9 Identification and Mapping of Utility and Subsurface Structures

4.9.1 The locations of subsurface utilities and subsurface installations shall be investigated, documented, and shown on a site plan (a scaled site plan shall be used when feasible). Refer to *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist.*

4.9.2 Documentation of utility and subsurface installation identification (calling one call, responses from utilities) along with the scaled site plan shall be available on the worksite at all times of intrusive activities.

4.10 Site Walk

4.10.1 A site walk shall be conducted by the AECOM Manager and any other appropriate personnel with the objectives of reviewing all planned intrusive activity locations, the locations of subsurface and overhead utilities, overhead obstructions, and the potential for subsurface installations, to determine the appropriate utility clearance activities, and to observe other physical hazards.

- Walk the area at least 50 feet (15.2 meters) from perimeter of the site to observe physical hazards.
- Walk the area of at least 50 feet (15.2 meters) radius from each proposed subsurface intrusion location.
- If possible, particularly at urban and industrial sites, the client/property owner or an individual knowledgeable about the site and site utilities will attend the site walk.
- Add discovered items/issues to map for use in location confirmation.

4.10.2 The Site Walk further supplements the Identification and Mapping of Utility and Subsurface Structures procedure. Site Walks should be repeated as necessary following the Identification and Mapping of Utility and Subsurface Structures as visual verification of the hazards. Examples include:

- Proposed location(s) does not lie on a line connecting two similar manhole covers (e.g. sanitary sewer or storm drain).
- Proposed subsurface location(s) has not subsided, been excavated and patched, nor gives the appearance it may be covering a former trench (e.g. linear cracks, sagging curbs, linear re-pavements, etc.).
- Proposed subsurface location(s) does not lie on a line with any water, gas, electrical meters, utility cleanouts, or other utility boxes in the surrounding areas.

4.11 Proposed Subsurface Investigation Locations

4.11.1 All proposed subsurface locations will be reviewed in comparison to subsurface and overhead utilities and subsurface installations and adjustments made as necessary.

4.11.2 Minimum set back distances from subsurface and overhead utilities and subsurface installations will be established including 5 feet (1.5 meters) from any subsurface utility, 7 feet (2.1 meters) from the pad surrounding any underground storage tanks, and 10 feet (3 meters) from any overhead energized electrical line (or further depending on line voltage). These set back distances are a minimum; government regulations and utility requirements may dictate a greater set back distance.

4.12 Utility Clearance Investigation Location Confirmation

4.12.1 As applicable, all client on-site safety procedures shall be understood and adhered to.

4.12.2 Hand exposure or non-destructive ground disturbance techniques to expose an underground utility or subsurface installation are necessary to accurately determine size, location and alignment prior to mechanical excavation or intrusive subsurface work in the vicinity of that utility or installation.

4.12.3 Non-destructive ground disturbance techniques shall be acceptable to the owner of the buried utility (i.e. hydro-vacuum temperature or pressure).

4.12.4 Hydro-vacuum or air-knife require proper grounding equipment at sites where the subsurface may contain flammable gases, liquids, or vapors

4.12.5 Jurisdictional, land owner, client and utility owner requirements shall be consulted to determine the distance of the hand exposure zone, and what requirements, when met, may allow mechanical excavation within these zones.

4.12.6 At a minimum, all underground utilities and subsurface installations within a 5 feet (1.5 meter) radius of the work site shall be identified and physically located (seen) before use of mechanical excavation equipment is permitted. Jurisdictional, client, land owner and utility owner requirements shall be consulted as the required hand exposure radius may be larger.

4.12.7 In urban areas, proposed subsurface locations will be hand cleared to 5 feet (1.5 meters) (soil borings and wells) or 12 inches (30 centimeters) (soil gas sampling probes) using non-mechanical methods.

- In non-urban areas, hand clearing should be conducted if possible and shall be conducted as required by the given jurisdiction.
- Hand clearance should be extended if locations of deep utilities and structures are not known.
- Hand exposure or non-destructive ground disturbance techniques should extend a minimum of 24 inches (60 centimeters) below the intended ground disturbance depth to minimize the hazard of mechanical equipment contact with any utility or installation.

4.12.8 Mechanical equipment and attachment dimensions shall be considered when establishing the zone in which all underground utilities and subsurface installations are physically located (seen) prior to the use of that equipment. The radius may require expanding to maintain safe distances when using large equipment.

4.13 Utility Strikes

4.13.1 Utility strikes shall be reported in accordance with *S3AM-004-PR1 Incident Reporting, Notifications & Investigation*.

4.13.2 All damaged utilities shall be repaired by a qualified and/or licensed professional.

5.0 Records

5.1 Retain completed *S3AM-331-FM1 Underground Utility & Subsurface Installation Clearance Checklist* and documents related the clearance process (e.g. Utility Owner communication, etc.) in the site or project files.

5.2 Documentation of employee training completed shall be retained in accordance with *S3AM-003-PR1 SH&E Training*.

6.0 Attachments

6.1 S3AM-331-ATT1 One-Call System

6.2 S3AM-331-ATT2 Underground Utilities & Subsurface Installation Flow Chart

6.3 S3AM-331-FM1 Underground Utility & Subsurface Installation Clearance Checklist

Americas

One-Call System

S3AM-331-ATT1

1.0 What Is It?

1.1 One-call systems are established across the Americas to provide one telephone number for excavating contractors and the general public to call for notification of their intent to use equipment for excavating, tunneling, demolition, or any other similar work. This one-call system provides the participating members an opportunity to identify and locate their underground facilities.

1.2 As described on their web site (http://www.call811.com), Common Ground Alliance (CGA) was "created specifically to work with all industry stakeholders in an effort to prevent damage to underground utility infrastructure and ensure public safety and environmental protection." CGA also serves as an organization to continuously update best practices amongst the growing underground industry. The CGA web site provides current one-call information for all states and provinces.

2.0 Why Is It Needed?

2.1 Damage to underground facilities increased considerably following the building boom of the 1950s, 1960s, and early 1970s when the trend was to go underground with utilities. Thousands of miles of underground facilities are vulnerable to excavating machines such as backhoes, and the resulting damage can interrupt utility service and threaten life, health, and property.

3.0 How to Get It

3.1 In the United States 811 is the Federally-mandated national "Call Before Your Dig" number that connects directly to the local one-call center. Each state has different rules and regulations governing digging, some stricter than others. The CGA web site provides current contact information to find state-specific information as well as links to submit an online digging request where available. Canadian one-call numbers vary by jurisdiction. One-call services are not available in Canada's Atlantic provinces (New Brunswick, Newfoundland, Nova Scotia) or in the three Northern Territories (Nunavut, Northwest Territories, Yukon).

4.0 Disclaimer

4.1 The purpose of this directory is to illustrate the extent of one-call service available. Some jurisdictions have a list of "Tier 1" subscriber utilities notified by 811, and a "Tier 2" list that the excavator/contractor is responsible for contacting directly. Users shall verify information is current including the extent and limit of service from local sources.

Province/State	One-Call Agency		Number
Canada	www.clickbeforeyoudig.com		
Alberta	Alberta One Call	www.albertaonecall.com	1.800.242.3447
British Columbia	BC One Call	www.bconecall.bc.ca	1.800.474.6886
Manitoba	Click Before You Dig	www.clickbeforeyoudigmb.com	Various – see website
Ontario	Ontario One Call	www.on1call.com	1.800.400.2255
Québec	Info Excavation	www.info-ex.com	1.800.663.9228
Saskatchewan	Sask 1st Call	www.sask1stcall.com	1.866.828.4888

United States	www.call811.com	811
Alabama	Alabama 811	1.800.292.8525
Alaska	Alaska Digline, Inc.	1.800.478.3121
Arizona	Arizona 811	1.800.782.5348
Arkansas	Arkansas One Call	1.800.482.8998
California	(North & Central) USA North 811	1.800.227.2600
	(South) Dig Alert	1.800.227.2600
Colorado	Colorado 811	1.800.922.1987
Connecticut	Call Before You Dig	1.800.922.4455
Delaware	Miss Utility of Delmarva	1.800.282.8555
District of Columbia	District One Call	1.202.265.7177
Florida	Sunshine 811	1.800.432.4770
Georgia	Georgia 811	1.800.282.7411
Hawaii	Hawaii One Call	1.866.423.7287
Idaho	Dig Line, Inc.	1.800.342.1585
	(Bonner/Boundary) Pass Word	1.800.626.4950
	(Kootenai County) Pass Word	1.800.428.4950
	(Shoshone-Benewah) Pass Word	1.800.398.3285
Illinois	(Chicago) Digger -Chicago Utility Alert Network	312.744.7000
	(Outside of Chicago) JULIE	1.800.892.0123
Indiana	Indiana 811	1.800.382.5544
Iowa	Iowa One Call	1.800.292.8989
Kansas	Kansas 811	1.800.344.7233
Kentucky	Kentucky 811	1.800.752.6007
Louisiana	LA One Call	1.800.272.3020
Maine	Dig Safe	1.888.344.7233
Maryland	(West of Chesapeake Bay) Miss Utility of Maryland	1.800.257.7777
	(East of Chesapeake Bay) Miss Utility of Delmarva	1.800.282.8555
Massachusetts	Dig Safe System, Inc.	1.888.344.7233
Michigan	Miss Dig	1.800.482.7171
Minnesota	Gopher State One Call	1.800.252.1166
Mississippi	Mississippi 811	1.800.227.6477

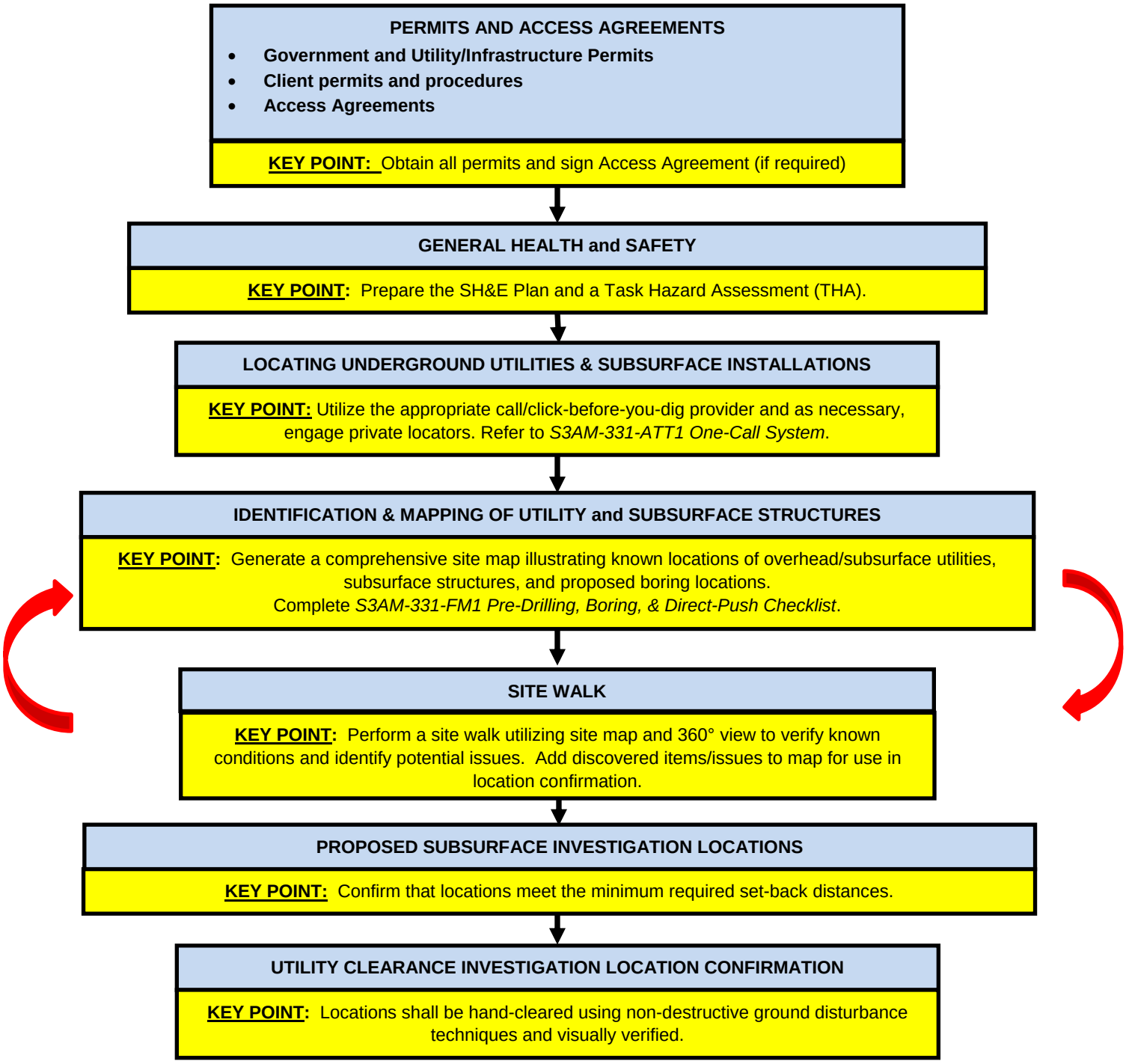
Missouri	Missouri One Call System	1.800.344.7483
Montana	Montana 811	1.800.424.5555
	(Flathead and Lincoln Counties) Montana One Call Center	1.800.551.8344
Nebraska	Nebraska 811	1.800.331.5666
Nevada	USA North 811	1.800.227.2600
New Hampshire	Dig Safe System, Inc.	1.888.344.7233
New Jersey	New Jersey One Call	1.800.272.1000
New Mexico	New Mexico 811	1.800.321.2537
New York	(North of 5 Boroughs) Dig Safely New York	1.800.962.7962
	(5 Boroughs and Long Island) New York 811, Inc.	1.800.272.4480
North Carolina	North Carolina 811	1.800.632.4949
North Dakota	North Dakota One Call	1.800.795.0555
Ohio	Ohio Utilities Protection Service	1.800.362.2764
Oklahoma	Call Okie	1.800.522.6543
Oregon	Oregon Utilities Notification Center	1.800.332.2344
Pennsylvania	Pennsylvania One Call System, Inc.	1.800.242.1776
Puerto Rico	Puerto Rico Public Service Commission 811	
Rhode Island	Dig Safe System, Inc.	1.888.344.7233
South Carolina	South Carolina 811	1.888.721.7877
South Dakota	South Dakota One Call	1.800.781.7474
Tennessee	Tennessee 811	1.800.351.1111
Texas	Texas 811	1.800.545.6005
	Lone Star 811	1.800.669.8344
Utah	Blue Stakes of Utah	1.800.662.4111
Vermont	Dig Safe System, Inc.	1.888.344.7233
Virginia	Virginia 811	1.800.552.7001
Washington	Utility Notification Center	1.800.424.5555
West Virginia	WV 811	1.800.245.4848
Wisconsin	Diggers Hotline	1.800.242.8511
Wyoming	One-Call Of Wyoming	1.800.849.2476

Americas

Underground Utilities & Subsurface Installation Clearance Flow Chart

S3AM-331-PR1

Before Any Underground Utilities and Subsurface Installation Clearance



Americas

Underground Utilities & Subsurface Installation Clearance Checklist

S3AM-331-FM1

Location:	Project #:	Date & Time:
Manager:	Contractor (if applicable):	Weather:
Client:	Inspector:	
Notes:		

Part 1

Part 1 and Part 2 shall be completed prior to any intrusive subsurface work. DO NOT DISTURB GROUND if a "No" or "N/A" answer to any of the Part 1 questions has not been initialed as authorized by the AECOM Manager.

Any variance from these procedures requires approval of the Vice President of the applicable business group.

		Yes	No	N/A
I.	**Permits and Access Agreements**			
1.	Have all appropriate permits and agreements been identified and obtained (e.g. client, drilling, encroachment, working near railroads, etc.)?	☐	☐	☐
2.	Have all client requirements been identified and obtained?	☐	☐	☐
3.	If working off-site is (are) site access agreement(s) executed?	☐	☐	☐
II.	**General Health and Safety**			
1.	Has a Health and Safety Plan (HASP) been prepared for AECOM employees?	☐	☐	☐
2.	Do on-site personnel have required-level PPE?	☐	☐	☐
3.	Do on-site personnel have required-level of training?	☐	☐	☐
4.	Is appropriate monitoring equipment as specified in HASP/THAs available at each clearance location?	☐	☐	☐
5.	Has the field screening equipment been calibrated as required by the HASP?	☐	☐	☐
6.	Are calibration gases available at the site?	☐	☐	☐
III.	**Identification and Mapping of Utility and Subsurface Structures**			
1.	Is a Site Plan showing proposed subsurface locations and utility locations attached to this check list?	☐	☐	☐
2.	Have above/below ground utilities & subsurface installations been investigated (Part 2 of this form)?	☐	☐	☐
3.	Have all Federal/State/Provincial/Territorial and other "One Call" providers marked their facilities or otherwise notified they do not have any facilities near the proposed subsurface/intrusive locations?	☐	☐	☐
4.	Have Federal/State/Provincial/Territorial or other "One Call" providers identified what utilities and underground structures are *not* included in their provider system (e.g. underground structures)?	☐	☐	☐
5.	As noted in the exception at the bottom of Section VI of this checklist, has a utility locating contractor performed geophysical and/or other surveys of the proposed subsurface/intrusive locations?	☐	☐	☐

Part 1 and Part 2 shall be completed prior to any intrusive subsurface work. DO NOT DISTURB GROUND if a "No" or "N/A" answer to any of the Part 1 questions has not been initialed as authorized by the AECOM Manager.

Any variance from these procedures requires approval of the Vice President of the applicable business group.

	Yes	No	N/A
6. Visual verification that each of the proposed locations does not lie on a line connecting two similar manhole covers (e.g. sanitary sewer or storm drain)?	☐	☐	☐
7. Visual verification that the ground in the vicinity of each of the proposed subsurface locations has not subsided, been excavated and patched, give the appearance it may be covering a former trench (e.g. linear cracks, sagging curbs, linear re-pavements, etc.) and does not lie on a line with any water, gas, electrical meters, utility cleanouts, or other utility boxes in the surrounding areas?	☐	☐	☐
IV. Site Walk			
1. Has a site walk been performed that includes the following:	☐	☐	☐
a. Reviewing all planned intrusive locations?	☐	☐	☐
b. Adjusting locations away from subsurface utilities and installations?	☐	☐	☐
c. Determining the appropriate utility clearance activities for each location?	☐	☐	☐
d. Determining the presence and location of overhead utilities and obstructions?	☐	☐	☐
e. Walk around perimeter of the site to observe physical hazards?	☐	☐	☐
f. Includes 50 feet (15.2 meters) from perimeter of the site to observe physical hazards and 50 feet (15.2 meters) radius from each proposed subsurface location?	☐	☐	☐
V. Proposed Subsurface Investigation Locations*			
1. Are all of the proposed subsurface locations at least 5 feet (1.5 meters) from any identified subsurface utility?	☐	☐	☐
2. Are all of the proposed subsurface locations at least 7 feet (2.1 meters) from the pad surrounding any underground storage tanks (USTs) shown on the Site Plan?	☐	☐	☐
3. Are all of the proposed subsurface locations at least 5 feet (1.5 meters) from any subsurface utilities shown on the Public Right-of-Way street improvements?	☐	☐	☐
** These set back distances are a minimum; government regulations and utility requirements may dictate a greater set back distance.*			
VI. Utility Clearance Investigation Location Confirmation*			
1. Have the hand clearance / tolerance zones of subsurface locations been observed and utilities exposed through the use of non-destructive techniques as follows? Hand / non-destructive technique clearance should be extended if locations of deep utilities and structures are not known. In non-urban areas hand clearing should be conducted if possible and according to local requirements.	☐	☐	☐
a. For soil borings/monitoring wells; excavated to a minimum of 5 feet (1.5 meters) below ground surface using non-mechanical methods?	☐	☐	☐
b. For soil gas sampling; excavated to 2 foot (0.6 meter) below grade or below the bottom of a concrete floor prior to the installation of soil gas sample probe points?	☐	☐	☐

** Exceptions to requirements of the utility clearance process, as permitted by the applicable jurisdiction, include the following:*

- *Sites where extensive utility mapping (e.g. geophysical survey) has been completed and/or where extensive activities have already been performed.*
- *Locations where facility layout is well documented and understood.*
- *Sites or portions of large sites where utilities are known not to exist currently or to not have ever existed throughout the life of the facility, property or site.*

Part 1 and Part 2 shall be completed prior to any intrusive subsurface work. DO NOT DISTURB GROUND if a "No" or "N/A" answer to any of the Part 1 questions has not been initialed as authorized by the AECOM Manager. *Any variance from these procedures requires approval of the Vice President of the applicable business group.*	**Yes**	**No**	**N/A**
Comments:			
Documentation supplied by one-call or private utility and installation locators, including email or written field confirmation / maps of mark-out requests and status shall accompany this form. If this form is supporting multiple ground disturbance activities, a copy of this completed form should be provided to each activity.			

Part 2

Public Utility Locate (OneCall) Prior Locate Ticket #					
Date Called:		Called By:		Valid Until:	
Ticket Number:		Area Requested To Be Cleared:			

Private Utility Locate Prior Locate Ticket #			
Company Performing Locate:		Date Completed:	
Area(s) Requested To Be Cleared (including distance around marked locations):			
Method(s) Used (e.g., GPR, EM):			
Confirm Area(s) Cleared:			

OneCall Utilities			**Field Observation**
Utility	**Notified by**	**Comments**	**Marked** (mains & services)
Electric (Red)	☐ OneCall ☐ Other		☐ Yes ☐ No ☐ Above
Gas/Petroleum Pipeline (Yellow)	☐ OneCall ☐ Other		☐ Yes ☐ No
Sewer/Drainage (Green)	☐ OneCall ☐ Other		☐ Yes ☐ No
Water (Blue)	☐ OneCall ☐ Other		☐ Yes ☐ No
Communications (Orange)	☐ OneCall ☐ Other		☐ Yes ☐ No ☐ Above
Other	☐ OneCall ☐ Other		☐ Yes ☐ No ☐ Above
Were all circuits on during subsurface checks if the checks were for identifying energized lines (e.g., circuits on timers or light sensing switches)?			☐ Yes ☐ No ☐ N/A

Utilities Not Identified By OneCall (Includes both Public and Private along with Regional and Site Utilities)			**Field Observation**
Utility (Colors may vary)	**Owner / Contact / Phone #**	**Notified**	**Marked**
Communications: (Orange) TV, computer, phone, cell towers, site communication, cameras, security, etc.		☐Yes ☐No	☐ Yes ☐ No ☐ Above
Electricity: (Red) Mains / Supplies / Interior / Exterior (signs, fuel pumps, low voltage security perimeters, gates, property light posts, equipment, substations, etc.)		☐Yes ☐No	☐ Yes ☐ No ☐ Above
Gas: (Yellow) Mains / Supplies / Equipment / Pipelines (Natural, Process, Oil, Crude, Refined (Gas, Diesel, Jet), etc.)		☐Yes ☐No	☐ Yes ☐ No ☐ Above
Steam: (Yellow)		☐Yes ☐No	☐ Yes ☐ No ☐ Above

Structures: Possible horizontally installed facilities, vaults, basements, tunnels, sub-grade structures, foundations, overhead obstructions, etc.		☐Yes ☐No	☐ Yes ☐ No ☐ Above
UST Systems (Tanks / piping / electric)		☐Yes ☐No	☐ Yes ☐ No
Sewer: (Green) Sanitary, storm, combined, septic, drainage (parking, buildings, fields), irrigation		☐Yes ☐No	☐ Yes ☐ No
Water: (Blue) Process, Plant, potable, well, cooling, return/makeup, fire, sprinkler, landscape irrigation, reclaim (Purple) other		☐Yes ☐No	☐ Yes ☐ No ☐ Above
Other: Abandoned lines, invisible dog fences, shopping cart perimeter monitoring, traffic lights		☐Yes ☐No	☐ Yes ☐ No ☐ Above

Manager: _____ _____ _____

Print Sign Date

Americas

Wildlife, Plants & Insects

S3AM-313-PR1

1.0 Purpose and Scope

1.1 Communicates the requirements and precautions to be taken by AECOM employees to protect against the biological hazards associated with insects, arachnids, snakes, poisonous plants, and other animals referred to herein collectively as “biological hazards”.

1.2 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document’s content.

2.0 Terms and Definitions

2.1 **Field Work –** Any activity conducted at a site that contains brush, overgrown grass, leaf litter, poisonous plants, or is located near mosquito breeding areas and includes work in structures where animals might exist that harbor fleas or ticks or where spiders and mites could be present. Field work includes, but is not limited to, Phase I, Phase II, Operations Monitoring & Maintenance, biological surveys, and other work that meets the definition of field work.

2.2 **Poisonous** – Capable of harming or killing by or as if by poison; toxic or venomous.

2.3 **Phase I Environmental Site Assessment –** Investigation of real property to determine the possibility of contamination, based on visual observation and property history, but no physical testing. Under new Environmental Protection Agency regulations that went into effect on November 1, 2006, a Phase I, as it is called for short, will be mandatory for all investors who wish to take advantage of Comprehensive Environmental Response, Compensation, and Liability Act defenses that will shield them from liability for future cleanup, should that prove necessary. The new Phase I rules, called “All Appropriate Inquiry” or AAI, also require more investigation than previously mandated. Investors can expect to see dramatic price increases over prior experiences.

2.4 **Phase II Environmental Site Assessment** – Investigation of real property through physical samplings and analyses to determine the nature and extent of contamination and, if indicated, a description of the recommended remediation method.

3.0 References

3.1 RS2-001-PR1 Firearms Standard

3.2 S3AM-004-PR1 Incident Reporting, Notifications & Investigation

3.3 S3AM-008-PR1 Fitness for Duty

3.4 S3AM-113-PR1 Heat Stress

3.5 S3AM-208-PR1 Personal Protective Equipment

3.6 S3AM-209-PR1 Risk Assessment & Management

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Managers / Supervisors**

- Responsible for managing field work.

- Work with employees to see that a Task Hazard Analysis (THA) for the work to be conducted has been performed prior to the beginning of the field work and that it includes an assessment of potential biological hazards.
- Implement control measures at the location to reduce the potential for employees to be exposed to injuries and illnesses from biological hazards while working.
- If the exposures cannot be eliminated or managed with engineering controls, approve the use and cost of Personal Protective Equipment (PPE) and protective repellents and lotions and confirm that exposed employees have and use these products.

4.1.2 **SH&E Manager**

- Confirm training and guidance is provided to employees consistent with this procedure.
- During the performance of site visits, assess the precautions being taken against biological hazards for compliance with this procedure.
- Assist AECOM personnel in identifying hazards and selecting appropriate control measures.
- As applicable, review and approve relevant SH&E Plans for locations that have biological hazards.

4.1.3 **Employees**

- Participate in required training related this procedure.
- Participate in the development of THAs for the task, identify control measures to limit exposure and request PPE, repellents, and protective lotions identified by this procedure.
- Update the applicable THA when a new, unaccounted for biological hazard is identified. Employee shall stop work to identify appropriate elimination or control measures (and obtain any necessary guidance) before continuing work.
- Obtain approval from Managers and/or Supervisors to purchase selected PPE prior to purchasing.
- Implement the precautions appropriate to prevent exposure to the hazardous wildlife, insects and plants.
- Observe requirements for reporting (e.g. tick bites, skin irritations, etc.) as detailed within the procedure and attachments.

4.2 Training

4.2.1 Employees shall be trained to recognize organisms that represent a threat in the regions in which they work – experienced field staff shall provide on the job training to assist staff with hazard recognition.

4.2.2 Employees shall be properly trained to the anticipated tasks and the associated required PPE.

4.3 Overview

4.3.1 The procedures discussed below are detailed because these hazards have historically posed the most significant risk to AECOM employees. Note that this discussion is not a fully encompassing list of hazards. As part of the SH&E Plan and THA developed by the AECOM personnel, in accordance with *S3AM-209-PR1 Risk Assessment & Management*, additional consideration shall be given to other biological hazards.

4.3.2 Departments of Public Health local to the worksite, as well as the Centers for Disease Control (CDC) can serve as a resource for identifying biological hazards not discussed in this procedure.

4.3.3 If additional biological hazards are identified, employees should stop work and contact the SH&E Manager to discuss the hazards and identify effective control measures. Those control measures shall be implemented at the location prior to restarting work.

4.4 Employee Sensitivity

4.4.1 Sensitivity to toxins generated by plants, insects and animals varies according to dosage and the ability of the victim to process the toxin; therefore, it is difficult to predict whether a reaction will occur, or how severe the reaction will be. Employees should be aware that there are a large number of organisms capable of causing serious irritations and allergic reactions. Some reactions will only erupt if a secondary exposure to sunlight occurs. Depending on the severity of the reaction, the result can be severe scarring, blindness or even death.

4.4.2 Employees also need to consider whether they are sensitive to the use of insect repellents.

4.5 Planning and Hazard Assessment

4.5.1 AECOM personnel shall confirm that the potential for exposure to specific biological hazards are assessed prior to the commencement of work and that the procedures specified by this procedure are integrated into the THA planning process and conveyed to employees conducting the field work. This information shall be communicated in the location-specific SH&E plan, the THA, pre-project kickoff meetings, and tailgate meetings at the location.

4.5.2 It is important to note that the precautions to be taken by employees to decrease the risk of exposure to biological hazards can directly increase the risk of heat-related illness due to thermal stresses. Therefore, heat stress monitoring and precautions shall be included as a critical component of the task-specific THA in accordance with *S3AM-511-PR1 Heat Stress.*

4.5.3 During the preparation of the location-specific SH&E plan and task specific THA, Managers, Supervisors, and employees shall determine what biological hazards might be encountered during the task or operations and shall prescribe the precautions to be taken to reduce the potential for exposure and the severity of resulting illnesses. Consideration will be given to conditions such as weather, proximity to breeding areas, host animals, and published information discussing the presence of the hazards.

4.5.4 It should be assumed that at least one of the biological hazards exists whenever working on undeveloped property. This can include insect activity any time that local temperatures exceed 40 degrees Fahrenheit (4.5 degrees Celsius) for a period of more than 24 hours. The stubble and roots of poisonous plants can be a hazard any time of year, including when some plants are dormant or mown.

4.5.5 The hazard assessments shall also consider the additional hazards posed by vegetative clearing such as the increased risk of coming in contact with poison ivy, oak or sumac and hazards associated with the use of tools and equipment to remove vegetation.

4.5.6 Employees in the field where biological hazards exist shall not enter the hazard areas unless they are wearing the appropriate protective clothing, repellents, and barrier creams specified below. If the hazard is recognized in the field but was not adequately assessed during the THA, the field staff shall stop work and not proceed until the THA has been amended and approved and protective measures implemented.

4.5.7 Employees who have severe allergic reactions are strongly recommended to notify their Manager, field Supervisor and co-workers of the potential for a reaction and demonstrate what medication they might need, where they keep it and how it is administered.

4.5.8 A decision flow chart and table for determining the potential for biological hazards in the Americas has been provided in *S3AM-313-ATT1 Biological Hazard Assessment Flow Chart.*

4.5.9 Restrictions:

- No firearms or weapons are allowed to be used without express permission by the Region Executive and Chief Resilience Officer, refer to the *RS2-001-PR1 Firearms Standard*.
- No weapons related work shall occur without an assessment that includes appropriate hazard control measures and training.

- Staff with life-threatening reactions shall not undertake work in areas infested with the allergen (e.g., wasps, poison ivy), unless precautions are met which satisfy a medical practitioner's requirements. Refer to *S3AM-008-PR1 Fitness for Duty*.

4.5.10 Precautions

- Be aware of the potential irritants in your area and know how to recognize them.
- Modify activities to avoid encounters (diurnal rhythms, seasonal rhythms).
- Avoid wearing perfume and cologne and strong smelling deodorants, lotions, soaps, and shampoos.
- When working in areas where there may be small insects that "hitchhike" (e.g., ticks, spiders, scorpions), it is recommended that clothes are turned inside out and shaken at the end of day; do not wear same clothes two days in a row.
- Staff should always be aware of where they are placing their hands, or where they are sitting in order to avoid contact with potential toxins. Avoid reaching into areas where visibility is limited.

4.6 Wildlife Hazards (Wild Animals, Reptiles and Birds)

4.6.1 Employees shall not work alone in areas where the risk of an encounter with dangerous wildlife is high. Wildlife handling shall only be completed under direct supervision of an experienced individual. Refer to the following work instructions for more specifics:

- *S3AM-313-ATT13 Alligators*
- *S3AM-313-ATT9 Large Carnivores & Ungulates*
- *S3AM-313-ATT10 Bear Safety*
- *S3AM-313-ATT11 Small Mammals*
- *S3AM-313-ATT12 Snakes & Scorpions*

4.7 Ticks, Spiders and other Insects

4.7.1 Insects for which precautionary measures should be taken include but are not limited to: mosquitoes (potential carriers of disease aside from dermatitis), black flies, wasps, bees, ticks, fire ants and European fire ants.

4.7.2 Employees with known allergies to insect stings should consult their personal physician for advice on any immediate medications that they should carry with them. Epi-pens[1] shall be carried at all times in the field by employees who are aware that anaphylactic shock is a possibility for them AECOM highly recommends that employees with known allergies inform their co-workers of the allergy and the location of the medications they might carry for the allergy.

4.7.3 Habitat Avoidance, Elimination and/or Control

- The most effective method to manage worker safety and health is to eliminate, avoid and/or control hazards. Clearing the location of brush, high grass and foliage reduces the potential for exposure to biological hazards. Clearing will not eliminate the exposure to flying insects and there might be an increased exposure to ticks and spiders during the clearing process.
- Projects such as subsurface environmental assessment or remediation are often candidates for brush and overgrown grass to be cleared. In these instances, the Manager shall either request that the client eliminate vegetation, or request approval from the client to have vegetation clearing added to the scope of work.
    - It should be noted that vegetation clearance may unintentionally serve to spread noxious and poisonous plant materials around the site.

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[1] Epi-pens must be prescribed by a personal physician. Renew epi-pens on a regular schedule to ensure effectiveness and make sure your field companions know where it is and how to use it if you cannot self-administer the dose.

- As applicable, measures should be taken to prevent spread, such as but not limited to, confirming equipment and materials are not placed on affected areas, and equipment is decontaminated after use and before removal from site.

- When work shall be conducted in areas that cannot or may not be cleared of foliage, personal precautions and protective measures shall be prescribed.
- Mosquitoes breed in stagnant water and typically only travel a quarter mile (less than half a kilometer) from their breeding site. Whenever possible, stagnant water should be drained to eliminate breeding areas. Managers and client site managers should be contacted to determine whether water can be drained and the most appropriate method for draining containers, containment areas, and other objects of standing water.
- If water cannot be drained, products similar to Mosquito Dunks® can be placed in the water to control mosquitoes. Once wet, the Mosquito Dunks® kill the immature, aquatic stage of the mosquito. The active ingredient is a beneficial organism that is lethal to mosquito larvae, but harmless to fish, humans, and other animals. Mosquito Dunks® provide long-term protection for 30 days or more.

4.7.4 Ticks

- Ticks can be encountered when walking in tall grass or shrubs. They crawl up clothing searching for exposed skin where they will attach themselves. The most serious concern is a possibility of contracting a disease.
- Data from the CDC indicates that tick-borne diseases have become increasingly prevalent. At the same time, tick repellents have become both safe and effective so it is possible to prevent the vast majority of bites and, therefore, most related illnesses. The use of permethrin is strongly advised.
- The most common and severe tick-borne illnesses in the U.S. are Lyme disease, Ehrlichiosis, and Rocky Mountain spotted fever. A summary table listing CDC informational resources for these diseases is provided in *S3AM-313-ATT2 Ticks* along with a listing of CDC information resources and maps showing the distribution of common tick-borne diseases in the U.S.
- When working in areas where ticks may occur, it is recommended that clothes are turned inside out and shaken at the end of day; do not wear the same clothes two days in a row.
- Employees should conduct a thorough full body tick check upon exiting the field. Shower within two hours of coming indoors to help wash away loose ticks. Clothes should be laundered in hot water or tumble dry clothes in a dryer on high heat for 10 minutes to kill ticks.
- To remove ticks that are embedded in skin, utilize a tick key. Alternatively use tweezers or fingers to carefully grasp the tick as close to the skin as possible and pull slowly upward, avoiding twisting or crushing the tick. Do not try to burn or smother the tick. Cleanse the bite area with soap and water, alcohol, or household antiseptic. Note the date and location of the bite and save the tick in a secure container such as an empty pill vial or film canister. A bit of moistened paper towel placed inside the container will keep ticks from drying out. Follow AECOM incident reporting guidelines to report the tick bite within 4 hours and notify the Manager or Supervisor.
- Familiarize yourself with the characteristic bulls-eye pattern of Lyme disease infection surrounding the bite. If you notice this type of pattern or rash resulting from a tick bite, immediately report the issue to your supervisor and follow the incident reporting requirements for your business group.
- If you experience symptoms such as fever, headache, fatigue, and a skin rash, you should immediately visit a medical practitioner as Lyme disease is treated easily with antibiotics in the early stages, but can spread to the heart, joints, and nervous system if left untreated.

4.7.5 Chiggers

- Chiggers are mite larvae, approximately ½ millimeter in size, and typically invisible to the naked eye. While chiggers are not known to carry infectious diseases, their bites and resulting rashes and itching can lead to dermatitis and a secondary infection.
- Chiggers are typically active from the last hard freeze in the winter or spring to the first hard freeze. They are active all year in the Gulf Coast and tropical areas.

4.7.6 Spiders

- Spiders can be found in derelict buildings, sheltered areas, basements, storage areas, well heads and even on open ground. Spiders can be found year round in sheltered areas and are often present in well heads and valve boxes.
- Most spider bites produce wounds with localized inflammation and swelling. The Black Widow and Brown Recluse spiders in the U.S. and others outside the U.S. inject a toxin that causes extensive tissue damage and intense pain.
- Additional information on spider identification can be found in attachment *S3AM-313-ATT3 Poisonous Spider Identification*.

4.7.7 Mosquitoes

- When a mosquito bites, it injects an enzyme that breaks down blood capillaries and acts as an anticoagulant. The enzymes induce an immune response in the host that results in itching and local inflammation. The tendency to scratch the bite sites can lead to secondary infections.
- CDC data indicates that mosquito-borne illnesses, including the strains of encephalitis, are a health risk. At least one of the Encephalitis strains listed below is known to exist in every area of the U.S. and in many other countries as well:
    - Eastern Equine encephalitis
    - Western Equine encephalitis
    - West Nile Virus
    - St. Louis encephalitis
    - La Crosse encephalitis
- Mosquitoes can transmit the West Nile Virus and other forms of encephalitis after becoming infected by feeding on the blood of birds which carry the virus.
- Most people infected with the virus experience no symptoms or they have flu-like symptoms. Sometimes though, the virus can cause severe illness, resulting in hospitalization and even death, so proper precautions should be taken. Consult a medical practitioner if you suspect you have West Nile Virus. Other diseases including Dengue Fever and Malaria are spread by mosquitoes in the sub-tropic and tropical parts of the world. See *S3AM-313-ATT4 Mosquito Borne Diseases* for information on the locations where mosquito borne diseases are known to be present.

4.7.8 Bees, Wasps and Hornets

- Wasps and bees will cause a painful sting to anyone if they are harassed. They are of most concern for individuals with allergic reactions who can go into anaphylactic shock. Also, instances where an individual is exposed to multiple stings can cause a serious health concern for anyone. These insects are most likely to sting when their hive or nest is threatened.
- Bees, hornets, and wasps may be found in derelict buildings, sheltered areas, behind covers or lids and even on open ground. Other protective measures are not normally effective against aggressive, flying insects. Be aware of the potential areas for these types of insects, approach these locations cautiously. Avoid reaching into areas where visibility is limited.
- If you see a nest in the area you are working in stop work. Contact the Manager or Site Supervisor for procedures to have the nest removed.

- If stung by a wasp, bee or hornet, notify a co-worker or someone who can help should you have an allergic reaction. Stay calm and treat the area with ice or cold water. Follow AECOM incident reporting guidelines to report the sting within 4 hours and notify the Manager or Supervisor immediately. Seek medical attention if you have any reactions to the sting such as developing a rash, excessive swelling or pain at the site of the bite or sting, or any swelling or numbness beyond the site of the bite or sting.

4.7.9 Fire Ants

- The fire ant (southern and western U.S.) and the European fire ant (northeastern U.S. and eastern Canada) is often very abundant where it is established. It is very aggressive and commonly climbs up clothing and stings unprovoked when it comes into contact with skin. Painful irritations will persist for an hour or more.

4.7.10 Personal Protective Equipment (PPE)

- Chemically-treated field clothing, full-length clothing, or Tyvek® coveralls.
- Gloves shall also be worn consistent with the recommendations of the site-specific SWP and/or THA to minimize hand exposure.
- Where ticks, chiggers, and spiders are presumed to exist, the Tyvek® or chemically treated clothing will be taped to the work boots.
- See *S3AM-313-ATT2 Ticks* for configuration of clothing for protection against ticks and insects.
- Application of insect repellent to clothing and/or exposed skin. Oil of lemon eucalyptus, DEET, and Permethrin have been recommended by the CDC for effective protection against mosquitoes that may carry the West Nile virus and related diseases.
- Note that DEET will reduce the effectiveness of Fire Resistance Clothing (FRC) and should not be applied to this clothing. If working in FRC, employees can use Permethrin as it has been shown not to reduce the effectiveness of FRC. Permethrin will need to be applied to FRC well in advance of the planned work. If permethrin is unavailable employees can apply DEET to their skin and let dry prior to putting FRC on.
    - Oil of Lemon Eucalyptus is a plant-based insect repellent on the market as Repel Lemon Eucalyptus. The products have been proven to be effective against mosquitoes, deer ticks, and no-see-ums for up to six hours. Derived from Oil of Lemon Eucalyptus, this non-greasy lotion or spray has a pleasant scent and is not known to be toxic to humans. The spray or lotions will be effective for approximately two to six hours and should be reapplied every two hours to sustain protection. Lemon Eucalyptus products cannot be applied to fire retardant clothing.
    - Permethrin is an insecticide with repellent properties registered with the Environmental Protection Agency and recommended by the CDC.
        - Permethrin is highly effective in preventing tick bites when applied to clothing, but is not effective when applied directly to the skin. Two options are available for Permethrin treatment of clothing worn during field work: 1) pre-treatment of fabric by the clothing manufacturer; or 2) manual treatment of their personal clothing using Permethrin spray in accordance with recommendations manufacturers recommendations. This will likely require treatment at home or the office prior to field mobilization. Caution should be used when applying Permethrin as it is highly toxic to fish and house cats. AECOM strongly recommends the first option (employees obtaining pre-treated clothing) to avoid the time required, potential risk, and housekeeping issues involved with manually treating the clothing with spray. Purchase pre-treated clothing in accordance with *S3AM-208-PR1 Personal Protective Equipment* and with the approval of your Supervisor or Manager.
        - The Permethrin pre-treatment is odorless and retains its effectiveness for approximately 25 washings. After 25 washings, the pre-treated clothing will be

considered no longer effective and removed from service. Clothing that has been manually treated by employees will be considered effective for five wash cycles.

- Also, use of clothing that has been pre-treated with Permethrin offers a reduction in the use and application of other insect repellents that shall be applied directly to the skin. Supervisor or Manager approval is required prior to purchase.
- If the employee opts not to utilize chemically pre-treated clothing while potentially exposed to insects, spiders and/or ticks, they shall either: 1) wear Tyvek® coveralls taped to the boots, or 2) wear full-length clothing consisting of long-legged pants and long-sleeved shirts treated with an insect repellent containing Permethrin, DEET, or an oil of lemon eucalyptus to their work clothing.
- Safety Data Sheets (SDS) for the repellents, lotions, and cleansers discussed in this Procedure are not required because the repellents, lotion, and clothing are consumer products used in the manner intended for the general public. Although not required, a SDS should be obtained for the products used and placed into the office SDS library and site-specific safety plan.

4.8 Poisonous Plants

4.8.1 Habitat Avoidance, Elimination and/or Control

- If poisonous plants are identified in the work area, employees will mark the plants using either flags or marking paint, and discuss what the specific indicator will be to signal to other employees to avoid the designated area. If employees decide to use ground-marking paint to identify poisonous plants, they should discuss this tactic with the Manager (and Client as appropriate) for approval.
- If removal of the plants is considered, it should be subcontracted to a professional landscaping service that is capable and experienced in removing the plant. If herbicides are considered for use, a discussion shall need to occur with the Manager (and Client as appropriate) to determine whether it is acceptable to apply herbicides at the work site. Application of herbicides may require a license.
- Employees shall not attempt to physically remove poisonous plants from the work area unless a clearing procedure, including PPE, is prepared in advance and approved by the SH&E Manager. The clearing procedure should be included in the SH&E Plan and THA and the required PPE specified.

4.8.2 Poisonous plants that employees should recognize and take precautions to avoid include: poison sumac, poison ivy (terrestrial and climbing), poison oak, giant hogweed[2] (or giant cow parsnip), wild parsnip, devil's club and stinging nettle. Many others are extremely poisonous to eat (e.g., poison hemlock; water parsnip) – do not eat anything that has not been identified. Refer to *S3AM-313-ATT5 Plants of Concern* for information on locations where some of these poisonous plants are found in the U.S.

- Of the toxic plants in the cashew family, poison ivy (*Rhus radicans*) is most widespread. It grows in a variety of forms such as a low sprawling shrub, dense ground cover, or a thick woody vine that grows high into the tree canopy. Poison oak (*Rhus diversiloba*) is typically a low shrub in drier soils. Both of these plants have leaves of three and white berries. Poison sumac (*Rhus vernix*) is a tall shrub that is less prolific in distribution. It grows in wet areas, has a compound leaf with a red leaf stem (rachis), and white berries. All of these plants possess urushiol oils in all parts of the plant. Touching the plant causes an itchy skin rash that can show up within 4-72 hours following contact. People have a wide range of reactions including swelling, itching, rash and bumps, patches or blisters.
- Uroshiol oil can also transfer onto clothing and equipment. The oil can remain active on surfaces for up to 5 years and can be transferred to your skin.

[2] Phytodermatisi producer: keep skin covered and wash well after exposure

- Wild parsnip is found throughout the U.S. and contains a poison that produces a rash similar to poison oak and ivy. Unlike poison oak and ivy, the active oil will not be present on unbroken leaves. See *S3AM-313-ATT6 Wild Parsnip Identification* for additional information and photos of wild parsnip.
- Several plants in the carrot family contain toxic sap that causes severe dermatitis if it comes into contact with skin that is then exposed to sunlight. The most serious reaction is caused by the giant hogweed (*Heracleum mantegazzianum*), a plant that is spreading in southern Ontario and is also present in southwestern British Columbia. The plant is enormous, attaining up to 16 feet (5 meters) in height, which it does in one growing season. Contact causes painful blistering that can cause permanent disfigurement. It is to be avoided. Similar but less serious reactions can be caused by meadow parsnip (*Pastinaca sativa*) and cow parsnip (*Heracleum lanatum*). Meadow parsnip can be very abundant on disturbed sites.
- Nettles, particularly stinging nettle (*Urtica dioica*) and wood nettle (*Laportea canadensis*) contain urticating hairs on the leaves and stems that cause sharp pain or itchiness on contact with skin. The irritation is immediate and normally lasts no more than an hour and there are no lasting consequences.
- Some plants contain abundant stiff spines that can present a safety hazard, particularly if one is to fall into them. These include the cactus (*Opuntia spp.*), devils club (*Oplopanax horridum*), and prickly-ash (*Zanthoxylon americanum*).

4.8.3 A large number of plants are not harmful to touch but may contain poisonous berries or foliage that could cause serious complications or death if they are ingested. It goes without saying to not eat any berries or plants if you are unsure of their identity.

- Remember that in the fall and winter the hazard still exists in the form of stubble and roots.

4.8.4 Personal Protective Equipment (PPE)

- Employees conducting clearing, grubbing, or similarly disturbing work activities in areas where poisonous plants exist shall wear long-sleeve clothing or Tyvek® coveralls, and disposable cotton, leather or synthetic gloves. Employees shall not touch exposed skin (neck and face) with potentially contaminated gloves. Tyvek® and gloves worn to protect from exposure to poisonous plants shall be treated as contaminated, removed from the body in a manner that the contamination is not spread, and placed in plastic bags for disposal.
- Personal clothing that has been exposed to poisonous plants shall be decontaminated with a poisonous plant cleanser such as Tecnu® or removed in a careful manner, bagged and washed separately from other clothing to remove urushiol.
- Work boots will be decontaminated with either soap and water or a cleansing agent such as Tecnu® cleanser.
- If foliage is being cleared and includes poisonous plants, exposed skin shall be treated with a dermal barrier cream such as Tecnu®'s Oak 'n Ivy Armor or Enviroderm's Ivy Block and either a full-face respirator or a half-face respirator (with goggles) fitted with a P-100 (HEPA) dust filter.

4.9 Bird Droppings and Biological Soil Hazards

4.9.1 Work in any area where pigeons or other flying animals (e.g. bats) may nest requires a written statement from the client which states the potential for, and extent of, accumulation of excrement on/in the structure from pigeons or other winged animals.

4.9.2 Substantial accumulations of droppings can pose physical and health risks as slippery surfaces (if wet) and if the material is disturbed and becomes airborne, it can be inhaled or ingested if personal hygiene practices are not implemented. Inhalation of airborne droppings can cause diseases such as histoplasmosis. Exposure to surfaces with bird droppings shall be safeguarded by implementing proper work practices, training employees for awareness and using PPE. See *S3AM-313-ATT8 Bird Droppings*.

4.9.3 Tularemia is a problem with contaminated soil in some locations. Tularemia is a disease of animals and humans caused by the bacterium *Francisella tularensis*. Rabbits, hares, and rodents are especially susceptible and often die in large numbers during outbreaks. Workers can contract Tularemia through tick and deer fly bites, but also through inhalation of contaminated aerosols or agricultural dusts. Check work areas for carcasses before disturbing the ground (e.g. mowing, brushing, grubbing, excavation, etc.).

4.10 Personal Hygiene and Body Checks

4.10.1 Tick-borne diseases typically require that the tick be imbedded for four hours to begin disease transfer. The oils from poisonous plants can take up to 4 hours after exposure to penetrate the skin and react with the live proteins under the skin.

4.10.2 It is recommended that exposed skin be checked frequently for the presence of ticks, insects, rashes, or discolorations. External clothing should also be checked for the presence of ticks and insects; these should be retained for identification and to determine if medical treatment is needed.

4.10.3 Employees shall shower as soon as practical after working in the field and examine their bodies for the presence of ticks, insect bites, rashes, or swollen areas. If imbedded ticks are found, they should be removed using the technique described in *S3AM-313-ATT2 Ticks*.

4.11 Employees shall immediately notify their Manager or Supervisor of the presence of an imbedded tick, bee, wasp or hornet sting, other insect bite, rash, or any abnormal reaction. Reporting shall occur within 4 hours for a significant incident and 24 hours for all other SH&E incidents, and in accordance with *S3AM-004-PR Incident Reporting, Notifications & Investigation.*

4.12 The Manager or Supervisor shall forward the report to the SH&E Manager for follow up.

5.0 Records

None

6.0 Attachments

6.1 S3AM-313-ATT1 Biological Hazard Assessment Flow Chart

6.2 S3AM-313-ATT2 Ticks

6.3 S3AM-313-ATT3 Poisonous Spider Identification

6.4 S3AM-313-ATT4 Mosquito Borne Diseases

6.5 S3AM-313-ATT5 Plants of Concern

6.6 S3AM-313-ATT6 Wild Parsnip Identification

6.7 S3AM-313-ATT7 Alligators

6.8 S3AM-313-ATT8 Bird Droppings

6.9 S3AM-313-ATT9 Large Carnivores & Ungulates

6.10 S3AM-313-ATT10 Bear Safety

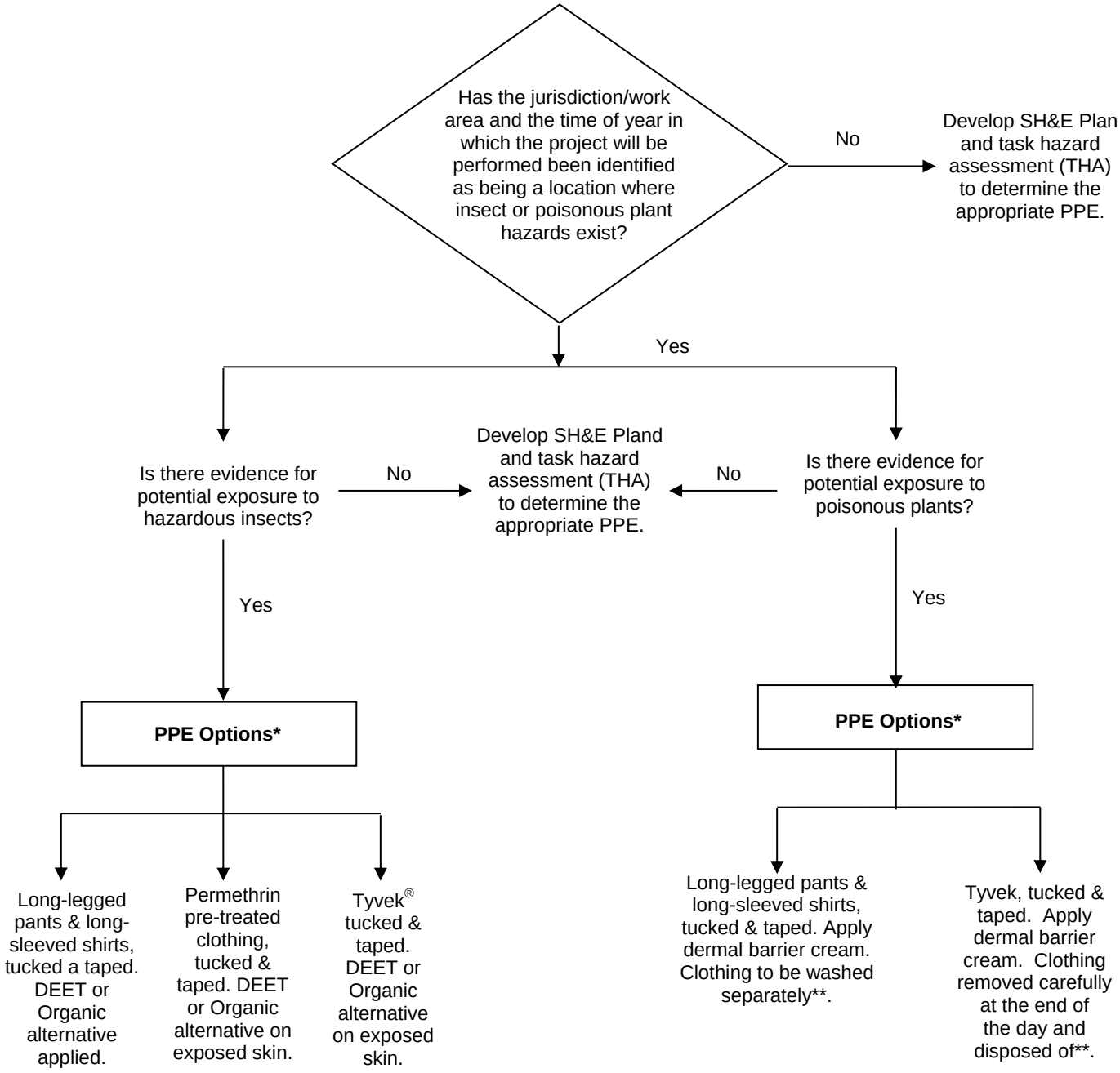
6.11 S3AM-313-ATT11 Small Mammals

6.12 S3AM-313-ATT12 Snakes & Scorpions

Americas

Biological Hazard Assessment Decision Flowchart

S3AM-313-ATT1



* indicates that when both insect and poisonous plant hazards are recognized hazards at a project site, the most conservative combination of the available PPE choices will be selected. Include the selected PPE option in the respective SH&E Plan and THA.

** indicates that clothing that has been known or suspected to have come in contact with poisonous plants must be washed before it can be worn again. Similarly, Tyvek® that has been known or suspected to have come in contact with poisonous plants will be disposed of rather than reused during a subsequent day or project.

Americas

Ticks

S3AM-313-ATT2

1.0 Background

1.1 The Public Health Agency of Canada and the Centers for Disease Control and Prevention work with States and Provinces, health authorities and other experts on research to define and monitor the occurrence of the ticks that carry bacterium that cause disease, including but not limited to:

1.1.1 *Borrelia burgdorferi*, the bacterium that causes Lyme disease.

- In the United States and Canada, the black-legged tick (*Ixodes scapularis*; often referred to as a deer tick) and the western black-legged tick (*Ixodes pacificus*) are the species known to transmit this disease-causing agent, as well as other less common agents.

1.1.2 *Rickettsia rickettsia,* the bacterium that causes Rocky Mountain Spotted Fever.

- In the United States and Canada, the American dog tick (*Dermacentor variabilis*), Rocky Mountain wood tick (*Dermacentor andersoni*), and brown dog tick (*Rhipicephalus sanguineus)* are known to transmit this disease-causing agent.

1.1.3 *Francisella tularensis*, the bacterium that causes Tularemia.

- In the United States, these include the American dog tick (*Dermacentor variabilis*), Rocky Mountain wood tick (*Dermacentor andersoni*), and Lone star tick (*Amblyomma americanum*).

1.1.4 *Ehrlichiosis*, the general name to describe several bacterial diseases that affect animals and humas.

- In the United States, these include the black-legged tick (*Ixodes scapularis*; often referred to as a deer tick) and the western black-legged tick (*Ixodes pacificus*), and Lone star tick (*Amblyomma americanum*).

1.2 Consult local health authorities to determine where tick populations are established or emerging. Locations where distribution may have previously been limited may show evidence of larger populations. Employees working in or adjacent to areas where there are established tick populations may have a greater chance of contact with ticks.

1.3 While there is a higher risk of coming in contact with infected ticks in areas where populations are established, there is also a low risk of tick-borne diseases being contracted almost anywhere in the Americas as migratory birds transport infected ticks over large geographic distances. Take precautions to reduce tick contact.

1.4 Lyme Disease

1.4.1 The rate of infection of ticks with the bacterium that causes Lyme disease varies. Infection rates are typically higher in adult ticks compared to the other stages (nymphs and larvae).

1.4.2 Despite the lower rates of infection, people are most likely to acquire Lyme disease from a nymph because this stage is so small and thus more likely to go unnoticed and feed for a sufficient amount of time for the Lyme disease bacterium to be transmitted (24-36 hours).

1.4.3 Infection rates are often greater in tick populations that have been established for long periods of time compared to newly established ones.

1.4.4 Lyme disease patients are most likely to have illness onset in April through November with onset peaking in June, July, or August and less likely to have illness onset from December through March

2.0 To Remove Attached Ticks



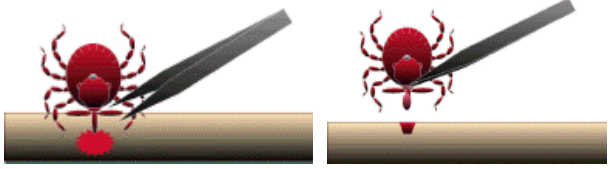
2.1 Use fine-tipped tweezers or notched tick extractor, and protect your fingers with a tissue, paper towel, or latex gloves (see figure). Persons should avoid removing ticks with bare hands.

2.2 Grasp the tick as close to the skin surface as possible and pull upward with steady, even pressure. Do not twist or jerk the tick; this may cause the mouthparts to break off and remain in the skin. (If this happens, remove mouthparts with tweezers. Consult your health care provider if illness occurs.)

2.3 After removing the tick, thoroughly disinfect the bite site and wash your hands with soap and water.

2.4 Do not squeeze, crush, or puncture the body of the tick because its fluids may contain infectious organisms. Skin accidentally exposed to tick fluids can be disinfected with iodine scrub, rubbing alcohol, or water containing detergents.

2.5 Save the tick for identification in case you become ill. This may help your doctor make an accurate diagnosis of potential diseases by determining what type of tick it is. Place the tick in a sealable plastic bag and put it in your freezer. Write the date of the bite on a piece of paper with a pencil and place it in the bag.



3.0 Folklore Remedies Don't Work

3.1 Folklore remedies, such as the use of petroleum jelly or hot matches, do little to encourage a tick to detach from skin. In fact, they may make matters worse by irritating the tick and stimulating it to release additional saliva or regurgitate gut contents, increasing the chances of transmitting the pathogen. These methods of tick removal should be avoided.

4.0 Configuration of Clothing

4.1 Loose-cuff trousers must be tucked into socks, wrapped with duct tape (or equivalent) completely around the cuff of the sock up on to the surface of the pant leg to prevent entry of insects between the sock and pants, and preferably reverse-wrapped with “sticky” side out (see figure below).



Americas

Poisonous Spider Identification

S3AM-313-ATT3

Black Widow Spider





- Found in warm, dry parts of throughout the United States and extend into the southern edge of Canada.
- Prefer to spin their webs in dark, sheltered spots close to the ground
- Abdomen usually shows hourglass marking.
- The female is 1 to 1.5 inches (3-4 centimeters) in diameter.
- Have been found in well casings and flush-mount covers.
- Not aggressive, but more likely to bite if guarding eggs.
- Light, local swelling and reddening of the bite are early signs of a bite, followed by intense muscular pain, rigidity of the abdomen and legs, difficulty breathing, and nausea.
- If bitten, see physician as soon as possible.

Brown Spiders (Recluse)





- Central and South U.S., although in some other areas, as well.
- 0.25-to 0.5-inch (0.6 to 1.3 centimeters)-long body and the size of silver dollar.
- Hides in decaying wood, baseboards, ceilings, cracks, and undisturbed piles of material.
- Bite either may go unnoticed or may be followed by a severe localized reaction, including scabbing, necrosis of affected tissue, and very slow healing.
- If bitten, see physician as soon as possible.

Hobo Spider





- Primarily found in Washington, Oregon, Wyoming, Colorado, Utah, Montana and the Pacific Northwest United States.
- 0.4-to 0.5-inch (1.1 to 1.3 centimeters)-long body and the size of silver dollar.
- Because of its common features and color, it is easily confused with other spider such as Brown Recluse Spiders.
- They rarely climb vertical surfaces and are uncommon above basements or ground level.
- Bite is initially painless. After 24 hours, the bite develops into a blister and after 24-36 hours, the blister breaks open, leaving an open, oozing ulceration.
- If bitten, see physician as soon as possible.

Exercise care when collecting samples and avoid reaching into areas where visibility is limited. If bitten by a spider, attempt to identify the spider, notify a co-worker or someone who can help should the bite site become painful, discolored, or swollen. Stay calm and treat the area with ice or cold water. Seek medical attention if you have any reactions to the sting such as developing a rash, excessive swelling or pain at the site of the bite or any swelling or numbness beyond the site of the bite.

Americas

Mosquito-Borne Diseases

S3AM-313-ATT4

1.0 Background

1.1 Employees working outdoors in the Americas may be exposed to mosquitoes that may transmit illnesses, including Encephalitis and Dengue.

1.2 Dengue is transmitted by the bite of a mosquito infected with one of the four dengue virus serotypes. Dengue is endemic to South America**.**

1.2.1 Dengue is a febrile illness that affects infants, young children and adults with symptoms appearing 3-14 days after the infective bite.

1.2.2 Symptoms range from mild fever, to incapacitating high fever, with severe headache, pain behind the eyes, muscle and joint pain, and rash.

1.2.3 Severe dengue (also known as dengue hemorrhagic fever) is characterized by fever, abdominal pain, persistent vomiting, bleeding and breathing difficulty and is potentially fatal.

1.3 West Nile encephalitis is an infection of the brain that is caused by a virus known as the West Nile virus.

1.3.1 Most individuals infected with WNV remain asymptomatic. West Nile (WN) fever is typically a mild illness lasting 3 to 6 days.

1.3.2 The main symptoms are sudden onset of fever with chills, rash, malaise, headache, backache, arthralgia, myalgia and eye pain. Other non-specific symptoms may include nausea, vomiting, anorexia, diarrhoea, rhinorrhoea, sore throat, and cough.

1.3.3 The main route of infection is via the bite of a mosquito that has been infected by feeding on West Nile Virus infected birds.

1.4 Arboviral encephalitis is a virus that exists in various forms in global distribution. Numerous forms occur in the Americas, including the following four primary forms that can be transmitted by mosquitoes:

1.4.1 Eastern equine encephalitis (EEE) – United States and Canada

1.4.2 Western equine encephalitis (WEE) – United States

1.4.3 St. Louis encephalitis (SLE) – United States and Canada

1.4.4 La Crosse (LAC) encephalitis.all of which are transmitted by mosquitoes – United States

1.5 Mosquitoes are known to breed in standing water; therefore, when standing water is found at a job site, actions should be taken to drain the water. Typically, mosquitoes will fly only a quarter of a mile (400 meters) from their breeding location.

1.6 The local Public Health Department and Center for Disease Control and Prevention (CDC) should be consulted to determine what diseases transmitted by mosquitoes are present and exposure prevention recommendations.

Americas

Plants of Concern

S3AM-313-ATT5

1.0 Background

1.1 Poison ivy, oak and sumac (poisonous plants) pose a significant threat to AECOM employees due to the dermatitis that results from exposure to the oil on these plants, called urushiol.



Poison Oak **Poison Sumac** **Poison Ivy**

1.2 Exposure to urushiol produces a rash that can be irritating and cause the exposed employee to scratch the infected area, increasing susceptibility for an infection to result from the rash.

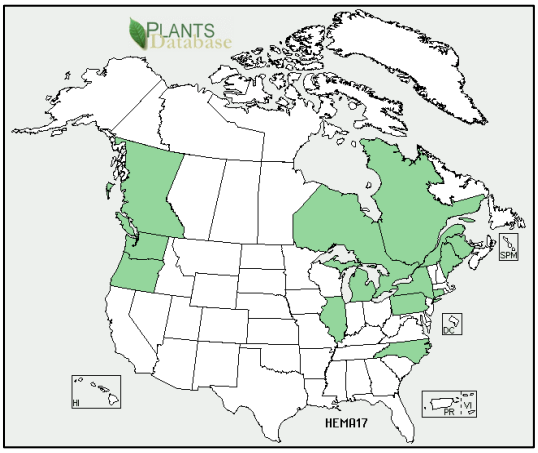
1.3 It should be noted that each time an employee is exposed to urushiol, it increases the severity of the reaction they will have in subsequent exposures.

1.4 Giant Hogweed is a phototoxic plant that causes skin irritation on contact with the sap and, when exposed to sun causes deep blisters.

1.5 Blisters from contact with Giant Hogweed can form black or purplish scars that can last for several years. Even a tiny amount of the sap in the eyes can cause temporary to permanent blindness.



Giant Hogweed



Giant Hogweed Distribution

Image obtained from www.gclandscape.com

2.0 Treatment

2.1 In cases that involve severe rashes, medical treatment may be necessary to control the rash.

2.2 Employees that develop a rash as a result of exposure to poison ivy, oak or sumac should report the exposure immediately to their Supervisor, Project Manager and Region Safety, Health and Environment Manager.

Pacific Poison Oak Distribution



Image obtained from www.cdc.gov

Atlantic Poison Oak Distribution



Image obtained from www.cdc.gov

Poison Sumac Distribution



Image obtained from www.cdc.gov

Western Poison Ivy Distribution



Image obtained from www.cdc.gov

Eastern Poison Ivy Distribution

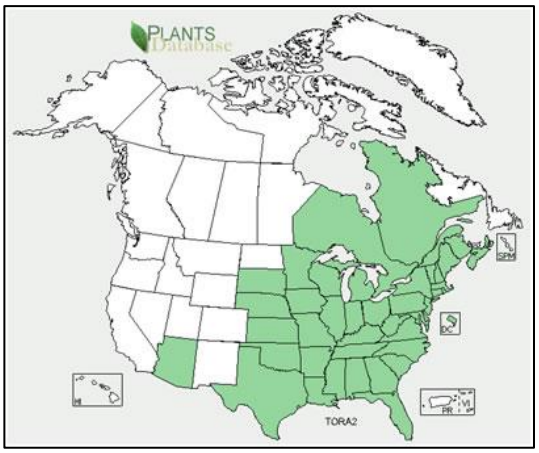


Image obtained from www.cdc.gov

Americas

Wild Parsnip Identification

S3AM-313-ATT6

1.0 Background

1.1 Wild parsnip (also known as poison parsnip) looks similar to a large carrot plant and is found in open places along roadsides and in waste places throughout the United States and Canada.

1.2 This plant produces a compound that causes severe blistering and discoloration after being exposed to sunlight—a condition known as photodermatitis. That is, when the skin comes in contact with this plant's juice and then is exposed to UV light, a severe burn develops.

2.0 Hazard

2.1 Everyone can get burned by wild parsnip. Unlike poison ivy, you don't need to be sensitized by a prior exposure. However, wild parsnip is only dangerous when the juice from broken leaves or stems gets on your skin—therefore, you can touch and brush against the undamaged plant without any danger.

2.2 If one gets some of the sap of hogweed (or meadow parsnip or cow parsnip) in contact with skin, it is critical that they stay out of the sun for 8 hours. If one needs to remove the plant they should be completely covered with overalls, gloves, hat and safety glasses.



Americas

Alligators

S3AM-313-ATT7

1.0 Hazard

1.1 Your chance of encountering an alligator is greatest during the animal's courtship and mating season, which takes place from March through September. This is when male alligators become most dominant and aggressive as they try to intimidate rival males and attract females by their show of power. Some males end up having to travel to find a mate. July through September is when mother alligators are guarding nests.

1.2 Mating season takes up much of the warmer months - a very popular time in the southeastern USA for outdoor activities - and alligators are solar-powered, so-to-speak. The warmth from the sun fires up their metabolism, giving them renewed energy; and renewed energy means great potential for conflict.

2.0 Encounter



2.1 The alligator is naturally wary of humans, and will flee quickly if you get too close to it, or it may utter a very audible and compelling warning hiss. In some cases, however, alligators may charge or attack. Here are some examples of such cases:

2.1.1 An alligator that is accustomed to being fed by humans may not be so shy.

2.1.2 An alligator that is surprised and alarmed by your approach may attack, thinking that it is being attacked itself.

2.1.3 A mother alligator caring for her nest or for live babies. If you see alligator babies, or if you encounter a nest (usually a mound of vegetation mixed with mud), remove yourself to a safe distance, the mother alligator is sure to be close by. If you get close, the mother may sound a very audible and intimidating warning hiss. Such a nest may be difficult to identify for a non-expert, but it is likely the mother will issue you a warning.

2.1.4 Alligator mothers are well-known to be practically fearless when defending their offspring, whether the little ones have hatched or not. A mother alligator was observed leaping, jaws agape, to attack a helicopter as it approached the nest area to land. The helicopter carried biologists studying alligator nests.

2.2 Also be careful near heavy vegetation in or near the water's edge. This is where an alligator likes to enjoy privacy and peace during the daylight hours. If you trudge through there and surprise it, the outcome may not be positive.

2.3 Generally, a good minimum distance to keep between you and an alligator or nest is 15 feet (4.6 meters).

2.4 When trying to get past an alligator, make sure not to walk between the alligator and the water, because if it's spooked, it's going to run to the water.

2.5 If an alligator does approach in a threatening manner, make as much noise and movement as possible. This should show the alligator that he has taken on more than he can handle and he'll back away.

3.0 Alligator Charge

3.1 The alligator is not a natural runner. Those short legs obviously don't serve it like a horse's legs do, and the alligator can actually tire out in a relatively short time. When it charges after a human or animal, it is either

trying to scare it away or seize it. It has a fast and furious burst of energy which serves it well for stealth hunting -- grabbing prey when it doesn't expect it. Furthermore, the reptile is opportunistic, which means, quite simply, it doesn't like to work very hard to get its food if it doesn't have to.

3.2 In the very rare event you are charged or chased by an alligator, move in as straight a line as possible away from it as fast as you reasonably can. In many cases, the vegetation features of the wild will serve to protect you by slowing the alligator down, like trees, bumps, bushes, etc. -- your comparatively long legs usually make it easier for you to maneuver through the trees and brush than an alligator's short legs do.

3.3 Most adult humans can outrun even a fast crocodilian, which has been clocked at a maximum of about 10 miles per hour (mph) (17 kilometers per hour [kph]), compared to a human speed of 15-17 mph (24-27 kph). But this doesn't matter much; an alligator will often give up the chase because it sees that the runner is moving away too quickly, and realizes that too much effort will be required to continue pursuit.

3.4 You may have heard somewhere that the zigzag run (running in a "z" pattern, side-to-side) is a good idea, but this is not only an unnecessary maneuver but probably a very unwise one. Here's why:

3.4.1 Unless you're an Olympic athlete, running zigzag over natural topography increases your risk of tripping and falling over rocks, plants, roots, and the like. And it goes without saying that falling while being pursued by an alligator is not good.

3.4.2 Furthermore, an alligator doesn't have the degree of stereoscopic vision we have. It actually has a small 'blind spot' directly in front of it. Hence, the alligator's vision is most effective in the 'sides' of its field of view. So, running zigzag not only slows your rate of distance from your pursuer, it may clearly indicate to the animal exactly where you are; even this point hardly matters since in many cases the alligator may keep its eyes shut while pursuing so as not to get them hit by twigs, grass stalks and branches in its path.

3.4.3 Finally, an alligator bites very effectively in a side-swiping motion, so if you are trying to run zigzag and are slowed down by plants, rocks, or other obstacles, the backwards flying leg of a running human is an optimal target for side-swiping, chomping jaws (the operative word here is "side").

3.5 Simply put, when faced with an attack, move directly away from the alligator as quickly as possible, navigating the terrain as carefully as possible. The zigzag idea will likely not serve you well.

4.0 Alligator Attack

4.1 If it seizes prey, and the prey fights back hard, the alligator may release it, depending on factors such as its own size relative to that of the victim, its own level of aggression, and its measure of hunger. Merely struggling to break free may not be enough counter-aggression to stop an alligator, and may actually prompt a devastating "death roll" response, in which the reptile furiously spins on its central axis to tear muscle and bone free of the victim's body.

4.2 These armored saurian are among the toughest beasts in the animal kingdom, so an attack victim should channel his or her nervous energy and will to survive and take the offensive by fighting hard. Not struggling...fighting very, very, very hard. Others on hand during such an event may be able to help by fighting the reptile, too. This should include punching the snout, poking the eyes, and even jabbing the ears, which are seen as small slits behind the eyes.

Americas

Bird Droppings Safe Work Practices

S3AM-313-ATT8

1.0 Background

1.1 According to the National Institute for Occupational Safety and Health (NIOSH), histoplasmosis is an infectious disease caused by inhaling spores of a fungus called *Histoplasma capsulatum (*abbreviated *H. capsulatum)* that may inhabit accumulated masses of pigeon droppings and excrement of other birds and flying animals. Its symptoms vary greatly, but the disease primarily affects the lungs. Occasionally, other organs are affected. This form of the disease is called disseminated histoplasmosis, and it can be fatal if untreated. The acute respiratory disease form of histoplasmosisis is characterized by respiratory symptoms, a general ill feeling, fever, chest pains, and a dry or non-productive cough. Distinct patterns may be seen on a chest x-ray. Chronic lung disease resembles tuberculosis and can worsen over months or years. If symptoms occur, they may start within 3 to 17 days of exposure, with an average of 10 days. On a positive note, histoplasmosis is not contagious.

1.2 Psittacosis, although primarily a respiratory disease, can cause a wide variety of clinical manifestations. Generally, about 10 days after infection occurs, the clinical illness begins abruptly with fever, chills, weakness, fatigue, muscle pain, anorexia, nausea, vomiting, excessive sweating and difficulty with breathing, headache, backache, and sensitivity to light.

1.3 Hypersensitivity pneumonitis is also known as pigeon breeder's disease.

2.0 Symptoms

2.1 The acute form of hypersensitivity pneumonitis is clinically characterized by chills, fever, cough, breathlessness without wheezing, and malaise 4-10 hours after exposure. In general, an acute attack subsides after 18 to 24 hours.

3.0 Treatment

3.1 If a person should develop any of the symptoms as noted above, or others, it is important to see a physician and inform him of an exposure to pigeon/bird or bat excrement. A failure to diagnose the preceding conditions could occur if a treating physician is unaware of a patient's exposure to pigeon/bird or bat excrement.

4.0 Prevention

4.1 Prior to work in any area where pigeons or other flying animals may nest, a written statement from the client shall be obtained in regards to the potential for, and extent of, accumulation of excrement on/in the structure from pigeons and other winged animals.

4.2 The client shall be asked to provide appropriate details as to the basis for their statement (e.g., date of last visual survey for pigeon/bird or bat excrement accumulation, date of last excrement removal effort, etc.).

4.3 In no case will an AECOM employee or contract employee be permitted to commence structure inspection procedures without the Project Manager having received and evaluated the aforementioned written statement from the client.

4.4 According to NIOSH, the best way to prevent exposure to *H. capsulatum* spores during survey and inspection work is to avoid situations where excrement and other potentially contaminated material can become airborne and inhaled. Therefore, it is preferable that the efforts to determine if, and to what extent, there is an accumulation of pigeon/bird or bat excrement on/in structures, or the efforts to clean-up/remove/dispose of such contaminated material, be left to the client or subcontracted out.

5.0 Safe Work Practices

5.1 In those cases where AECOM employees or contract employees are contracted by the client to determine the extent of accumulation of animal excrement in/on structures, the following minimum safety and health precautions shall be taken. (NOTE: precautionary measures are based on recommendations and best practices prescribed in the NIOSH 2004 public document titled *Histoplasmosis – Protecting Workers at Risk*).

5.2 All workers shall wear disposable protective clothing (Tyvek® coveralls). Disposable overalls with hoods shall be donned when working in areas where *H. capsulatum* spore-contaminated material is likely to fall from overhead.

5.3 All workers shall wear disposable shoe coverings fitted with ridged soles made of slip-resistant material to reduce the likelihood of slipping on wet or dusty surfaces. Gloves shall be worn.

5.4 All workers shall wear a full facepiece air purifying respirator fitted with P100 (HEPA) cartridges. If entering an enclosed area in which the extent of excrement contamination is unknown, additional protective measures shall be taken such that workers shall wear a powered air-purifying respirator (APR) with full facepiece fitted with P100 (HEPA) cartridges. Any variance from these requirements must be approved by the Region Safety, Health an Environment Manager. Workers donning APRs shall be medically screened, cleared, and trained in their proper use in accordance with AECOM safety program standards.

5.5 If contaminated material must be disturbed for purposes of removal/disposal or during the structure inspect process, it shall be wetted down prior to all work and will be rewetted as necessary to minimize airborne dusting.

5.6 After working in *H. capsulatum* spore-contaminated areas and before removing any respiratory protective equipment, workers shall remove all protective clothing and shoe coverings and seal them in a heavy-duty plastic bag for disposal.

5.7 Workers shall observe a high degree of personal hygiene, even if the exposure is casual. Special care shall be taken to wash hands, face, and other areas of exposed skin thoroughly before eating, drinking or smoking.

Americas

Large Carnivores & Ungulates

S3AM-313-ATT9

1.0 Hazard

1.1 Most wild carnivores in the feline family (cougars, lynx, and bobcat) or the canine family (wolves and coyotes) are more predictable than bears and are not predatory towards humans; however, all wild animals can be dangerous if they feel threatened or if they are sick or starving.

1.2 Most ungulates (deer, moose, elk, and caribou) will avoid humans and will flee as soon as a human is sighted; however, females with young (during May and June) and males during the mating season (September to November) can be very aggressive, especially if provoked.

2.0 Personal Protective Equipment

2.1 Noise makers such as bear bangers, whistles and bells can be used as deterrents for an approaching animal.

2.2 Pepper (bear) spray can be used to ward off an imminent attack.

3.0 Safe Work Practice

3.1 Most negative encounters with ungulates or carnivores can be avoided with a few key preventative measures:

3.1.1 When working in wilderness isolation, always travel in pairs and make lots of noise.

3.1.2 Always store food in air-tight containers away from sleeping areas (if camping) and never carry strong smelling foods which could attract animals.

3.1.3 Keep your eyes open for fresh animal signs which may indicate a dangerous situation:

- Extensive fresh rubbing on branches in the fall might indicate the presence of a rutting male ungulate that may become aggressive to defend a potential mate.
- A fresh kill or carcass which might indicate the presence of a carnivore that may become aggressive to defend its food.

3.2 Maintaining a distance of at least 100 feet (30 meters) allows large animals an escape route. If you notice any signs of aggression or behavioral changes, you should move away to a safe location. Wildlife should not be enticed by reaching out or simulating calls.

3.3 Pets should be kept secure and away from wildlife as their actions can provoke an attack. Moose, deer and other wildlife may appear quite docile; however, if a dog makes them feel threatened, their behavior can become unpredictable.

3.4 **If you are approached by a carnivore (wolf, coyote, or cougar):**

3.4.1 Pick up small children immediately.

3.4.2 Try to appear bigger, hold your arms or an object over your head.

3.4.3 Face the animal and retreat slowly. Do not run or play dead.

3.4.4 Maintain steady eye contact with the animal.

3.4.5 If the animal continues to approach, deter an attack by yelling, waving a stick or throwing rocks.

3.4.6 If you are attacked, fight back. Hit the animal with a heavy stick or rock.

3.5 **If you are approached by an ungulate (moose, elk, deer, bison or caribou):**

3.5.1 An angry moose, elk or deer will face you with its head and ears lowered.

3.5.2 Back away slowly.

3.5.3 Look for something to get behind like a tree or a car. You can go faster around an obstacle than the ungulate can.

3.5.4 An ungulate is more likely to bluff charge but if it continues the charge and you are attacked in the open, curl up in a ball on the ground. Always protect your head with your arms and lie still.

3.5.5 Stay still after the attack until the ungulate moves away.

Americas

Bear Safety

S3AM-313-ATT10

1.0 Hazard

1.1 An encounter with a bear of any species can have a wide variety of outcomes, ranging from a simple sighting, to a false charge, to a serious mauling or even death. Consequently, the risk of a bear encounter must be taken very seriously.

1.2 The hazard or risk associated with a bear encounter varies significantly depending on the location. It is important to research the project area before field work commences to determine the expected probability of encountering a bear. Remoteness from urbanized areas should not be a criterion, as bears have been encountered within city limits, especially near landfills.

1.3 The risk associated with a bear encounter also varies with the species of bear, the season, and the circumstances under which the bear is encountered.

1.4 Preparing staff for any type of encounter is key to managing the risk.

2.0 Personal Protective Equipment

2.1 The best deterrent of a “bad bear encounter” is knowledge: a good understanding of the ecology and the behavior of the bears that will likely be encountered.

2.2 Bear Spray and Bear Bangers

2.2.1 Staff must have hands-on training for the safe use of bear spray (a pre-season practice run is a good use of expired bear spray).

2.2.2 Prior to work commencing, staff must ensure that the bear spray they are carrying is still valid and not past its expiration date.

2.2.3 During travel, bear spray must be sealed in an airtight container or bag and must not travel in the cab of a vehicle, aircraft, or helicopter.

2.3 Firearms

2.3.1 Environments and conditions which pose a high risk of bear encounters, may warrant the use of an armed wildlife monitor. Project managers, in consultation with appropriate project staff and Safety, Health and Environment Management, are responsible for determining the level of risk for their projects and whether or not such measures are required.

2.3.2 A person hired as an armed bear monitor must be properly trained in wildlife monitoring as well as certified in the expert usage of firearms.

2.3.3 The usage of an armed bear monitor is intended only as an additional precautionary measure to be used in specific environments to ensure the protection of field staff; staff should still be equipped and trained appropriately for the risk.

3.0 Restrictions

3.1 Staff must not work alone in areas where there is a medium or high risk of a bear encounter.

3.2 AECOM personnel shall not carry firearms or attempt to function as a wildlife monitor and/or perform their professional duties. For possible exceptions contact the Regional SH&E Manager who will evaluate the potential hazards with Regional Manager and Legal and provide written response. This can only be over-ridden with expressed permission of Region Executive and AECOM Chief Resilience Officer, refer to *WP-001-PR Firearms Standard*.

4.0 Training

4.1 In-house Bear Awareness training must be taken by all field staff who work in bear country every three years at a minimum, or more often as required.

4.2 The Bear Awareness training involves testing and improving the employee's knowledge about bear encounters, watching videos regarding bear awareness and behavior, and participating in group discussions about how to avoid and how to respond to bear encounters.

4.3 Specific considerations are given to black bear, grizzly bear, and polar bear encounters.

5.0 Safe Work Practice

5.1 Staff must be aware of wildlife signs and avoid wildlife encounters.

5.2 Bear Signs

5.2.1 Fresh tracks – It is often better to see the bear's tracks than to see the actual bear. If you can tell the direction that the bear is travelling in, it is prudent to change your course of direction. Bears will travel down the same pathways people or other large animals use. If you have a clear track you can determine which type of bear has passed through the area. If you see more than one track, you can tell that it is possibly a female with cubs. Avoid females with cubs!

5.2.2 Scat – Bear scat will look different depending upon the bear's diet. Close examination of bear scat can sometimes give you an indication of what the bears have been eating at that time of year. If the scat contains remnants of human garbage, there is a human food conditioned bear in the area. These bears associate people with food and can be the most dangerous type of bear to encounter.

5.2.3 Animal carcasses – IF YOU COME ACROSS A CARCASS, LEAVE THE AREA IMMEDIATELY. Grizzly bears will often cover their kills for a few days and let it rot, then come back and eat it. THE BEAR WILL STAY CLOSE BY. Grizzly bears will defend their kill and this is a situation that could prompt a defensive attack by a bear.

5.2.4 Torn-up logs and stumps – Bears will forage for insects in dead logs and rotting trees. You will often see torn up logs and stumps, evidence of their foraging.

5.2.5 Evidence of digging – Holes dug into the ground are often made by grizzly bears digging for roots or ground squirrels. In particular, grizzlies will dig for food in the early spring soon after they leave their dens.

5.2.6 Claw marks on trees – Claw marks can be left on trees by black bears when they have climbed up a tree. Grizzly bears will also leave claw marks on trees and on the ground. Bears will often chew a small tree or a sign-post, so watch for signs of chew marks along the trail.

5.2.7 Hair on trees – Bears will rub against trees, usually trees with rough bark, to scratch themselves. You can find evidence of bears by the hair left in the tree's bark. The higher the hair left on the tree, the bigger the bear. Remember that the bear will often stand on its back legs to scratch its back on the tree.

5.2.8 Daybeds – Bears will be most active in the early morning and in the evening. It would be prudent for field staff to restrict their field activities during the bear's most active foraging times as much as possible. During the heat of the day, bears will rest in daybeds. These can be shallow depressions of piled up leaves in the forest, trampled vegetation, a shallow scrape or a hole. Daybeds are usually located in cool places. Bears will make daybeds along streams and rivers. Daybeds are often associated with feeding places and therefore should be avoided.

5.3 Prevention

5.3.1 Your best defense against bears is to actively practice bear avoidance techniques when working in the field. You can prevent chance encounters by taking the following precautions:

- Know the areas and habitats bears use at different times of the year, and attempt to avoid such areas or be extremely cautious if you have to travel through them.
- Contact the local Fish & Wildlife Office to get current information on the bears in the area. Ask what other camps are in the area and if they are following good bear avoidance practices. (i.e., do they keep a clean camp?) If there are nearby human food sources available, e.g., an open dumpsite, the local bears may not be afraid to approach your camp.
- Always be aware of your surroundings. Stay alert. Watch for signs of bears along your route.
- Use binoculars to look around for bears when you are in open terrain.
- Never approach a bear if you see one feeding in the distance.
- Note the behavior of other wildlife in the area. Flocks of ravens can alert you to a possible animal carcass, and perhaps a bear. The area should be avoided. Bird or squirrel alarm calls might be telling you that a bear is near.
- Whenever possible, travel in daylight and try to avoid areas with restricted visibility, e.g., dense brush.
- Make lots of noise, especially when travelling in dense vegetation. Sing, shout, or talk loudly. You can carry portable air horns or cans of rocks. (Please note that bear bells are not effective – they do not make enough noise to warn a bear that you are approaching. You need to be loud so the bear can hear you coming.) Remember that the noise you make can be masked by loud natural sounds such as the wind or water. Therefore it is possible that the noise you make can go unnoticed by a bear whose attention is focused on feeding. You must make every attempt not to surprise a bear. In areas of loud natural noise, be louder!
- Stay together and travel in groups. Bears are less likely to attack groups of people. When travelling in groups, stay close together. Being in a group doesn't help if the individuals have spread apart along the trail.
- Pets should not accompany you when you are travelling in bear country. If you must take your pet, keep the animal on a short leash at all times. Unleashed dogs will harass bears and once scared, run back to their owner with an angry bear in pursuit.
- Do not wear perfumes or cosmetic products when you are travelling in bear country. Do not mask your human scent.
- All sanitary products should be stored in a similar fashion as food (stored at least 10 feet [3 meters] above site).
- Children should be kept very close by in bear country.
- Carry bear deterrents and know their limitations. Be familiar with how to use the deterrents, how to transport the deterrent safely and under what conditions it is most effective. Carry the deterrent in a belt, out in front and ready to grab at a moment's notice, never in your backpack.

5.4 Field Worker Precautions in Bear Country

5.4.1 Field workers should take extra precautions when working in bear country:

- Make every effort to go out into the field with another person; you should not be working alone in the field. One person can act as a lookout for the other. Keep watch for bear signs.
- Never approach a bear.
- Report where you are going and when you will return every time you leave camp. Have a plan of action if someone does not report back to camp at a specified time.

- Bears do get used to a camp's schedule and you will have fewer surprise encounters if everyone in the camp comes and goes at the same time every day.
- Take a two-way radio with you when you go out into the field.
- Always carry bear deterrents with you in the field and understand each deterrent's limitations. Carry your deterrents on a belt, out in front and ready to use instantly. Do not carry your deterrents in your backpack.
- Keep any food that you take with you sealed in odor-proof/bear-proof containers. Make every attempt to take odorless food with you, not something with a heavy scent.
- Pack out any garbage in odor-proof containers and burn once you return to camp.
- The noise of an ATV or skidoo can scare off a bear. Starting the machine and revving it up can scare off a curious bear. DO NOT CHASE A BEAR WITH AN ATV OR SKIDOO. You may need to drive the ATV around in circles to scare off the bear, but do not chase the bear.
- Take extra precautions when travelling along lakes or stream beds; bears use streams and river beds as travel routes. Be sure to carry noise makers.
- Limit your workday so you are not out in the early morning or evening when bears are most likely to be foraging.
- All **employees** should be proficient in First Aid. Do not go out into the field without first aid training.
- All field camps should have a First Aid Kit.
- All field camps should have means of communication with local ambulance or air ambulance personnel.
- A person's best defense against bears is to avoid them. If this is not possible, then being heard, smelled, or seen may lessen your chances of surprising a bear and/or provoking an attack.
- All wildlife should be respected, avoided, and not harassed at any time.
- Cooking in remote areas should be avoided. Any food should be stored in airtight containers and all garbage should be managed appropriately: "pack it in, pack it out".
- A bear in camp or within human structures is not a chance encounter. If this bear challenges you, you must fight, scream, and do whatever is necessary to live, no matter what species the bear is!
- In general, there are two types of bear encounters: Defensive and Non-defensive for grizzly bears and black bears. Your response will vary based on your assessment of the situation (your training will help you in identifying these situations and the appropriate response).

6.0 Encounters

6.1 General Recommendations When Encountering a Bear

- Consider your surroundings and assess the situation before you act.
- Remain calm. Do not turn your back to a bear.
- DO NOT RUN – Running may trigger the bear's natural pursuit response. Bears are able to reach speeds of 25 miles per hour [40 kilometers per hour], must faster than Olympic sprinters. Bears are also excellent swimmers.

6.2 Bear Encounters in the Field

6.2.1 Your response will depend upon the type of encounter.

6.2.2 Bears are more predictable than once believed and you can determine your best course of action in a confrontation by understanding the bear's characteristics and motivation. There are two pieces of information you should be aware of in any bear encounter:

- The type of bear you are dealing with, and
- The reason for the encounter.

6.2.3 Some people believe that when you stand your ground against a predatory black bear attack, the bear will feel threatened and leave. This has been effective in some cases. HOWEVER, it is not effective against a grizzly bear predatory attack and it is very difficult to know when it will be effective against black bears. Polar bears do not follow the same behavioral patterns as grizzly and black bears; polar bears are almost always aggressive and will not back down. Special considerations must be given to projects where polar bear encounters are anticipated.

6.3 If you can leave undetected:

6.3.1 Leave the area quietly in the same direction that you came from.

6.3.2 Move while the bear's head is down. Stop moving when the bear lifts its head to check its surroundings.

6.3.3 Stay downwind so the bear will not pick up your scent.

6.3.4 When you have moved a safe distance away, you can either watch and wait until the bear leaves or make a wide detour around the bear.

6.3.5 If the bear is unaware of you and approaching, allow the bear the right of way.

6.4 If you cannot leave undetected:

6.4.1 Let the bear know that you are present by smell first; therefore move upwind so they can pick up your scent.

6.4.2 If it is possible, try to keep the bear in your sight. Watch to see if the bear leaves when it smells that a person is nearby.

6.4.3 Attempt to move out of the way without being noticed by the bear. If you cannot do this, talk loudly to let the bear know where you are.

6.5 If the bear is aware of you but in the distance:

- Remain calm.
- Continue walking slowly in the same general direction, but head away from the bear.
- DO NOT RUN.
- If the bear begins to follow you, drop your pack or some article, (not food) to distract the bear. This may distract the bear long enough for you to escape. If you drop food for the bear – you will help the bear associate food with humans and teach it that aggressive behaviour will be rewarded with food.
- If it is a grizzly following you, climb a tree if there is a large tree around. Proper escape up a tree would require sclimbing at least 33 feet (10 m), however this is applicable only to Grizzly encoutners. Black bears are excellent climbers. Tree climbing should be last resort.

6.6 If the bear is aware of you and close:

- A bear will feel threatened in a close confrontation. The bear's natural tendency will be to reduce or to remove the threat. Assist the bear by acting as non-threatening as possible.
- Do not make direct eye contact with the bear.
- Do not make any sudden moves.
- Do not run!

- The bear needs to identify you as a person, so talk in low tones and slowly wave your arms over your head.
- Attempt to give the bear an opportunity to leave. Be sure the bear has an open escape route. Do not corner a wild animal.
- Try to back away slowly and/or climb a tree if appropriate.
- Attempt to deter the bear if you are in a safe position.

6.7 If the bear is close and threatening:

- If you have a deterrent such as a bear banger or bear spray, be prepared to use it depending on how close the bear is. Try to scare the bear off.
- If you do not have a deterrent, or if using the deterrent is not successful, act as non-threatening as possible.
- Talk to the bear in a calm authoritative tone of voice.
- Do not startle or provoke the bear by making sudden moves.
- Never imitate the bear's aggressive sounds, signals or posture. The bear is attempting to establish dominance and imitating its moves is a challenge to its dominance.
- Back slowly away from the bear and drop a pack or some other article in order to distract the bear momentarily.
- Remember that the bear may be defending cubs that you have not yet seen or they have a food cache nearby. Attempt to look as non-threatening as possible.

6.8 If the bear is very close and approaching:

- A distance of less than 164 feet (50 meters) in an open area and closer in a forested area.
- If the bear continues to approach, use your deterrent.
- If the bear does not respond to the deterrent you must now STAND YOUR GROUND!
- If the bear continues to approach and is acting aggressive, YOU MAY HAVE TO SHOOT if you are carrying a firearm.

6.9 If the Bear Charges:

- A bear will charge you at high speed down on all four legs and often crouched low to the ground.
- Bears do not charge when standing up on the hind legs.
- Many charges are bluffs and the bear will often stop or veer off just at the last minute. It is difficult to know if the bear is bluff charging or not until it gets very close.
- When faced with a charging bear you have two options:
    - Use your bear deterrent; or
    - Roll into a ball and cover your neck and head with your arms if you are unarmed and have no other choice.

Americas

Small Mammals

S3AM-313-ATT11

1.0 Hazard

1.1 Working in the field either directly or indirectly with small mammals has inherent risks of injury or exposure to zoonotic diseases (infectious diseases that can be transmitted from animals to humans) that all field staff need to protect themselves against.

1.2 The risks are usually higher when there is direct contact with a wild animal, either through a break in the skin (blood), saliva, or excrement; however, there are also risks through air-borne diseases (e.g., Hantavirus).

1.3 Obviously, wildlife biologists directly handling wildlife, dead or alive, or working with wildlife feces or in enclosed habitats (such as caves), have an increased risk of exposure to a wider range of zoonotic diseases and should take extra precautions.

2.0 Personal Protective Equipment

2.1 Full-length clothing (long sleeves and pants)

2.2 Insect repellent

2.3 Respiratory equipment (when directly handling wildlife)

2.4 Gloves (when directly handling wildlife)

3.0 References

3.1 None.

4.0 Restrictions

4.1 Wildlife handling must only be completed under direct supervision of an experienced individual.

5.0 Training

5.1 Any staff that will be handling wildlife must be adequately trained and/or supervised by a wildlife biologist experienced in the job task.

6.0 Safe Work Practice

6.1 Wild animals can carry a variety of diseases that humans can contract: viral, parasitic, bacterial, and protozoal. Basic Personal Protective Equipment such as full-length clothing, gloves and a respiratory mask will greatly reduce the risk of exposure.

6.2 Treat unknown dogs encountered in field activities in the same manner as a wild animal. Be conscious of behaviors that seem to indicate anxiety (tail under the belly), defensiveness or aggressiveness, and attempt to leave the area if these are identified.

6.3 Whenever a wild animal must be handled, the procedure must be accomplished as safely and quickly as possible.

6.4 Proper techniques must be employed to avoid or minimize the risk of personal injury while, at the same time, avoiding or minimizing injury to the animal.

6.5 Gloves, catch sticks, caging, and other appropriate equipment may be necessary when handling a wild animal. Most of these animals will be extremely stressed, resisting every restraint attempt.

6.6 In the unfortunate circumstance that a person is bitten or scratched, he or she should cleanse the wound thoroughly with soap and flush with water immediately, providing for a mechanical removal of potentially infective organisms. This should be followed by cleansing under medical supervision and consultation with a physician to consider the potential exposure to the rabies virus.

7.0 Rabies

7.1 You will not be able to accurately determine if an animal has rabies simply by observation as traditional symptoms of rabies (foaming at the mouth, biting, etc.) do not occur in all animals nor at all stages. There are some mammals that are at a higher risk than others for the rabies virus, such as raccoons, skunks, stray cats and dogs, foxes, coyotes, rodents. and bats; however, any mammal can contract the virus.

7.2 Rabies is contracted by contact of an infected animal's saliva with an open wound – a bite or a scratch.

7.3 Symptoms of rabies in humans usually do not present themselves for a minimum of 10 days to a year or longer (the average is 30 to 50 days). Symptoms are typical of a flu, including malaise, loss of appetite, fatigue, headache, and fever. Over half of all patients have pain (sometimes itching) or numbness at the site of exposure. They may complain of insomnia or depression. Two to ten days later, signs of nervous system damage appear; these include hyperactivity and hypersensitivity, disorientation, hallucinations, seizures, and paralysis.

7.4 Because rabies is so difficult to detect and positively identify, it is very important to consult a physician immediately. If rabies is a possibility, begin treatment with the rabies vaccine as soon as possible (unlike other vaccines, rabies vaccination begins after exposure because the virus takes a comparatively long time to induce disease).

8.0 Hantavirus

8.1 Rodents can carry a variety of diseases; of notable concern is the North American hantavirus which can cause Hantavirus Pulmonary Syndrome (HPS).

8.2 A common host of the hantavirus is deer mouse and related species (*Peromyscus* spp.), which are common throughout much of North America.

8.3 Although infection is rare, it can be fatal and, therefore, it is necessary that risk of exposure be minimized. Infection can be spread to humans when they:

8.3.1 Breathe air contaminated by deer mouse saliva, urine or feces containing infectious hantaviruses; or

8.3.2 Accidentally rub eyes, mouth or broken skin with hantavirus-infected deer mouse saliva, urine or feces.

8.4 The following precautions will be taken for all field operations:

8.4.1 Limit exposure to soils handling and use gloves where appropriate.

8.4.2 Wash or sanitize hands often throughout the day and before meals.

8.4.3 Equipment bags, storage areas, and vehicles will be inspected daily for signs of deer mouse infestation.

8.4.4 Rodent-proof storage containers will be used when practical.

8.4.5 Do not enter buildings infested with deer mice without adequate respiratory protection.

8.4.6 Droppings should never be removed by vacuuming or sweeping. Wetting down an area with a mixture of 1:9 household bleach and water solution will reduce risk of airborne exposure.

8.5 If flu-like symptoms develop three days to six weeks after exposure to rodents, a doctor should be contacted immediately (mechanical ventilation is the primary method of treatment).

9.0 Bubonic Plague

9.1 The bacteria that cause plague, *Yersinia pestis*, maintain their existence in a cycle involving rodents and their fleas.

9.1.1 In urban areas or places with dense rat infestations, the plague bacteria can cycle between rats and their fleas.

9.1.2 Humans may contract the plague bacteria through:

- Infected flea bites.
- Contact with contaminated fluid or tissue of a plague infected animal.
- Infectious droplets from an infected person coughing into the air (very uncommon in the United States, but relatively frequent in developing countries.

9.1.3 Individuals infected develop sudden onset of fever, headache, chills, and weakness and one or more swollen, tender and painful lymph nodes (called buboes).

9.1.4 Immediate medical attention is necessary to prevent complications or death.

9.1.5 Rodent control measures should be employed at AECOM locations.

9.1.6 Wear gloves if handling potentially infected animals to prevent contact between skin and the plague bacteria. Contact the local health department with and questions about disposal of dead animals.

9.1.7 Repellent shall be used if there is potential exposure to rodent fleas. Products containing DEET can be applied to the skin as well as clothing and products containing permethrin can be applied to clothing (always follow instructions on the label).

Americas

Snakes & Scorpions

S3AM-313-ATT12

1.0 Hazard

1.1 Snakes have the ability to inject venom. A bite from a venomous snake, which may inject varying degrees of toxic venom, is rarely fatal but should always be considered a medical emergency.

2.0 Personal Protective Equipment

2.1 Long pants and shirts

2.2 Heavy gloves if staff will be handling debris or be close to the ground

2.3 Rubber boots, or boots that fully cover the foot (not sandals!) and preferably are at least 10 inches (25 centimeters) high

2.4 Snake Chaps that cover at least the shin

2.5 Personal first aid kit

3.0 Restrictions

3.1 Staff must not work alone in areas where the risk of a snake encounter is high.

4.0 Safe Work Practice

4.1 Prior to going into the field, staff should research the area and identify what species are present. Once confirmed, staff should contact local hospitals to identify which carry anti-venom and include that information into the SH&E Plan and THA.

4.2 Staff working in areas known to be inhabited by venomous snakes should take extra precautions, be able to identify the local snake species, and understand the best practices for administering first aid.

4.3 Most snakes in Canada are non-venomous; and most snake bites are not fatal, only painful. Learning to identify snake species will assist you in responding appropriately to an encounter, and will assist medical professionals in determining if antivenin needs to be administered if anyone is bit.

4.4 Most snakes are non-aggressive and will only attack if immediately threatened.

4.5 Prevention

4.5.1 Before venturing out into the wilderness, familiarize yourself with the snakes in your area, both venomous and non-venomous species.

4.5.2 Learn which habitats the venomous species in your region are likely to be encountered in, and use caution when in those habitats.

4.5.3 Try as much as possible not to take a snake by surprise.

4.5.4 Stay on trails where possible, and watch where you place your hands and feet, especially when climbing or stepping over fences, large rocks, and logs, or when collecting firewood. Take care when overturning any objects on the ground when in snake country.

4.5.5 If you see a snake, give it as much room as possible. Most snakes have a strike distance that is only half the length of their body.

4.5.6 If you get very close to a rattlesnake, hold very still until it calms down and starts to move away. Then slowly move backwards until you are at least one snake-body length away.

4.6 Treatment

4.6.1 A bite from a venomous snake should be considered a major medical emergency. Emergency services should be contacted immediately and staff should follow the direction of the medical responders.

4.6.2 Try to keep the snakebite victim still, as movement helps the venom spread through the body.

4.6.3 Keep the injured body part motionless and just below heart level.

4.6.4 Keep the victim warm, calm, and at rest, and transport him or her immediately to medical care.

4.6.5 Do not allow him to eat or drink anything.

4.6.6 If medical care is more than half an hour away, wrap a bandage a few inches above the bite, keeping it loose enough to enable blood flow (you should be able to fit a finger beneath it). Do not cut off blood flow with a tight tourniquet. Leave the bandage in place until reaching medical care.

4.6.7 Identify the snake that caused the bite to determine if it is venomous, and if antivenin needs to be administered. Do not waste time or endanger yourself trying to capture or kill it. Note the shape and color of the snake's head.

4.6.8 If you are alone and on foot, start walking slowly toward help, exerting the injured area as little as possible.

- Note that there are several species of snakes that superficially resemble rattlesnakes. Several species, including Bull, Milk, Fox, and Rat Snakes will even rattle their tails when startled.
- Massasauga Rattlesnake is recognized as a Threatened Species in Ontario and it is an offence to harass, or destroy the habitat of this species.

4.6.9 Workers in scorpion habitat have the potential to be stung.

- Scorpions usually hide during the day and are active at night. They may be hiding under rocks, wood, or anything else lying on the ground. Some species may also burrow into the ground. Most scorpions live in dry, desert areas. However, some species can be found in grasslands, forests, and inside caves.
- Scorpions are found in Southern and Southwestern United States.
- One scorpion species, the Northern Scorpion (*Paruroctonus boreus*) occurs in semi-arid areas of southern British Columbia, Alberta, and Saskatchewan. It carries a stinger on the end of its tail. The sting is painful but not life threatening unless there is an allergic reaction.
- Workers should wear longsleeves and pants. Clothing and shoes should be shaken out before putton on.
- Symptoms of a scorpion sting may include:
  - A stinging or burning sensation at the injection site (very little swelling or inflammation)
  - Convulsions
  - Staggering gait
  - Slurred speech
  - Drooling
  - Muscle twitches
  - Abdominal pain and cramps
- Scorpion stings may be painful, but most are harmless. In the United States, only the Bark Scorpion has venom that can potentially cause severe symptoms.
- Scorpions capable of lethal stings are found predominantly in Mexico and South America.
- If the is any question as to what type of scorpion caused the sting, contact medical services immediately.

5.0 Species

5.1 Venomous Snakes in Canada

Eastern Massasauga Rattlesnake (*Sistrurus catenatus*) found around Wainfleet, Windsor, Bruce Penninsula and eastern Georgian Bay in Ontario.	 Eastern Massasauga Rattlesnake picture by Michael Redmer/Courtesy Lincoln Park Zoo
Northern Pacific Rattlesnake (*Crotalus viridis*) found primarily in Okanagan and Thompson River valleys of southern British Columbia.	
Prairie Rattlesnake (*Crotalus viridis*) found in south eastern Alberta, and south western Saskatchewan.	

5.2 Venomous snakes in the United States

Rattlesnake(*Crotalus cerastes)* found mostly concentrated in the southwestern United States, they extend north, east and south in diminishing numbers and varieties. Every contiguous state has one or more varieties of rattlesnake. The rattlesnake is found in many different biomes ranging from along the coast at sea level, the inland prairies and desert areas to the mountains at elevations of more than 10,000 feet. Species include: Sidewinder, Santa Catalina, Western,	 Western Rattlesnake

Mojave, Red Diamond, Western Diamond, Ridge Nosed, Eastern Diamondback, and Pigmy.	 Eastern Diamondback
Copperhead (*Agkistrodon contortrix*) is the most common venomous snake found in the eastern United States. It can be found in the states of Texas, Oklahoma, Kansas, Missouri, Arkansas, Louisiana, Mississippi, Alabama, Georgia, Florida, South Carolina, North Carolina, Tennessee, Kentucky, Virginia, Illinois, Indiana, Ohio, Iowa, Pennsylvania, Maryland, New Jersey, Delaware, New York, Connecticut, and Massachusetts.	
Cottonmouths (water moccasins) (*Agkistrodon piscivorus)* found in the eastern United States from Virginia, south through the Florida peninsula and west to Arkansas, eastern and southern Oklahoma, and east and central Texas.	
Coral Snake (*Micrurus sp.)* found in the southern range of many temperate United States including North Carolina, Georgia, Alabama, Mississippi, Louisiana, Texas, Arkansas, Kentucky, Arizona, and New Mexico.	 Eastern Coral Snake, *Micrurus fulvius*

Americas

Working Alone

S3AM-314-PR1

1.0 Purpose and Scope

1.1 This procedure establishes the requirements for communication and accountability between personnel at a work site to reduce the potential for incidents occurring to one employee without help readily available and to facilitate the rapid mustering of assistance to employees in the event of an emergency.

1.2 This procedure applies to all AECOM America-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 **Buddy System** – A system of organizing employees at a work site in such a manner that each employee is accompanied by or in communication with at least one other employee or is escorted by a client or contractor representative during work site activities.

2.2 **Controlled Work Areas** – One or more designated work areas on a field project site where hazardous activities and/or strictly defined operations take place. Such controlled work areas include, but are not limited to, remediation or construction sites; a restricted radius where a critical lift operation will take place could be declared a controlled work area. On a HAZWOPER site, the controlled work area is divided into the exclusion zone, the contaminated reduction zone, and the support zone.

2.3 **Working Alone** – Performing work with no line of sight or direct voice communication with another person who is aware of your assignment and capable of initiating emergency response.

3.0 References

3.1 S3AM-005-PR1 Driving

3.2 S3AM-209-PR1 Risk Assessment & Management

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager or Supervisor**

- Establish if employee is permitted to work alone, through evaluation of employee's experience, training and any personal limitations (e.g. life-threatening allergic reactions).
- Provide the resources, communication devices, emergency response plans, and check-in procedures as listed in the Task Hazard Assessment (THA) or SH&E plan, etc. necessary so that employees are not working alone or have a buddy system in place.
- Act as point of contact if employees miss their check-in.

4.1.2 **Employees**

- Complete training as required to prepare for working alone.
- Confirm emergency contacts are provided to the Manager or supervisor in case of an emergency.
- Establish a buddy system and check in procedure in accordance with the THA or SH&E Plan provided by the Manager and Supervisor.

4.1.3 **SH&E Managers**

- Review and approve relevant planning documents entailing employees working alone and on remote travel.

4.2 General

4.2.1 All projects/programs shall conduct a review of all tasks performed by AECOM to establish specific work alone procedural requirements as defined here. They shall have at minimum a THA and SH&E Plan that has been reviewed by the SH&E Manager.

4.2.2 Employees are discouraged from working alone on any site due to the risk of delayed assistance in the event of an incident. If they will be out of contact with other employees, they shall establish a buddy system or check-in procedure with another employee or responsible person.

4.2.3 Employees working alone or in small crews in remote isolation shall have an effective means of communication including cell/radio/satellite phone as well as established check-in times.

4.2.4 When traveling alone, staff shall take appropriate precautions, including notifying someone of their travel plans as well as carrying a communication device and safety equipment, as appropriate. See *S3AM-005-FM1 Journey Management Plan*.

4.3 No employee shall work by themselves or without a buddy system established if they are conducting a hazardous job task.

4.3.1 The following tasks are considered hazardous:

- Working at heights.
- Working in a confined space.
- Working in a trench.
- Lock out/tag out tasks.
- Work on energized equipment.
- Working with electricity.
- Working with hazardous substances or materials.
- Working with material under pressure.
- Working where there is a possible threat of violence, including civil unrest.
- Working in avalanche areas.
- Working on water or ice.
- Working in remote or wilderness isolation.
- Working in a controlled area.
- Extreme heat or cold stress environments.
- Working with power tools/equipment.
- Working with/operating heavy equipment or machinery.
- Working in isolation from first aid services or immediate/emergency assistance.
- Working around mobile equipment.
- Highway and road work.

4.3.2 The following tasks (identified as hazardous) may permit working alone provided it can be demonstrated there is no substantial increased risk associated with working alone:

- Working with power tools/equipment (e.g. power drill versus chainsaw).

- Working with material under pressure (e.g. small air compressor versus compressed gasses).

4.4 Office Work

4.4.1 The supervisor shall have in place and shall communicate as part of location specific orientation, its procedures for the safety and security of an employee working alone in the office. Contact numbers to be used in case of emergency are posted at all common gathering areas or major exits.

4.4.2 Employees working in the office after regular working hours or in situations where they are working alone shall keep the entrance to the office locked.

4.4.3 If the building is monitored by a security service, employees working in the office after regular working hours or working alone shall notify the security guard of their presence and anticipated hours. If the building does not have a security service, the employee working alone shall notify their supervisor or a family member or friend if agreed to by their supervisor.

4.4.4 During all working hours, employees shall stay alert to unauthorized entries into the building and to other suspicious activities and shall report them to security or their supervisor immediately.

4.5 Field Work

4.5.1 Prior to work commencing, a THA shall be prepared for all assignments on which employees are to work alone (in accordance with *S3AM-209-PR1 Risk Assessment & Management*). The THA shall consider travel time, weather, available communications, and the impact of working alone when establishing risk ratings of the hazards associated with the task and work environment.

4.5.2 The THA should also consider whether the employee assigned to work alone has sufficient training and qualifications in the tasks to be performed to allow the employee to work safely alone. The employee's personal medical conditions may be considered if the employee has voluntarily made the medical condition known to the Manager or Supervisor.

4.5.3 The THA should identify the controls required for the safety of employees as applicable to the job task and location. Some controls associated with working alone or in remote isolation include a buddy system, standardized check-in times, what to do if a check-in is missed (e.g. worker in proximity attends site, utilizing secondary communication method, etc.), specialized communication devices, and enhanced emergency supply kits.

4.5.4 The THA is completed in addition to the SH&E plan which details the work activities and the procedures to manage the hazards and in accordance with *S3AM-209-PR1 Risk Assessment & Management*.

4.6 Buddy System

4.6.1 When conducting non-hazardous work, employees shall work with a buddy (another responsible individual) or follow check –in procedures listed in the THA or SH&E Plan.

4.6.2 When conducting hazardous work, employees shall work with a buddy (another responsible individual) at all times.

4.6.3 Once assigned as buddies, personnel shall remain in contact.

4.6.4 When electronic communication devices are used, prior to starting work, a protocol shall be established and agreed to by each buddy to confirm that periodic effective and faultless communications are maintained

4.6.5 When unanticipated conditions develop that do not permit line of sight and direct voice contact, and alternate communication was not established in the THA, Stop Work and notify the Supervisor. If permission from the Supervisor is obtained to continue the work, voice contact shall be achieved using reliable electronic communication devices such as, but not limited to, hand-held radio or cell phone. The THA shall be updated to reflect this change.

4.6.6 If crews will separate once they reach their work site, they shall then be considered to be "working alone". The buddy system or check-in procedures shall be established, as determined by the work being hazardous or non-hazardous and as identified in the THA.

4.6.7 Client or contractor personnel may be substituted for an AECOM employee's buddy only if they are designated by the client or contractor and the AECOM manager or supervisor, and are properly trained to the tasks and the site's emergency response procedures.

4.6.8 A missed communication event shall initiate the applicable missed check-in actions established in the THA (e.g. worker in proximity attends site, utilizing secondary communication method, etc.) and may trigger emergency response procedures. The results of each communication event shall be documented in the program or project files.

4.7 Check-In Procedures

4.7.1 All field crews shall establish check-in procedures as part of the THA or SH&E Plan prior to leaving the office. These procedures shall be reviewed daily as part of the Task Hazard Assessment review or more frequently if there is a change in work arrangements that could adversely affect a worker's well-being or a report that the system is not working effectively. These procedures shall be confirmed with the assigned Check-In Person daily.

4.7.2 The timing and frequency of those check-in procedures schedule shall be established prior to the initiation of field operations and shall vary depending on the task and location of the work.

4.7.3 If communication is lost between buddies or a check-in time is missed, it shall be assumed that an emergency situation exists, and the site's emergency response procedures shall be implemented. Site work shall cease until the emergency is resolved and the Supervisor directs personnel to restart work.

4.7.4 If crews will separate once they reach their field site, they will then be considered to be "working alone" and will establish a buddy system with the other members of the crew.

4.7.5 Employees working alone or in small crews in remote isolation will have an effective means of communication system including cell/radio/satellite phone as well as established check-in times.

4.7.6 The Check-In Procedure will be reviewed daily as part of the THA review or more frequently if there is a change in work arrangements that could adversely affect a worker's well-being or a report that the system is not working effectively.

4.8 Emergency Response Procedures

4.8.1 All field employees and the Check-In Person shall be provided with the location specific Emergency Response Plan (may be included in the THA or SH&E plan, or exist as a separate document).

4.8.2 The Check-In Person shall have access to a route map or understands their anticipated route of travel.

4.8.3 The established contact person shall follow the procedures below, with specifics established in the SWP Plan or THA, if a field employee has missed a check-in:

- First, they shall attempt to make contact with the field employee directly.
- If that fails to provide a response, they shall contact other persons who may have been on site, including client supervisors, or other locations where the field employee might be (e.g., hotel, home, office).
- If the field employee still cannot be located, the emergency contact person notifies the manager or supervisor responsible for the employee.
- Depending on the location and situation, they shall then dispatch another employee, another supervisor, or an appropriate emergency response agency (e.g., police) to travel to the last known location of the field employee.
- If the dispatched responder arrives at the site but cannot locate the field employee, the appropriate public emergency contacts (e.g., police, search and rescue) shall be made and the employee's personal contacts shall be notified by Human Resources.

- If the dispatched responder finds the crew in an emergency situation (medical, environmental, structural, etc.), the appropriate steps shall be taken to isolate the hazard, administer first aid, and contact emergency support services.

4.9 Training

4.9.1 All employees shall receive an initial orientation that includes the hazards and controls associated with working alone.

4.9.2 If working in wilderness, all field employees will be able to orienteer using a map and compass—if not, the basic skills of orienteering will be provided by an experienced employee before work commences. Refer to the *S3AM-314-ATT1 Wilderness Isolation* instruction for more specifics.

4.9.3 Employees working alone should be trained in First Aid. Consideration should be given to Wilderness First Aid training based on the anticipated work environment.

4.9.4 Employees regularly working in remote, isolated wilderness locations will either participate in a wilderness survival course from a qualified provider (one or two day) or will obtain management approval based on their level of experience/competence in wilderness situations.

5.0 Records

5.1 None

6.0 Attachments

6.1 S3AM-314-ATT1 Wilderness Isolation

Americas

Wilderness Isolation

S3AM-314-ATT1

1.0 Planning

1.1 Working in wilderness isolation presents many more potential hazards and should only be conducted by teams with documented experience, safety plans, and equipment appropriate for the tasks and conditions of the work.

1.2 A safety plan and Task Hazard Analysis will be reviewed by the SH&E Manager.

2.0 Safety Equipment

2.1 All field employees should regularly carry the following on their person:

- GPS Unit.
- Compass.
- Lighter, matches, or a "flint' of fire steel.
- A knife or folding saw.
- Map.
- First aid kit.
- Communication device appropriate to the type of coverage anticipated in the area.

2.2 When hiking long distances, it is recommended that a “mini survival kit” that includes the following items be carried in addition to the items listed above:

- Fire starter (tinder). Cotton balls with lip balm work well, or paper egg cartons with cotton balls and paraffin wax; if buying commercial fire starter, test it after several months.
- A whistle.
- Heavy tinfoil (to melt snow, to cook on, or to boil water in).
- Water and/or portable water purification device (e.g. steri-pens®).
- Some high-energy food.
- Cordage or rope (about 50 feet).
- Bear spray and/or bear bangers.

2.3 When using an ATV or helicopter for isolated work, it is recommended that a survival bag or backpack that can be left at a known muster point be put together. This bag should include the following items:

- Additional fire starter (tinder).
- Matches, fire steel.
- A multi-tool (like a Swiss Army knife).
- A folding saw.
- 3-8'x6" tarps plus one 12 X 16" tarp or larger (or a tent).
- 100 " of utility cord or parachute cord.
- A small pot.
- A small stove (a small folding military stoves with trioxethelyne tablets will work well).
- Closed cell foam pads or several square feet of double-wall bubble insulation (the silver sided bubble wrap used in construction) to use as a sleeping pad or for hypothermia treatment.
- Emergency Food.
- Water.
- Sleeping bag with a mylar® bivouac (bivy) sack to be used as a vapor barrier inside.

3.0 Drinking Water

3.1 No surface water can be considered safe for human consumption without treatment. Even the cleanest looking spring water could be polluted. Untreated water may be contaminated with bacteria, viruses, or protozoa.

3.2 On short trips, carry treated water or obtain water from another safe source.

3.3 When field projects take you into remote isolation where there is the potential for not having access to clean drinking water, be sure to take the appropriate tools with you: a water filter, tin foil or a pot for boiling water, or tablets or chemicals for treating the water prior to consumption.

3.4 Generally, the chances of finding safe drinking water in the mountains increase as you gain altitude. Intense sunlight at high altitudes kills undesirable bacteria and viruses but harmful cysts are unaffected.

3.5 Runoff water from streams below glaciers is often cloudy with silt and should be filtered.

3.6 Well water and moving rivers are the best locations to obtain water. Avoid stagnant water, shoreline water, and water close to human habitations and campsites.

3.7 During the winter, it is best to use an open water source or to obtain water through a hole in the ice. Check the safety of the ice first. Melting ice and snow consumes fuel and takes extra time. Eating snow or ice directly can lead to chilling and hypothermia and could also cause stomach cramps and headaches. Beware of colored snow, which indicates the presence of algae that could cause diarrhea if ingested. Even in winter, all water should be purified.

3.8 Water Treatment

3.8.1 Each method of water treatment has its advantages and disadvantages. Use only boiled or treated (filtered and disinfected) water for drinking, brushing teeth, or washing fruits and vegetables that will be eaten raw. Heat is the oldest, safest and most effective method of purifying water. However when boiling is not practical because of time and lack of a heat source, water should be treated by filtration and disinfection .This method may not be as effective as boiling the water.

3.8.2 Use two water containers: one for treating water and the other for carrying purified water. After disinfection, shake the container vigorously. Wait five minutes. Shake it again with the lid loose so that some water leaks out to cleanse the mouth of the container. Then pour the water into a clean container for drinking water.

3.8.3 Boiling. Bring the water to a boil for at least one minute (adding one more minute for each 300 m (1000 ft.) above sea level. If the water is cloudy, filter it before boiling.

3.8.4 Filtration. Water filters for use in the wilderness are available. Avoid filters that allow particles larger than 0.5 microns to pass. Filters with a pore size of 0.1 to 0.3 micron can remove protozoa and some bacteria but may not remove viruses. Filtration alone is insufficient to purify water; hence, it should be combined with disinfection to kill viruses and bacteria.

3.8.5 Disinfection. Disinfect with chlorine or iodine compounds, following the manufacturers instructions. Disinfection alone may not kill some protozoa..

Table 1: Summary of Water Purification Methods

	Boiling	Chlorine	Iodine	Filters
Bacteria	E	E	E	M
Viruses	E	E	E	N
Protozoa	E	M	M	M
Chemicals	M	N	N	N

E = effective M = may be effective (see text) N = not effective

3.8.6 Additional portable water purification devices are available, using methods such as ozone disinfection, ultraviolet purification, or solar water disinfection.

3.8.7 Water treatment methods should be evaluated for suitability to the work environment, the potential water hazards, and limitation of the device.

3.8.8 Some water-borne diseases are difficult to diagnose. If you are not feeling well and have recently drunk water from a source in the wild, inform your doctor that you may have consumed untreated water.

Americas

Driving

S3AM-005-PR1

1.0 Purpose and Scope

1.1 The purpose of this document is to establish policies and procedures for operation of AECOM-owned, rented, or leased vehicles, client or customer-owned vehicles, and personal vehicles used by AECOM employees.

1.2 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content. Policies and procedures related to the operation of commercial motor vehicles are in addition to this procedure; refer to *S3AM-320-PR1 Commercial Motor Vehicles.*

2.0 Terms and Definitions

2.1 **AECOM Business** – Any activity that is performed in the name of AECOM. This includes, but is not limited to, vehicle travel between work locations, client sites, meeting locations as well as driving performed as a part of work-related travel (e.g., driving to and from airports, hotels, train stations). AECOM business does not include driving that is a part of a daily routine commute from home to an AECOM location.

2.2 **Authorized Driver** – AECOM employees who receive manager approval following evaluation of driver criteria to drive and maintain an AECOM-owned, leased or rented vehicle, a client or customer-owned vehicle, or a personal vehicle operated in the course of conducting AECOM business. Authorized Drivers shall maintain a current driver's license with full privileges applicable to the vehicle to be operated. There are three categories of Authorized Drivers;

- Professional (AECOM employee who operates a commercial motor vehicle. Please refer to *S3AM-320-PR1 Commercial Motor Vehicles*).
- Hired (Employee's specific AECOM role is to drive employees in a normal street vehicle, which may or may not require commercial licensing by the applicable authorities. This category does not include busses or vans with a capacity of more than 12 people.).
- General (Driving is required as a part of the employee's job duties. This includes driving AECOM-owned, leased, or rented vehicles, client or customer-owned vehicles, or personal vehicles on AECOM business).

2.3 **Collision** – Any incident in which a motor vehicle that (whether in motion, temporarily stopped, or parked) makes contact with another vehicle or pedestrian, or results in property damage and/or bodily injury, regardless of who was injured, what property was damaged, or who was responsible.

2.4 **Commercial Motor Vehicle (CMV)** – Any self-propelled or towed motor vehicle used for AECOM business (e.g., to transport passengers or property) when the vehicle is one of the following:

- Has a gross vehicle weight rating (GVWR) or gross combination weight rating equal to or greater than the weight specified by the applicable jurisdiction (e.g.,U.S. $\geq$ 10,001 pounds [4,536 kilograms]); or
- Is designed or used to transport more than the number of passengers specified by the applicable jurisdiction, including the driver, for compensation; or
- Is designed or used to transport more than the number of passengers specified by the applicable jurisdiction, including the driver, and is not used to transport passengers for compensation; or
- Is used in transporting hazardous material in quantities ≥ 1,001 pounds (454 kilograms) combined total weight at any time.
- Refer to *S3AM-320-PR1 Commercial Motor Vehicles* for additional information.

2.5 **Distracted Driving** – An activity that takes the driver's attention away from the primary task of driving.

2.6 **Driving Under the Influence (DUI)/Driving While Intoxicated (DWI)** – The operation of a vehicle while under the influence of alcohol, drugs, medications, or other substances capable of inducing an altered mental state and/or impairing physical and mental judgments, such that the influence of the substances produces impairment in violation of the applicable governmental laws.

2.7 **Fatigue** – A general term used to describe the experience of being "sleepy", "tired" or "exhausted". The effect of fatigue is both physiological and psychological and can severely impair a driver's judgement. Fatigue can cause lapses in concentration which could prove fatal. Fatigue is not just a problem for drivers on long trips, as drivers can also suffer from fatigue on short trips.

2.8 **Incident** – For the purposes of this procedure, a vehicle collision or other event where personal injury or property damage occurs, or where a citation is issued while the employee is on AECOM business. This may also include acts of theft, vandalism, and criminal mischief.

2.9 **Journey Management** – A process for planning and executing necessary journeys safely.

2.10 **Local Laws** – Signs, postings, laws, regulations, ordinances and codes applicable for the jurisdiction in which the motor vehicle is being operated.

2.11 **Motor Vehicle Report (MVR) / Driver's Abstract** – A listing of the tickets (violations), incidents collision for an individual driver over a period of time (e.g., 3 years, 5 years) provided by a state or provincial authority such as the Department of Motor Vehicles.

2.12 **Personal Vehicle** – A motorized vehicle owned or leased by an employee.

2.13 **Portable Electronic Device** – A mobile electronic device that is used to receive or communicate voice, email, internet, and/or public media. The device requires user interaction (typing, dialing, reading, keying, etc.) that distracts the motor vehicle operator. Example devices include, but are not limited to:

- Mobile Communication Devices (MCD)
  - Mobile/Cellular phones
  - Two-way Radios
- Personal Data Assistant (PDA)
- iPads, iPods, or other tablet models
- Computers
- Global Positioning System (GPS) receivers

2.14 **Spotters –** Extra personnel that may provide guidance when maneuvering in close and/or complex situations in order to avoid the occurrence of an incident.

2.15 **Task Hazard Analysis (THA)** – A tool for evaluating work activities for the purpose of:

- Identifying the SH&E hazards and risks associated with the activity being performed;
- Identifying and implementing control measures to eliminate or reduce hazards and risks; and,
- Evaluating the effectiveness of control measures and making modifications as needed.

3.0 References

3.1 AECOM Global Travel Policy

3.2 RS2-001-PR Firearms Standard

3.3 S3AM-003-PR1 SH&E Training

3.4 S3AM-004-PR1 Incident Reporting, Notifications & Investigation

3.5 S3AM-009-PR1 Fatigue Management

3.6 S3AM-010-PR1 Emergency Response Planning

3.7 S3AM-209-PR1 Risk Assessment & Management

3.8 S3AM-314-PR1 Working Alone

3.9 S3AM-319-PR1 All-Terrain Vehicles

3.10 S3AM-320-PR1 Commercial Motor Vehicles

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager / Supervisor**

- Confirming employees are informed of the provisions of this procedure and related vehicle procedures.
- Providing a copy of this procedure to an employee who will be driving an AECOM-owned, leased or personal vehicle for AECOM business.
- Allowing employees to designate time to complete required driving safety training, vehicle inspections and related activities.
- Assigning driving tasks to authorized employees only.
- Selecting and providing vehicles for use by authorized employees that are appropriate for the planned working conditions and environment.
- Supporting employees in the reporting of vehicle incidents per *S3AM-004-PR1 Incident Reporting, Notifications & Investigations,* including the entry of the incident into the on-line incident management system (e.g., IndustrySafe).
- Confirm notification of AECOM Human Resources and Counsel upon receipt by an employee of a legal summons associated with a moving violation related to the use of a company vehicle.

4.1.2 **Employee**

- Follow this procedure and applicable laws while operating a vehicle.
- Complete assigned driver safety training based on the training matrix and any additional training assessments developed at the business group. Refer to *S3AM-003-PR1 SH&E Training, including S3AM-003-FM1 SH&E Training Matrix.*
- Report to the Manager / Supervisor if the vehicle selected is not appropriate for the working conditions and environment.
- Report to the Manager / Supervisor if the employee is inexperienced in operating the type of vehicle assigned.
- Report to the Manager / Supervisor if the employee is inexperienced in driving in the type of working conditions and environment assigned.
- Review the completed Task Hazard Assessment and complete journey management. If required, document the Journey Management Plan using *S3AM-005-FM1 Journey Management Plan* or equivalent.
- Immediately report vehicle incidents per *S3AM-004-PR1 Incident Reporting, Notifications & Investigations*, including the entry of the incident into the on-line incident management system (e.g., IndustrySafe).
- Notify the appropriate Manager / Supervisor and SH&E Manager upon receipt of a legal summons associated with a moving violation related to the use of a company vehicle.
- Immediately report a change or limitation(s) to his/her Driver's License to the appropriate AECOM Human Resources representative or his/her Manager / Supervisor.

- Conducting a pre-operational inspection of the vehicle for damage or deficiencies and reporting discovered deficiencies affecting the safe operation of the motor vehicle to the appropriate authority (e.g., supervisor, rental car agency, etc.).

4.1.3 **SH&E Manager**

- Maintaining and updating training resources for vehicle and driver safety.
- Providing guidance.
- Assisting operational leaders with determining the risk incurred by the use of motor vehicles.
- Assist in the incident investigation and review process.

4.2 General Procedures and Practices

4.2.1 Only Authorized Drivers are to operate a motor vehicle (rental, personal, client or customer-owned, or AECOM-owned/leased) while on AECOM business.

4.2.2 Drivers must comply with *AECOM's Global Travel Policy* and applicable laws, and employ safe driving practices. (NOTE: *Individual state, provincial, and local laws vary*.) Refer to *S3AM-005-ATT1 Authorized Driver Safety Practices*.

4.2.3 Authorized Drivers shall confirm their operating license is on their person, and valid registration and insurance is maintained with the respective vehicle prior to operation.

4.2.4 All local laws including, signs, postings, regulations, ordinances, and codes applicable for the jurisdiction in which the motor vehicle is being operated shall be adhered to.

4.2.5 At-risk driving behavior by AECOM employees shall be identified and managed accordingly.

4.2.6 Authorized Drivers must be at least 18 years of age (noncommercial license) or 21 years of age (commercial license) and have a current driver's license for the appropriate class of vehicle (unless more stringent requirements are established by the leasing/renting agency). Employees with conditional licenses are prohibited from operating vehicles on AECOM business.

4.2.7 If an Authorized Driver receives a citation resulting in their license being suspended, has his/her driver's license revoked, or is otherwise unauthorized to drive, he/she shall notify the appropriate AECOM Human Resources representative or his/her Manager prior to start of the following work day. Failure to do this may result in disciplinary action up to and including termination.

4.2.8 The office to which the vehicles are registered is liable for any damages to the vehicle being operated by an Authorized Driver.

4.2.9 Seat belts are to be worn by the occupants. The number of passengers shall not exceed the manufacturer's specifications for the vehicle.

4.2.10 The vehicle may not move until all passengers have fastened their restraints in the proper manner (e.g., lap belt secured and shoulder harness placed over the shoulder). Vehicles are not to be operated or used by AECOM employees if seatbelts are not included as part of the vehicle's safety equipment.

4.2.11 The vehicle's engine is to be turned off during refueling. Smoking or cellular phone use is not allowed while refueling.

4.2.12 Motorcycles may not be operated on AECOM business unless the following requirements are met:

- Specific approval is provided by the Supervisor with concurrence from the SH&E Manager.
- A hazard analysis is completed.
- Required training and license is in place.
- Headlights or daytime running lights will be used when the vehicle is in operation.
- A Class 2 or 3 safety vest and appropriate helmet shall be worn while operating a motorcycle.

4.2.13 When practical, drivers should travel during daylight hours and avoid driving during adverse weather conditions. Drivers should also inform colleagues of their travel itinerary including destination and anticipated departure and arrival times.

4.2.14 Fire arms and weapons are not permitted in AECOM-owned, leased or rented vehicles insured by AECOM. Firearms and weapons in personal vehicles are subject to the laws and regulations of the respective local, provincial, state, territory, federal and region and/or country. Refer to the *RS2-001-PR1 Firearms Standard*.

- Exceptions to this standard may exist where there is a credible and demonstrated risk to AECOM employees or assets, or when knives or weapons are required as part of the work activity. Under such circumstances, the exception must be approved by the Chief Resilience Officer, and must strictly adhere to the procedures set forth by the Global Resilience Group.

4.2.15 Vehicles are to be selected based on the nature of planned use. In some working conditions, specialized vehicles, such as four-wheel drive and higher clearance vehicle, may be required to confirm safe travel. These specialized vehicle requirements/specifications shall be identified in the project specific SH&E Plan and/or THA.

4.2.16 Vehicles are to be maintained according to manufacturer's specifications and the applicable environmental and operating factors (e.g. winterized with appropriate fluids, winter tires installed, appropriate coolant for hot climates, etc.).

4.2.17 Vehicles are to be outfitted with the appropriate support equipment based on the THA or client vehicle specifications. Support equipment may include, but is not limited to, cones, rotating warning lights, warning flags, vehicle identification (magnetic door signs or similar), wheel chocks, cargo nets, and rollover protection.

4.2.18 Drivers are to operate vehicles in a manner that avoids situations where backing is necessary. Whenever possible and as permitted, reverse parking of all vehicles while on business is required. A spotter shall be used when backing of trucks and heavy equipment presents a risk of collision.

4.2.19 Non-AECOM drivers (those other than AECOM employees [e.g., subcontractors, joint venture partners, clients, etc.]) are prohibited from operating an AECOM company owned, leased or rented vehicle unless the activity is specifically agreed to in the applicable contract and only if the use of the vehicle is consistent with the terms of the contract.

4.2.20 Authorized drivers required to operate vehicles with special hazards (e.g., trucks carrying fuel cells, vehicles used to tow trailers, vehicles with limited visibility, etc.) will be thoroughly briefed on the hazards and control measures necessary for safe operation of the vehicle. The local AECOM operation will maintain documentation of the briefing.

4.2.21 Define specific vehicle travel routes and parking areas at field sites through the use of fencing, cones, or other markings.

4.2.22 When a vehicle will be left unattended without an authorized driver in the driver's seat, the vehicle must be turned off, placed into park (or gear for manual transmissions), and the emergency brake set. When parked on a grade, the wheels or tracks of mobile equipment shall be either chocked or turned into a bank.

4.3 Distracted Driving

4.3.1 Distractions while driving are a major cause of incidents. Distractions include the use of cellular phones (including texting), eating, drinking, smoking, and engaging in intense conversations. AECOM Authorized Drivers must exercise proper control of the vehicle at all times, including the management of possibly distracting actions and behaviors.

4.3.2 The use of portable electronic devices that may distract the driver while driving is prohibited. This includes cell phones, two-way radios and other items whether hand-held or hands-free. Electronic devices include, but are not limited to, all mobile phones pagers, iPods, MP3s, GPS units, DVD players, tablets laptops and other portable electronic devices that can cause driver distraction.

- Employees shall not use a personal or company mobile communication devices (MCD) while driving any vehicle on AECOM business.
- Employees shall not use a company MCD while driving a personal vehicle.
- Driving includes the time spent in traffic or while stopped at red lights or stop signs.

4.3.3 GPS units and devices (e.g., smart phones, tablets) used for navigation may only be used if factory installed or secured to the vehicle with a bracket that allows the driver to view the image without having to take their eyes off the road. Note: windshield mounting brackets are not permitted in many jurisdictions, with dashboard mounts being acceptable. Consult jurisdictional requirements.

4.3.4 Electronic devices shall be setup for operation prior to commencing driving activities and shall not be changed by the driver while driving.

4.4 Impairment

4.4.1 Impairment can take many forms ranging from fatigue, to the use of prescription medication or alcohol (even small amounts), to the abuse use of illegal and legal drugs and alcohol. AECOM employees shall not drive in an impaired condition.

4.4.2 AECOM employees are prohibited from being under the influence of alcohol or drugs or improperly using medication in a way that could diminish, or raise questions concerning, an employee's ability to perform at his or her best while performing services for or on behalf of AECOM. Operation of vehicles while under the influence may void insurance coverage.

4.4.3 Drivers/operators will not drive or operate vehicles while under the influence of medications when told by a physician, another healthcare provider, or the manufacturer (e.g., instructions on the label) the medication could render the activity unsafe.

4.4.4 AECOM employees are prohibited from operating a vehicle if they are experiencing signs and symptoms of fatigue. Employees should stop work and rest before driving. No employee should operate a vehicle if they have worked 14 consecutive hours within a 24 hour period. Refer to *S3AM-009-PR1 Fatigue Management*.

4.5 Journey Management

4.5.1 When practical, alternatives to road travel should be evaluated including teleconferencing/video conferencing, the use of public transportation or carpooling.

4.5.2 Journey management is a process for planning and executing necessary journeys safely and may or may not be documented. Review the completed THA and complete the journey management process. If required, document a Journey Management Plan (JMP) using *S3AM-005-FM1 Journey Management Plan* or equivalent. The journey management process includes the following steps:

- Determining if the trip is necessary.
- Evaluating alternative safer modes of transport.
- Evaluating the potential to combine journeys with others.
- Planning the trip.
- Select the safest and most efficient route. Confirm compliance with any site specific specified routes, route rules, or restrictions.
- Confirm route planning factors in fatigue management. Refer to *S3AM-009-PR1 Fatigue Management*.
- Review road conditions and potential hazards associated with the route.
- Review weather conditions and forecast.
- If applicable, review *S3AM-314-PR1 Working Alone*.
- Confirm Emergency Response Plan includes procedures to be taken in the event of a collision or vehicle incident.
- Allow for adequate travel time.
- Inform others of destination, estimated time of arrival and routing.

4.5.3 Drivers who are to undertake trips in excess of 250 miles (400 km) each way, drive in remote or hazardous areas, or when otherwise deemed necessary, shall develop and document a JMP. This plan typically includes the route, location of route hazards, timing, rest periods and locations, communications, emergency response and security arrangements.

4.5.4 Drivers are responsible for developing the JMP and coordinating with the applicable parties identified in the plan.

4.6 Driver Safety Training

Authorized drivers shall have a current driver's license for the appropriate class of vehicle (unless more stringent requirements are established by the leasing/renting agency).

Driver safety training is to be assigned based on the risks posed with the work environment, driver type and vehicle type, using the training matrix and any additional training assessments developed at the business group level. Refer to *S3AM-003-PR1 SH&E Training, including S3AM-003-FM1 SH&E Training Matrix*. A determination of training type is at the discretion of the Manager / Supervisor, with the following guidance applied.

4.6.1 All Authorized Drivers (Professional, Hired, and General Drivers) shall be trained in this procedure; *S3AM-005-PR1 Driving*.

4.6.2 All Authorized Professional Drivers shall be trained in *S3AM-320-PR1 Commercial Motor Vehicles.*

4.6.3 Vehicle / Driver Safety Training

- Recommended for all employees who drive on behalf of AECOM (Professional, Hired and General Drivers).
- This may be completed online (e.g., AECOM University – Driver Safety).
- Recommended to be completed within 1 month of the Authorized Driver's hire date.

4.6.4 Defensive Driver (online) Training

- Recommended for all Authorized Drivers (Professional, Hired, and General Drivers) who are assigned an AECOM company owned, leased or rented vehicle for a significant period of time with the expectation that the employee utilizes the vehicle on a regular basis for AECOM business.
- It is recommended that authorized drivers who have completed web-based defensive driver training or equivalent also complete a refresher every three years.
- Defensive Driver training is available online through AECOM University (e.g., Alert Driving Basic, Alert Driving Skills) or one of the following AECOM-approved training resources:
  - The National Safety Council
  - Alert Driving

4.6.5 Defensive Driver (hands-on) Training

- Recommended for all Authorized Professional Drivers and Authorized Hired Drivers.
- Recommended for Authorized General Drivers who drive in remote locations, hazardous environments (such as refineries, ports, terminals etc.), at-risk drivers, and when required by clients.
- Defensive Driver hands-on training is provided through an AECOM-approved training resource, such as Smith Systems.
- Hands on defensive driver training may be required as a result of an incident or negative Motor Vehicle Report.

4.6.6 Driver Retraining

- Drivers involved in repeated motor vehicle incidents, incidents of sufficient severity or concern, or drivers identified as at-risk through review of their Motor Vehicle Report/Driver Abstract may

be retrained or, as applicable, subject to disciplinary action and refused the right to drive on behalf of AECOM.

- Retraining programs will be implemented at the discretion of the Supervisor and SH&E Manager.
- Employees eligible to continue driving shall be subject to a driver retraining program that may include any of the above programs or other training programs appropriate for the type of driving the employees performs.

4.6.7 Special Vehicles and Driving Conditions

- Vehicles such as All-Terrain Vehicles (ATVs), four wheel drive vehicles, motorized carts, snowmobiles, box vans and trailers (towing) require specialized training and supervision. For ATVs, Refer to *S3AM-319-PR1 All-Terrain Vehicles* for additional information.
- Use of these types of vehicles is limited to AECOM projects, therefore training and qualification programs for drivers will be project specific. The Manager / Supervisor shall work with the SH&E Manager to tailor training to the specific needs of the project.

4.7 Personal Vehicles (additional requirements)

4.7.1 The requirements of this procedure apply to the use of a personal vehicle for AECOM business. Additional requirements are set forth in the *AECOM Global Travel Policy*.

4.7.2 Personal vehicles driven by Authorized Drivers for business use must satisfy the jurisdiction's registration and inspection requirements and may not be modified beyond manufacturer's specifications.

4.8 Rental Vehicles (additional requirements)

4.8.1 The requirements of this procedure apply to the use of a rental vehicle for AECOM business. Additional requirements are set forth in the *AECOM Global Travel Policy*.

4.9 Requirements for Authorized Drivers

4.9.1 Review the *S3AM-005-ATT1 Authorized Driver Safety Practices* for specifics.

4.9.2 Drivers are not to permit unauthorized persons to operate an AECOM-owned/leased/rented vehicle.

4.9.3 All Authorized Drivers shall perform a walk-around inspection of the vehicle prior to operation.

4.9.4 Pre-operation vehicle inspections shall be performed and documented by all Authorized Professional Drivers and all Authorized Hired Drivers. A sample vehicle inspection checklist is provided in *S3AM-005-FM2 Vehicle Inspection Checklist*.

4.9.5 Vehicles with deficiencies that affect or could potentially affect the safe operation of the vehicle shall be removed from service and promptly repaired as necessary to permit safe vehicle operation.

4.9.6 As applicable, arrange for and/or coordinate with appropriate AECOM personnel to facilitate preventive maintenance services for the vehicle. Maintain it in sound mechanical condition, as per the manufacturer's recommendations provided in the owner's manual.

4.9.7 Do not operate the vehicle if unsafe maintenance conditions exist that would likely result in vehicle damage or personal injury. This applies to vehicles owned or leased by AECOM and to personally-owned vehicles used for AECOM business. Escalate other maintenance issues for correction to appropriate authority (e.g., manager, rental car agency, supervisor, etc.).

4.9.8 Transport only persons on AECOM related business or those persons receiving transportation as a prescribed service. Only drive vehicles in conditions for which the driver has the appropriate training and experience.

4.9.9 AECOM-owned, rented, or leased vehicles are for official business use only and are not to be used for personal activities. Exceptions to this requirement can be made only with the specific written approval of the Manager of the office or location the vehicle is registered to.

4.9.10 Smoking (including the use of e-cigarettes) and chewing tobacco is not permitted in AECOM-owned, leased or rented vehicles.

4.9.11 Drivers are responsible for damage caused by abuse of the vehicle.

4.9.12 Secure the vehicle when left unattended.

4.9.13 Securing loads in the inside and outside compartments of the vehicle.

- Do not rely on weight/shape of load alone. Always use a cargo net, straps, containers or other mechanical device when necessary to confirm load is secure.
- Mark loads that extend the beyond the end of truck, trailer or similar edge with a red warning flag of at least 16 square inches.
- Red lights will be utilized at night to mark loads that extend the beyond the end of truck, trailer or similar edge.

4.9.14 Do not modify existing equipment (warning sounds, backing alarms etc.) or install aftermarket equipment including toolboxes, truck caps, specialty lights, or towing equipment) without approval from the Manager of the office or location the vehicle is registered to and AECOM Procurement Department.

4.10 Emergency Preparedness

4.10.1 AECOM-owned or leased vehicles are to have a “Safety Kit” that contains a first-aid kit, portable fire extinguisher, safety triangle, and two reflective safety vests. If not available, contact the Manager / Supervisor or SH&E Manager to determine how to obtain a kit.

4.10.2 The following suggested items should be kept in vehicles used for AECOM business in remote project locations:

- First aid kit, appropriate to the work and crew size, or per regulations.
- Fire extinguisher, safety triangle, and safety vest.
- Emergency equipment (e.g., flares, flashlight, blanket, drinking water, etc.) based on conditions.
- Means of communication (cell phone, radio or satellite phone), extra batteries or a charger.

4.10.3 To the extent possible, employees should refrain from changing tires or making repairs to vehicles in the field.

- A road side assistance service should be identified for vehicles used for AECOM business in advance travel.
- If changing tires or making repairs to vehicles is necessary in the field, assessment of hazards shall be completed and all applicable safe procedures and manufacturer’s specifications shall be followed.

4.10.4 Specific emergency procedures are to be identified in the applicable Emergency Response Plan, JMP or the THA. Refer to *S3AM-010-PR1 Emergency Response Planning*.

4.11 Vehicle Incidents

4.11.1 Vehicle incidents are to be reported and managed in accordance with *S3AM-004-PR1 Incident Reporting, Notifications and Investigation* regardless of how minor the incident might be.

4.11.2 The Employee(s) involved in a collision shall follow the below guidelines:

- Assess the situation to confirm everyone is safe, and remove any vehicle occupants from harm’s way. Call, or have someone else call 911 immediately, if necessary.
- As appropriate, remain at the scene of a collision to contact the police. Ask another motorist to call the police if necessary; never leave the scene of a collision.

- As applicable, provide (if requested) to police and the other driver(s) the liability insurance information. Obtain the officer's jurisdiction, name, and badge number and a copy of the police report.
- As applicable, consider moving the vehicle out of the traffic flow if it is safe to do so, the vehicle is operational, and/or no further damage to the vehicle can occur.
- Do not operate a damaged vehicle if its safety is questionable, its operating condition is illegal by applicable laws or its condition is such that further damage would likely result from its operation.
- Turn on the vehicle's flashers to warn other motorists.
- Obtain:
  - Names, phone numbers, and addresses of owner(s), driver(s), and occupants of the other car(s) involved.
  - Other party's insurance company's name, address, phone number, policy number, and insurance agent.
  - Names, phone numbers, and addresses of all witnesses.
  - Photographs of the accident scene when safe to do so.
- Cooperate with AECOM Counsel if the incident results in unresolved risks or third party claims, or if the employee receives a summons, complaint or other legal documents relating to a traffic incident.
- DO NOT ADMIT LIABILITY, AGREE TO PAY FOR DAMAGE OR SIGN A DOCUMENT RELATED TO AN INCIDENT EXCEPT AS REQUIRED BY LAW.
  - Statements made in haste or anger may be legally damaging.
  - If contacted by a third party, do not answer any questions. Immediately report this contact to the Manager / Supervisor and/or Legal Counsel
- Employees shall report the incident to AECOM's Global Travel Department. If the incident involved a third party, the driver is responsible for obtaining a copy of the police report and providing to global travel

4.11.3 Employees must cooperate with the incident investigation team during any investigation of an incident meeting the investigation protocol.

4.11.4 Vehicle repairs shall be conducted at the authorization of the Manager / Supervisor.

4.12 Drug and Alcohol Testing

4.12.1 Testing for Alcohol and/or Drugs procedures shall be administered in accordance with the applicable policy and procedures. Refer to *S3AM-019-PR1 Substance Abuse Prevention.*

4.12.2 In the event that a police/regulatory officer responding to a vehicle incident administers field and/or laboratory impairment testing AECOM reserves the right, as permitted, to obtain copies of such testing results for inclusion in the incident report and consideration in a subsequent incident investigation.

4.13 Driving Privileges, Citations and Violations

4.13.1 A violation of this vehicle safety standard is subject review by the appropriate AECOM Human Resources representative and may be subject to disciplinary action, up to and including termination. The applicable Manager / Supervisor will review all incidents involving AECOM-owned, rented, or leased vehicles.

4.13.2 Citations and violations which occur while driving for AECOM business are to be reported as a vehicle incident in accordance with *S3AM-004-PR1 Incident Reporting, Notification & Investigation* within 24-hours. Incidents will be investigated as appropriate.

4.13.3 The AECOM Manager responsible for the employee, in consultation with the appropriate AECOM Human Resources representative, may suspend the privilege to operate vehicles on AECOM business due to noncompliance with the AECOM Vehicle and Driver Safety Program, involvement

in a motor vehicle incident, or resulting citations or other legal actions associated with motor vehicle violations.

4.13.4 The employee's driving privileges will be suspended for any of the following:

- Accidents or legal action involving alcohol or drug use (e.g., driving under the influence).
- Driving without a license.
- Hit-and-run driving or leaving the scene of an accident.
- Unauthorized use of AECOM vehicles (e.g., using an AECOM vehicle for moving personal items, carrying passengers who are not associated with work activities, etc.).

4.13.5 The employee's driving privileges may be suspended for any of the following:

- Two or more at-fault accidents involving the same Authorized Driver within a 12-month period.
- Multiple complaints from other employees or members of the public about driving performance.
- Any accident caused by an AECOM Authorized Driver where damages exceed $2,500.
- Failure to comply with the distracted driving requirements.
- Gross misconduct or violation of policy.

4.13.6 An Authorized Driver's driving privileges may be reinstated as follows:

- For any suspension resulting from law enforcement agency legal action involving drugs and alcohol on the part of the former Authorized Driver, driving privileges may be reinstated only by concurrent agreement of the Vice President of SH&E for the applicable Business Group and Human Resources Manager.
- For those Authorized Driver's privilege suspensions that are not related to driving under the influence of drugs or alcohol, privileges may be reinstated with concurrent agreement by the AECOM Manager, the SH&E Manager, and Human Resources Manager upon completion of required remedial training.

4.13.7 Disciplinary action may include the following:

- Loss of AECOM driving privileges.
- Disciplinary warning.
- Termination.

4.13.8 The employee is personally responsible for payment of fines for moving violations and parking citations incurred while driving a vehicle on AECOM business and for reporting such incidents to his/her Manager / Supervisor. The Manager is responsible for notifying Counsel.

4.13.9 If an Authorized Driver receives a citation resulting in the license being suspended from driving or has his/her driver's license revoked, he/she is required to notify his/her Manager / Supervisor prior to start of the following work day. Failure to do so may result in disciplinary action up to and including termination.

5.0 Records

5.1 Documentation of employee training completed shall be retained in accordance with *S3AM-003-PR1 SH&E Training*.

5.2 As applicable, completed *S3AM-005-FM2 Vehicle Inspection Checklists* and/or *S3AM-005-FM1 Journey Management Plans* shall be retained in project files.

6.0 Attachments

6.1 S3AM-005-ATT1 Authorized Driver Safety

6.2 S3AM-005-FM1 Journey Management Plan

6.3 S3AM-005-FM2 Vehicle Inspection Checklist

Americas

Authorized Driver Safety

S3AM-005-ATT1

1.0 Before Vehicle Operation

1.1 Learning and practicing good driving habits will help reduce the chance of a traffic collision. Learning to properly scan surroundings will improve hazard awareness and avoidance. With correct driving habits, errors can be significantly reduced and incident response time can be decreased.

1.2 All Authorized Drivers shall perform a walk-around inspection of the vehicle prior to operation.

1.2.1 Authorized Drivers should use the “Get Out And Look” (GOAL) method before placing a vehicle in motion. Drivers are to make a 360-degree (360°) walk around of the vehicle immediately before placing vehicle into motion in order to determine whether there are hazards or possible obstructions in the proposed path of travel. Drivers are to clear the area of people and objects before placing the vehicle in motion. A check will also be performed to confirm overhead and side clearances are adequate. The following are recommended best practices:

- Placement of cones on the right side of the front and rear of vehicle upon parking and retrieved during the 360° GOAL walk-around.
- In lieu of cones, place GOAL magnets on the right side of the hood and truck/tailgate of the vehicle upon parking. The GOAL magnets should then be retrieved during the 360° GOAL walk around just prior to moving the vehicle again.
- Place a GOAL sticker on the driver side door window as a reminder to get out and look.

1.2.2 Pre-operation vehicle inspections shall be performed and documented by all Authorized Professional Drivers and all Authorized Hired Drivers. A sample vehicle inspection checklist is provided in *S3AM-005-FM2 Vehicle Inspection Checklist*.

1.3 Drivers shall be familiar with applicable client rules and regulations when on the client’s sites. The employee may, for example, be required to leave their keys in the ignition with the vehicle turned off or to display a vehicle pass. When parking, it is recommended that employees back the vehicle into the parking space.

1.4 Drivers must be trained, competent and in possession of a current driver’s license that is valid to the jurisdiction and the vehicle driven. Any additional certification required given the particular vehicle and equipment transported must also be current (e.g. air brake certificate).

1.5 Execute proper travel planning to avoid being in a rush, traveling during peak traffic hours, and traveling through high traffic volume areas. Utilize the *S3AM-005-FM1 Journey Management Plan* as appropriate.

1.6 All drivers must be involved in a task hazard assessment applicable to the task(s) undertaken (may exclusively be the driving task or may include the driving task).

1.7 Confirm current insurance and registration is maintained with the vehicle and any equipment being towed. License plates must be clean.

1.8 As applicable, check all safety equipment (e.g. First Aid Kit, Fire Extinguisher, Flares, Triangles, Reflective Vest, etc.).

1.9 As applicable, check for survival gear and equipment. Emergency kits should include blankets, food, water, flashlight, extra batteries, a method of communication and a heat source such as a candle.

1.10 When accessing any pickup truck box, staff will: step up into the box to avoid excess reaching and strain and; use three point contact getting in and out of the truck box (i.e., avoid jumping off the tailgate).

1.11 Confirm no items are hanging from the rear view mirror that could obstruct vision.

1.12 Adjust mirrors to confirm optimal visibility.

2.0 Vehicle Operation – General

2.1 Be vigilant of differences between trucks and small cars related to blind spots, turning radius, and required overhead and undercarriage clearances.

2.2 It is a personal responsibility of the driver to operate a vehicle safely and in compliance with regulations (e.g. Cargo Securement, Traffic, Dangerous Goods, etc.).

2.3 Confirm compliance with applicable traffic legislation, driver regulations, and rules (e.g. commercial driver hours of service, state / provincial highway acts, municipal bylaws, private road/property owner rules, site specific rules, etc.).

2.4 All vehicle occupants shall wear seatbelts at all times.

2.5 Keep reflectors, lights and windows (inside and out) clean.

2.6 Window cleaner should be on hand for cleaning the interior of the windows as well as headlights that have become obscured due to road spray or slush.

2.7 A shovel and a supply of sand or gravel can help to extract a stuck vehicle that does not have traction.

2.8 Maintain good housekeeping practices and confirm items and loaded materials are secured from movement on both the interior (e.g. cab, glove box, etc.) and exterior (e.g. box, flat deck, etc.) of the vehicle.

2.9 Conduct en-route inspections as required to check cargo securement.

2.10 Pulling Over

2.10.1 Pull the vehicle off the road to a safe location as required by the applicable jurisdiction (e.g. rest stops, a side road, an unused approach):

- If, in the ongoing assessment of road and weather conditions, it has been concluded that travel is no longer safe (i.e. heavy rain, sleet), and wait until conditions allow for safe travel.
- To review or adjust navigation equipment and check cargo securement.
- To check telephone messages, text messages or to take notes.
- For interval breaks, to stretch and if fatigued (try to take a break every two hours).
- To manage and eliminate driver distractions.

2.10.2 If it is necessary to park a vehicle on the shoulder of an active roadway, park as far off the road as possible, and turn on the four-way indicators (hazard lights) prior to leaving the vehicle. Use cones or other warning devices, and wear a high visibility traffic vest.

2.10.3 Observe extra caution in and around emergency and construction zones.

2.10.4 Avoid unattended rest areas, when possible, and especially at night.

2.10.5 If the vehicle breaks down, attempt to get to a secured location. Call police or roadside assistance as appropriate.

2.10.6 Contact the police to help those with car trouble instead of stopping to assist.

2.10.7 When possible, employees should have a car mechanic or roadside assistance change or repair a flat tire. If the Driver or passenger must change a tire, the Driver and passenger must adhere to the manufacturer's specifications and observe the proper lifting technique and safety procedures. Proper lifting is addressed in *S3AM-104-PR1 Manual Material Handling*.

2.10.8 When parking or leaving a vehicle, the following procedures must be followed:

- Engage the transmission in park (automatic transmission) or first gear (standard transmission).
- Shut off the engine.

- Set the parking brake.
- Remove the ignition keys, and lock the vehicle.

2.10.9 If work (e.g., surveying) is required alongside an active road, park the vehicle behind the area of work to provide a barrier against out-of-control vehicles.

2.11 Backing Up

2.11.1 Keep reverse motion to a minimum as the most common incidents involve backing up.

2.11.2 Whenever possible, vehicles should be parked in a manner that prevents the driver from backing (reversing) upon departure. For example, the vehicle should be backed into a parking spot or drivers should select a parking spot that allows them to “pull” through” so that the vehicle is facing the direction of departure.

2.11.3 Confirm the area behind the vehicle is clear prior to and while reversing a vehicle.

2.11.4 All vehicles with limited visibility operated around workers or on a construction site:

- Should have an audible back-up alarm installed that functions automatically when the vehicle is put into rear motion; or
- Shall be backed up only when a signaler communicates that it is safe to do so.
- If a vehicle is not equipped with an audible back-up alarm, the operator shall sound the vehicle horn twice to indicate intention to back vehicle up.

2.11.5 Confirm compliance with applicable traffic legislation regarding backing up (i.e. Texas – An operator may not back the vehicle on a shoulder or roadway of a limited-access or controlled-access highway; Ontario – No driver of a vehicle shall back the vehicle upon the roadway or shoulder of any highway divided by a median strip on which the speed limit is in excess of 80 km/h; etc.).

2.11.6 Take the time to become acquainted with the area the vehicle is to be backed into.

2.11.7 Inspect the area to be backed into (i.e. walk around it by foot, identify obstructions and possible hazards).

2.11.8 Line up as straight as possible with intended final position prior to backing equipment or vehicle up.

2.11.9 If the area is congested with people or equipment a signaler SHALL be used.

2.11.10 Before putting the vehicle into motion, decide:

- The method of communication (hand signals, two-way radios or other means).
- If hand signals are going to be used, confirm both the driver and signaler agree on signals to be used.
- If two-way radios are being used confirm there is continuous voice contact between the signaler and driver. If there is nothing being transmitted on the two-way radio the driver shall STOP the vehicle.

2.11.11 While backing up:

- Confirm there is constant visual contact with the signaler when the vehicle is in motion if using hand signals.
- If driver loses eye contact with the signaler at ANY time, the driver shall STOP the vehicle until eye contact is regained. The exception is where the communication between the signaler and driver is conducted by two-way radio.
- When possible, the signaler shall stand on the driver’s side of the vehicle during motion.

- The signaler must always keep a safe distance from the vehicle or equipment and never stand directly in the path of motion. Refer to Safe Work Practice – Red Zone.
- While backing up using a signaler, the driver must confirm that the vehicle radio (not to be confused with two-way radio) is off and the windows are down (if possible) to avoid distraction and to be able to hear outside of the vehicle.
- If the driver notices anything out of the ordinary (despite what the signaler is directing) the driver will STOP the vehicle or equipment and assess the situation.
- If at any time the safety of any person or property is at risk, including that of the signaler, the signaler shall signal the driver to STOP the vehicle IMMEDIATELY.
- Any person (other than the signaler) can direct the driver to STOP the vehicle or equipment and the driver must take that as a valid direction to STOP.

3.0 If Vehicle is to be Left Unattended

3.1 Turn the ignition off, remove the key and set the emergency brake (if parked on an incline).

3.2 Lock and secure the vehicle.

3.3 Secure equipment and property in a locked trunk or tool chest.

3.4 Do not leave keys in an unattended vehicle.

4.0 Defensive Driving

4.1 Demonstrate an effective and positive driving attitude.

4.2 Use road courtesy, expect the unexpected and be patient. Do not rush or drive aggressively.

4.3 Follow and obey regulations.

4.4 Do not make sudden lane changes and always use signal lights.

4.5 Be Visible – Be seen by all other drivers, pedestrians, cyclists and others using or crossing the road:

4.5.1 Avoid driving in blind spots of other vehicles.

4.5.2 Confirm vehicle lights are on, working and clean before and during travel.

4.5.3 Confirm the vehicle's horn works and use it as necessary to warn others.

4.5.4 Tapping the vehicle brakes may provide a visible alert for following vehicles.

4.5.5 Confirm adequate distance to enable passing of other motorists safely.

4.6 If it is necessary to turn a vehicle around, confirm that the operation is conducted safely and according the applicable traffic legislation and rules.

4.7 Always operate a vehicle within operator driving limitations. Do not be enticed by others to exceed driving capability for any reason. When behind the wheel, drivers must be in control of all driving related situations.

4.8 Maintain awareness of all objects in the immediate circle of influence. Whenever possible, stay well clear of other vehicles, machinery, equipment and pedestrians.

4.9 Scan Ahead – Check the path of travel for obstacles and other vehicles:

4.9.1 Utilize three driving monitoring zones (should not be confused with safe following distances):

- Action Zone (approximately 4 to 6 seconds in front of the vehicle) – activity in this zone generally requires immediate reaction by the driver.

- Planning Zone (at least 15 seconds in front of the vehicle) – look ahead to visually identify if there is slowing traffic or another type of road hazard ahead or to the side. Do not drive behind vehicles that block visibility.
- These zones may require enlarging based on speed and driving environment (e.g. traffic congestion, weather, etc.).

4.9.2 Get the big picture and look for hazards (other motorists, pedestrians, cyclists, road debris, etc.).

4.9.3 Moving eyes every 2 seconds can help to avoid fixating on any one object. Check rear view mirror every 5 to 8 seconds and any time braking.

4.9.4 Read and obey traffic signage and controls.

4.9.5 Use high beam head lights when possible.

- Use low bean headlights when following closely behind other vehicles or when approaching and meeting oncoming traffic.
- Use low beam headlights in fog or heavy snow.

4.9.6 Wear appropriately tinted sunglasses to improve visibility in sunny conditions. Do not wear sunglasses at night and, if wearing at dusk or dawn, confirm the tint is of the type that improves and does not hinder visibility.

4.10 Keep a Space Cushion:

4.10.1 Maintain a space cushion around the vehicle to improve the potential of avoiding a collision. Create an out by monitoring the space in front, behind and to each side of the vehicle, leaving enough area as a cushion to enable evasive action if needed.

4.10.2 Maintain a minimum of 2 seconds plus 1 second for every 10 feet (3m) of vehicle length between the vehicle driven and the vehicle ahead:

- Pick a marker on the road ahead, such as a road sign or pole.
- Count "one thousand one, one thousand two”.
- When the front of the driven vehicle reaches the marker, stop counting.
- If the marker is reached before "one thousand two," increase the space cushion.
- Add more time (space) in poor driving conditions.
- Add more time (space) if the vehicle operated is heavily loaded.
- Add more time (space) if the vehicle ahead is smaller and lighter and may stop more quickly than the vehicle operated.

4.10.3 When stopped behind another vehicle leave 1 vehicle length between the vehicle driven and the vehicle ahead.

4.10.4 Do not travel in a traffic cluster. Manage the space to the front, left and right of the vehicle driven.

4.10.5 Fog, heavy rain, snow, slush or wind require speed and distance between vehicles to be adjusted accordingly.

4.11 Recognize and Anticipate Hazards:

4.11.1 Exercise increased caution at night, dawn and dusk.

4.11.2 When driving at night look to the right of the on-coming headlights and not directly head-on.

4.11.3 Identify changing road hazards or conditions.

4.11.4 Identify changing weather or driving conditions:

4.11.5 Light rain and heat can draw oil to the surface of asphalt creating slippery driving conditions.

4.11.6 Heavily rain soaked roads can result in a vehicle hydroplaning / aquaplaning.

4.11.7 Fluctuating cold temperatures may produce ice.

- Open hilltops may become icy due to blowing snow accumulating and freezing on the road.
- Shaded areas, such as overpasses and bridges, will freeze first and dry out last. These locations are prone to black ice.
- Be aware that black ice may be very difficult to spot. Darker, glossy spots may indicate black ice.

4.11.8 At dawn or dusk, the low sun can create a significant visibility hazard.

4.11.9 Be aware of changing conditions (i.e. traffic patterns, accidents, traffic lights, other vehicles).

4.11.10 Watch for large loads or slow moving agricultural equipment:

- Exercise extreme caution, provide extra room and pass only if it is safe to do so.
- Be aware that large loads or heavy equipment cannot stop as quickly as smaller vehicles and require a longer stopping distance.
- Never pull directly in front of these vehicles after passing or merging, but leave adequate space to confirm safe operation.
- Signal well in advance of any intended maneuver to give large vehicles additional time to react.

4.11.11 Avoid travelling in the blind spots of other vehicles or mobile equipment.

4.11.12 Scan road and shoulders for wildlife and pedestrians:

- Animals may travel in groups. Maintain heightened awareness when spotting one.
- Leave plenty of room when driving around an animal on or near the road – a frightened animal may run in any direction.
- Honk in a series of short bursts to make animals move out of the way.
- Avoid *swerving* for wildlife as this could result in veering into oncoming traffic.

4.12 Reduce Speed:

4.12.1 Adjust speed to accommodate traffic flow and patterns.

4.12.2 Adjust speed to all weather pattern changes (Rain/Hydroplaning, Ice & Frost/Traction Loss, and Restricted Visibility).

4.12.3 Adjust speed in response to inconsistent road surfaces.

4.12.4 Reduce speed when required by law, in construction zones and school and playgrounds.

4.12.5 Safely and appropriately reduce speed upon observing any hazard to increase reaction time.

4.12.6 Always be prepared to brake at an intersection.

4.12.7 Always come to a full stop at uncontrolled railway intersections and verify it is safe to proceed.

4.12.8 Make eye contact with other motorists at intersections (particularly uncontrolled intersections) before proceeding.

4.12.9 Never assume other motorists are following and obeying road rules.

4.12.10 Keep to the right of the road or in the right-hand lane on multi-lane roads unless turning left or passing another vehicle.

4.12.11 Confirm driving practice and vehicle position allow for a defensive or avoidance maneuver.

4.13 Eliminate Distractions

4.13.1 Confirm appropriate time is taken to become acquainted with an unfamiliar vehicle prior to driving.

4.13.2 Do not operate a vehicle if preoccupied, agitated or have existing health issues that could potentially pose a safety issue.

4.13.3 Do not operate a vehicle if under any form of impairment (i.e. fatigue, alcohol, drugs, etc.).

4.13.4 Remain engaged. Do not succumb to boredom, complacency, or allow the focus to drift from the driving task.

4.13.5 Remain focused on driving defensively and follow any given direction when passing an accident scene.

4.13.6 Avoid any activity that requires moving a hand from the steering wheel (e.g. changing radio stations, handing articles to passengers, etc.).

4.13.7 Do not engage in activities that may distract from the driving task (e.g. operating navigation systems, ridding the cab of an insect, etc.).

4.13.8 Do not engage in eating or drinking that may distract from the driving task.

4.13.9 The use of electronic devices that may distract the driver while driving is prohibited. This includes cell phones, two-way radios and other items whether hand-held or hands-free (a simple text message sent while travelling at highway speed results in an operator's eyes being off the road for the length of a football field).

5.0 Road Rage

5.1 Road rage is a dangerous driving situation that can occur and should be avoided whenever possible, but NEVER instigated. Do not get drawn into a confrontation. Avoid any confrontational eye contact or gestures.

5.2 The driver should be aware of the vehicles around them, paying frequent attention to the vehicle's mirrors.

5.3 Get out of the way if safely possible, even if the other motorist is speeding. The other driver may be dealing with an emergency situation.

5.4 Unless it is necessary to use the horn as an alert, do so sparingly.

5.5 If followed after an on-the-road encounter, drive to a public place or to the nearest police station and seek assistance.

5.6 Attempt to note the offender's license plate number and write it down as soon as it is safe to do so and the vehicle is not in motion.

5.7 Report any aggressive driving to the police immediately. This action may aid in preventing further occurrences by the same driver.

6.0 Winter Driving

6.1 Clear snow from exterior vehicle surfaces.

6.2 Do not cruise control on icy roads.

6.3 Accelerate and brake gently to reduce skids or spinouts.

6.4 Wear winter clothing that does not restrict movement, vision or hearing.

6.5 Where required, have snow chains for the vehicle and be familiar with their installation.

6.6 Use extra caution while driving during hazardous winter conditions.

6.7 Avoid sudden changes of speed or direction to reduce possibility of skidding.

6.8 Drivers should leave extra distance between their vehicle and the vehicle ahead of them. Stopping on ice takes approximately eight times the distance that it takes on dry pavement.

6.9 Carry suitable warm clothing and emergency equipment during the winter months. Temperatures can plunge rapidly.

6.10 Be aware of icy patches on the road bridges and intersections that are especially prone to icing.

6.11 Be familiar with the skid control procedures for the type of vehicle being driven (e.g., front, rear or four-wheel drive).

7.0 Gravel Roads and Remote Locations

7.1 Prior to driving on a road with an assigned radio frequency, the passenger will test the two-way radio to confirm that the proper radio frequency is set, and that the transmission is being received clearly by other traffic. The passenger will operate the two-way radio.

7.2 Drivers will maintain appropriate speed for the road conditions.

7.3 Headlights will be used when operating the vehicle.

7.4 Drivers will respect the understood road protocol, drive defensively and respect intersections.

7.5 4WD options will be utilized at the discretion and comfort level of the driver. If road conditions are questionable even for 4WD use, the road will not be traveled and either another route found or the job postponed until road conditions improve.

8.0 Off-road

8.1 If inexperienced, seek supervisory advice and training.

8.2 Vehicles should only be driven off roads after other available options (e.g., use of ATV's, etc.) have been considered.

8.3 Prior to driving off-road, check to see that the vehicle is in good operating condition and tires are properly inflated.

8.4 Realize the limitations of the vehicle and do not become over confident.

8.5 Seat belts should be kept fastened and loose objects in the vehicle securely fastened to prevent them from becoming projectiles in the event of a sudden stop.

8.6 Drive according to the ground conditions.

8.7 Speed and power are normally not required in rough off-road driving.

8.8 Learn to read the surrounding terrain. Monitor the ground conditions ahead of the vehicle -- it is essential to know what to expect in light of the road conditions.

8.9 When slowly traversing difficult areas of soft ground, try to keep the vehicle in motion.

8.9.1 Once stopped it is far more difficult to get the vehicle going again.

8.9.2 If the vehicle becomes stuck, do not spin the wheels, as they will only dig in further or deeper until the vehicle chassis rests on the ground.

8.9.3 Try to slowly back the vehicle in its own tracks, as these have been previously compressed by the vehicle. In most cases this will be successful. If not, place appropriate material (e.g., wooden planks, mats, branches, etc.) under the wheel to improve traction.

8.10 Before driving over rough terrain, the terrain should be inspected on foot first.

8.11 When climbing hills in the vehicle travel straight up or down.

8.11.1 Be aware of what is on the other side of the hill prior to climbing.

8.11.2 At the base of the hill the driver should apply more power. Ease up on the power while approaching the top and before going over the crest.

8.11.3 If the vehicle stalls on the ascent, back straight down the hill in reverse.

8.11.4 For downhill travel in a vehicle with manual transmission, always use the lowest appropriate gear, and do not disengage the clutch to allow the vehicle to coast. If the vehicle is equipped with an automatic transmission, use low range and the lowest drive setting.

8.11.5 DO NOT drive a hill at an angle this increases the risk for a roll-over incident.

8.11.6 DO NOT attempt to climb a very steep hill if there is doubt the vehicle can successfully climb the hill.

8.12 When driving through water, consider the maximum wading depth of the vehicle.

8.12.1 The air intake must always be kept clear of water.

8.12.2 Driving through water should always be done slowly to keep the bow wave low.

8.12.3 In addition, slow speed prevents a hot engine from suffering tension cracks by sudden contact with cold water.

8.12.4 Check the brakes after leaving the water.

8.13 Prior to returning to the road, do a vehicle inspection to confirm the vehicle is road worthy.

9.0 Towing

9.1 Conduct a pre-start inspection of the equipment to be towed.

9.2 Only hook-up equipment, using a signaler to do so, that has been verified as safe for transport.

9.3 Confirm the hitching equipment of the vehicle and that of the equipment to be towed are compatible.

9.4 Always inspect the hitch for defects and to confirm it is securely closed (e.g. safety pin in place, safety chains hooked up using the “crossed” or “cradle” method, locking devices on hooks).

9.5 Confirm light cord is plugged in and any emergency braking devices are hooked up. Verify all lights are in working order.

9.6 Conduct a brake test prior to travelling.

9.7 Confirm speed of travel does not exceed the manufacturer’s specification for the equipment towed.

9.8 Maintain awareness of total dimensions of the vehicle plus the equipment towed. Adjust driving accordingly (i.e. widen turning radius, increase distance between vehicles).

Americas

Journey Management Plan

S3AM-005-FM1

Project:	Journey Management Plan Identifier # (optional):
Project Specific Requirements:	
Journey Management Plan – Minimum – required for trips > 250 miles / 400 kilometers (one way) and as identified in the project specific requirements.	
1. Driver and Passenger Information	
Driver Name:	Driver Training Completed:
Passengers:	
2. Vehicle Information	
Company Owned ☐ / Rental / Leased ☐ / Personal ☐	
Vehicle Type/Description/Registration No.:	
3. Trip Information	
What is the purpose of the trip?	Estimated distance:
Single Trip: ☐ Reoccurring Trip: ☐ / / to / /	
This Journey Management Plan is to be assessed and reviewed prior to each trip.	
Have alternate modes of travel (telepresence, public transportation, air, train) been evaluated? ☐ Yes ☐ No	
Has a Safe Work Plan or Task Hazard Assessment been completed and attached? ☐ Yes ☐ No ☐ NA	

Destination 1:			
Departure Date:	Time:	Arrival Date:	Time (ETA):
Destination 2:			
Departure Date:	Time:	Arrival Date:	Time (ETA):
Destination 3:			
Departure Date:	Time:	Arrival Date:	Time (ETA):
Destination 4:			
Departure Date:	Time:	Arrival Date:	Time (ETA):

4. Special Conditions / Hazards (Check all that may apply)	
☐ Night Driving ☐ Weather ☐ Road Conditions (e.g., construction, ice, snow) ☐ Rush Hour/Heavy Traffic ☐ Long Driving / Fatigue (Over 2 hours) ☐ Potential for distraction	☐ Rugged Terrain (4 x 4 ☐ Large Vehicles ☐ Animals ☐ Towing (e.g., trailer) Other
Additional Conditions / Hazards Details:	
Weather forecast:	

5. Contact Information	
Traveler No. 1 (Driver) - Name:	Phone No:
Traveler No. 1 (Driver) - Personal Contact Name:	Phone No:
Traveler No. 2 - Name:	Phone No:
Traveler No. 2 - Personal Contact Name:	Phone No:

Traveler No. 3 - Name:		Phone No:
Traveler No. 3 - Personal Contact Name:		Phone No:
Manager - Name:		Phone No:
Check-In Contact - Name:		Phone No:
Alternate Check-In Contact - Name:		Phone No:
Destination Contact (if applicable) - Name:		Phone No:
Other (description)	Name:	Phone No:
Other (description)	Name:	Phone No:

6. Route of Travel

Route of travel (insert map or give detailed route directions):

Is the return route of travel the same? ☐ Yes ☐ No

7. Check-In Procedure

- Check-In Interval -
- Advise Manager and any other applicable personnel of travel plans and supply with a copy of this form (including attachments)
- Confirm availability of Manager or Check-In Contact. Confirm check-in interval with Manager or Check-In Contact.
- Discuss with contacts the possibility of travel within a cell phone “dead zone”.
- Advise Manager or Check-In Contact of departure.
- Call Manager or Check-In Contact upon arrival at destination (e.g. worksite, office, home).
- If multiple destinations, the process is repeated.

7.A Missed Check-In Procedure for Manager

- Attempt to call traveler(s) using contact number(s) listed above.
- Contact traveler’s personal contact listed above.
- If unsuccessful, discuss options with Manager, Check-In Contact (is anyone nearby who can be sent out along the route to destination, how much daylight remains, etc.?).
- Call 911 or local police.

8. Emergency Planning

AECOM Supervisor	Name:	Phone Number:
AECOM Manager	Name:	Phone Number:
Roadside Service:		
Emergency: 911 or equivalent	Incident Reporting:	

9. Approvals: All Journey Management Plans shall be reviewed and acknowledged by the driver and the driver’s manager / supervisor. Copies of the form shall remain with the driver and the manager / supervisor for the duration of the journey. (Electronic copies are acceptable).

Driver’s Signature:

Manager or Supervisor	Name:	Signature:

Americas

Vehicle Inspection Checklist

S3AM-005-FM2

Vehicle Tag No:	Mileage:	Date:	Time:	Driver Name:	Location:

Inspection Checklist: This Pre-Trip Vehicle Inspection Checklist is intended to be completed by the vehicle driver prior to departing on a trip. Checking boxes means that item is present and functioning. Deficiencies that affect or could potentially affect the safe operation of the vehicle shall be repaired or corrected prior to departure. This checklist should only be used in addition to an on-going vehicle maintenance program.

Item	Yes	No	N/A
1. General			
1-1 Proof of insurance and registration available and current?	☐	☐	☐
1-2 Is the date of the last regular maintenance known, or is the mileage/date of next scheduled maintenance known?	☐	☐	☐
1-3 Is the overall condition of the vehicle good (no body damage, unusual sounds, leaks, odors, etc.)?	☐	☐	☐
2. Tires			
2-1 Do all tires have sufficient tread for driving conditions? Legal limit: 2/32" (for rain/snow: > 4/32")	☐	☐	☐
2-2 Are tires sufficiently inflated for driving conditions?	☐	☐	☐
2-3 Are the lug nuts and stem caps present and tight for each tire?	☐	☐	☐
2-4 Is the spare tire and jack present and in good condition?	☐	☐	☐
3. Vehicle Interior			
3-1 Are the brake and accelerator pedal pads in good condition?	☐	☐	☐
3-2 Are the floor mats in good condition and not interfering with the brake or accelerator pedals?	☐	☐	☐
3-3 Is the seat properly adjusted (including the headrest)?	☐	☐	☐
3-4 Is the seatbelt in good condition?	☐	☐	☐
3-5 Are the mirrors in good condition (not broken, dirty)?	☐	☐	☐
3-6 Are the dashboard/instrument lights working?	☐	☐	☐
3-7 Is the dashboard free of warning lights and do the gauges appear to work when the car is started?	☐	☐	☐
3-8 Does the horn work?	☐	☐	☐
3-9 Are distractions such as cell phones and GPS units secured so they do not encourage use?	☐	☐	☐
4. Lights and Signals			
4-1 Do the headlights and high beams work?	☐	☐	☐
4-2 Do the tail lights function properly?	☐	☐	☐
4-3 Do the turn signals work (front and rear)?	☐	☐	☐
4-4 Do the brake lights work (including high light in the rear window if applicable)?	☐	☐	☐
4-5 Do the hazard lights (emergency flashers) work?	☐	☐	☐
4-6 Do back up / reverse lights work?	☐	☐	☐
4-7 If equipped with a back-up alarm can it be heard clearly?	☐	☐	☐
5. Mechanical			
5-1 Do the brakes work and feel solid (not soft)?	☐	☐	☐
5-2 Does the parking/emergency brake work?	☐	☐	☐
5-3 Is the steering in good working condition (not loose)?	☐	☐	☐
5-4 Is the engine oil level full or in the operating zone?	☐	☐	☐
5-5 Excessive vehicle bounce going over bumps reported (possible sign of worn shock absorbers)?	☐	☐	☐
5-4 Is the fuel level full or at an adequate level for the proposed usage?	☐	☐	☐

Item	Yes	No	N/A
6. Windows and Windshield			
6-1 Is the windshield clean and unbroken?	☐	☐	☐
6-2 Are the wiper blades in good condition (front and rear)?	☐	☐	☐
6-3 Are all the windows clean and unbroken and windshield fluid available and operational?	☐	☐	☐
7. Emergency Equipment (as needed per conditions/project requirements)			
7-1 Is there a “Safety Kit” (fire extinguisher, first aid, safety triangle and 2 reflective vests)?	☐	☐	☐
7-2 Is there a first aid kit, has it been inspected recently?	☐	☐	☐
7-3 Is survival gear and equipment available (blanket, water, heat source, flashlight, etc.)?	☐	☐	☐
7-4 Is a means for emergency communication available?	☐	☐	☐
8. Other Equipment (as needed per conditions/project requirements)			
8-1 Is there a means to secured loads (cargo next, container)?	☐	☐	☐
8-2 Are cones or other warning devices available?	☐	☐	☐
8-3 Is weather specific equipment (snow chains, tired etc.)?	☐	☐	☐
8-4 Does the vehicle have a snow brush/ice scraper?	☐	☐	☐
8-5 Does the vehicle have a fire extinguisher?	☐	☐	☐
9. Comments			

Inspector Name:	Signature:	Date:

Americas

SH&E Training

S3AM-003-PR1

1.0 Purpose and Scope

1.1 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content. These are the minimum safety, health and environment (SH&E)-related training requirements and tracking procedures. Additional training requirements may exist related to a specific task. Specific geographic entities, business units, and projects may have additional training requirements.

1.2 This procedure was developed to assist employees and managers in the identification of training requirements and to define the AECOM procedures for tracking and documenting SH&E training. The goals of this procedure are to ensure regulatory compliance and to provide employees with the information and training they need to accomplish their work assignments safely; prevent injuries to themselves, coworkers, surrounding communities, and customers; and protect company and/or customer property and the environment.

1.3 Major objectives of this procedure include:

- Identify accountability, responsibility, and authority pertaining to SH&E training program requirements.
- Establish minimum training course and/or instructor criteria to support compliance with applicable regulatory requirements as well as AECOM policy.
- Provide a framework to assess participant competency and understanding.
- Define recordkeeping requirements for the training program.
- Maintain consistency in SH&E training content throughout the Americas.

2.0 Terms and Definitions

2.1 **Compliance Training –** Training meant to provide a safe and healthy workplace for AECOM employees and others through adherence to legislative and regulatory mandates (e.g., Federal, State, Provincial, Territorial, local/municipal governments and agencies thereof).

2.2 **Conformance Training –** Training developed by AECOM intended to further develop the AECOM SH&E culture, as specified in AECOM SH&E policy and procedure, or client requirements.

2.3 **Learning Management System (LMS) –** An electronic training delivery and data management system utilized for implementation of the SH&E training program.

3.0 References

3.1 S3AM-015-PR1 Newly Hired or Transferred Employees

3.2 S3AM-202-PR1 Competent Person Designation

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Executives**

- Establish adequate resources (budget, staffing, etc.) to implement this procedure.
- Assignment/support of Learning Management System administration duties.

4.1.2 **Supervisors/Managers**

- Confirm new employees complete the AECOM Safety Orientation.

- Assist employees in identifying training requirements.
- Confirm supplemental employee training courses are identified based on local/client requirements.
- Confirm additional employee SH&E training requirements are identified based upon prudent risk management considerations and local performance issues.
- Confirm employee's training requirements are re-evaluated whenever an employee's assigned duties change significantly.
- Provide time and resources to allow employee to complete required training.
- Verify corrective actions are implemented when employees fail to meet training requirements.
- Confirm that the appropriate level of training is being assigned to the employee with regard to their specific job and task assignments and client needs.
- Confirm employees have current and applicable training to the employee's assigned tasks associated with the program or project.
- Confirm their own supervisory or management training is complete and current as applicable to the scope of work and type or oversight (e.g., AECOM employees, subcontractors, etc.).

4.1.3 **Vice President SH&E**

- Establish and maintain this procedure.
- Provide the necessary tools, support, and staff for on-going development and support of the training program.
- Report/communicate training status to senior management.

4.1.4 **SH&E Managers**

- Confirm management understands the function of the LMS and provide training, access and resources.
- Work with management to develop schedules, develop skills of employees assigned with training and recordkeeping duties, and provide training classes as requested.
- Confirm qualifications of safety training providers are reviewed and approved.
- Confirm training lesson plans and course agendas for training courses are reviewed and approved to verify the course content meets compliance/conformance requirements.
- Offer training participants the opportunity to evaluate training events.
- Report compliance with training program requirements to line management.
- Develop a training calendar.

4.1.5 **Employees**

- Complete the AECOM Safety Orientation.
- Coordinate with their supervisor to complete required training within any specified timeframes.
- Monitor their training expiration dates and coordinate refresher training to prevent expiration of any required training certification.
- Maintain a personal record of all training certifications.
- Supply copies of training completion certificates for inclusion in the LMS, as requested.
- Provide feedback on training through the evaluation process.

4.2 Identifying Required Training

4.2.1 All new employees shall complete the AECOM Safety Orientation.

- The AECOM Safety Orientation communicates the responsibility of each employee for a safe working environment and establishes AECOM's commitment to safety.
- The orientation communicates AECOM's Safety, Health and Environment (SH&E) Policy and the fundamental principles of the SH&E Management System; Safety for Life and the Life

Preserving Principles. Employees are informed of various aspects of the program, including but not limited to:

- Monitoring and evaluation of the program by leadership on an ongoing basis.
- Availability of AECOM policies and procedures and reference to the AECOM intranet site.
- The importance and requirement of pre-planning, including hazard assessment basics.
- Responsibility to report unsafe actions and conditions and the authority to stop unsafe work.
- The availability and importance of task specific training, refresher training, and related initiatives.
- Basic requirements and importance of incident reporting, notifications and investigation.
- Substance abuse prevention program, fit for duty requirements and the availability of medical support.

- Employees shall also complete any applicable site specific field or office orientations.
  - Employees shall be oriented to the layout of the site and instructed on the recognition of unsafe conditions.
  - Employees shall be informed of the site specific field or office hazards, any applicable control measures and any site specific field or office requirements and restrictions (e.g. rules, required PPE, etc.) through the review of the applicable field or office SH&E Plan.
  - Site specific orientations shall include the location specific Emergency Response Plan, including any required actions and responsibilities.
  - As applicable, the site specific orientation may address any Short Service Employee requirements. Refer to *S3AM-015-PR1 Newly Hired or Transferred Employees*.
  - As applicable, any regulatory or client specific requirements and restrictions.

4.2.2 Employee training requirements are dictated by the work each employee performs (or is expected to perform) and the geographic area(s) where the employee performs these activities. Employees include all AECOM personnel (e.g. office/field personnel, supervisors, managers, etc.).

- The attached *SH&E Training Matrix (S3AM-003-FM1)* is a matrix of the most common courses that may be required, the frequency, and expected participants. The Attachment contains four tables. Table 1 is applicable to all Business Groups of AECOM. Table 2-4 are Business Group-specific requirements. Table 1 and the applicable Business Group-specific table should be used to evaluate an employee's training requirements.
- Additional tools such as a Training Assessment may be developed at the business group level if desired to further define training requirements.

4.2.3 Training requirements shall be evaluated upon hire. Employees shall not undertake a task for which they have not been adequately trained. SH&E training needs shall also be re-evaluated periodically and may also be identified through individual risk assessments, incident investigations, observed non-compliance, when procedures change, or through the annual staff appraisals process, and whenever an employee's assigned duties change significantly.

4.3 Training Competency Levels

4.3.1 Information Dissemination

- Information is provided to employees through verbal or written communication.
- This type of training may be used in scenarios where the goal is to provide information to employees with no expectation of implementation or executing a regulatory requirement or SH&E procedure.
- The communication is mostly one way and there is no confirmation or knowledge assessment (e.g., test, interactive discussion, etc.) that the employee shall pass to demonstrate understanding and meet a training goal. Examples of this type of communication would be newsletters, safety alerts, webinar presentations, video only presentations, etc.

4.3.2 Awareness Level

- Awareness-level training is applicable to training where the primary goal is to transfer knowledge from the organization to participants.
- Training will typically take the form of instructor-led discussions, presentation of related video content, and/or self-directed e-learning modules.
- In most cases comprehension assessment will be performed through discussion of the training topic with the participants and/or a simple quiz. When quizzes are provided employees will successfully complete at least 80% of the questions.

4.3.3 Performance Level

- Performance-level training will build upon the Awareness level. The goal of Performance Training is to have an employee successfully demonstrate that they can apply the knowledge discussed during training and perform the desired skills necessary to perform their job.
- Training materials are provided and discussed, and will incorporate a demonstration of the skills to be completed.
- The instructor will gauge the level of understanding through interactive discussion with participants and a pass/fail designation of demonstrated skills by the employee. A test or quiz of moderate difficulty will be provided, with participants scoring 80% or better, followed by the successful demonstration of the desired skill to receive certification.

4.3.4 Competent Person Level

- Competent Person-level certifications may be applicable to, and dictated by, specific regulatory standards. Refer to *S3AM-202-PR1 Competent Person Designation* for additional guidance.
- When Competent Person-level certifications are offered, comprehension assessments will build upon Performance-level certification.
- Competent Person certifications will incorporate classroom training along with on-the-job mentoring provided by employees previously certified to the Competent Person-level in the area of competency being sought. Candidates for Competent Person certification will be required to score 80% or better on administered written exams.
- Additionally, candidates shall be capable of repeatedly demonstrating the desired skills and regulatory knowledge, both in a classroom setting as well as in an actual work setting to the Instructor, Manager for the program or project the employee is seeking to gain and apply the certification to, and/or the mentoring Competent Person.
- Competent Person(s) will be designated on a program/project-by-program/project basis, in accordance with *S3AM-202-PR1 Competent Person Designation.* Forms to document certification and designation of a Competent Person are provided with the procedure and a record of the designation will be maintained within the project files and LMS.

4.4 Training Delivery

4.4.1 Internal Training

- Internal training is performed by AECOM's internal resources and may include intranet and classroom-based training.
- To ensure consistency in content and duration and in meeting regulatory and company requirements, AECOM training materials should be used as the basis for training whenever they are available. Trainers may always elect to supplement the base training materials for these courses with specifics for the program, project, customer, office, or geographic unit.
- AECOM instructors shall have the experience, education and competency and any required current licensing, registrations and/or certifications relevant to the course taught. Training format and material shall be appropriate to the topic and audience. Refer to *S3AM-003-FM4 SH&E Training Syllabus Template.*

- Course content of training provided on an annual basis will be updated as appropriate, or multiple versions of training may be developed for rotating use, to provide participants with new learning materials and avoid stagnation.
- Course content shall be periodically reviewed, with no greater than five years between reviews.

4.4.2 External Training

- External vendors conduct training that is not available through internal training sources. This training may be classroom or on-line training. External vendors should be pre-approved by the SH&E Department prior to any employee attending a training class.

4.5 Training Evaluation

4.5.1 At the conclusion of a training event, participants will be provided with the opportunity to anonymously evaluate the training session with through the use of *S3AM-003-FM3 Course & Instructor Evaluation* or an online survey.

4.5.2 Training instructors will review evaluations at the conclusion of training and request assistance addressing consistently noted issues if appropriate.

4.6 Training Expiration

4.6.1 Training will expire in accordance with requirements specified in applicable regulations or on syllabus. Expiration of training will be tracked electronically using the AECOM LMS. Employees tracking training outside of the AECOM LMS are responsible for tracking their individual training expiration dates. If training expires for an employee, they will be disqualified from performing tasks associated with the training when training is required by AECOM defined requirements or legislation/regulation to perform the tasks. Once training has been renewed, the employee will again be qualified to perform associated tasks.

5.0 Records

5.1 Courses denoted in *S3AM-003-FM1 SH&E Training Matrix* or commonly required training shall be tracked in the AECOM LMS when completed. Employee training tracked in the AECOM LMS shall be retained for the duration of the employee's employment.

5.2 Classroom training shall be documented using an attendance record and course agenda. Attachment *S3AM-003-FM2 SH&E Training Sign-In Sheet* may be used to document attendance. Attachment *S3AM-003-FM5 SH&E Training Certificate Template* may be used to document course completion. Course completion may also be documented by LMS-generated certificates when allowed by regulation.

5.3 For training provided by customers/vendors, training documentation shall be entered into a training database or LMS and documentation shall be maintained by the employee. Copies of certificates or other evidence of required project training may be included in program or project training files.

5.4 In some cases, objective evidence of comprehension is required (passing a test) and this information may be tracked in addition to the course information.

5.5 Attendance sheets, agendas, course evaluations, completed tests, and copies of certificates will be maintained. These should be filed in program or project training files by course then by date for easy access/auditing.

5.6 Locations/projects/programs will maintain records on any project, program, or location- or site-specific training requirements.

6.0 Attachments

6.1 S3AM-003-FM1 SH&E Training Matrix

6.2 S3AM-003-FM2 SH&E Training Sign-In Sheet

6.3 S3AM-003-FM3 Course and Instructor Evaluation

6.4 S3AM-003-FM4 SH&E Training Syllabus Template

6.5 S3AM-003-FM5 SH&E Training Certificate Template

6.6 S3AM-003-FM6 New Employee SH&E Orientation

Americas

SH&E Training Matrix

S3AM-003-FM1

Employee Name: **Employee Number:**

Location: **Date:**

Table 1 – All Employees

Course Title	Regulatory	Frequency	Should You Attend?	Check if Required ☒	Comments
10 Hour Outreach Course (OSHA – General Industry or Construction)	N	Once	As required by client or local regulations.	☐	
30 Hour Outreach Course (OSHA – General Industry or Construction)	N	Once	As required by client. Required if you serve as a site safety and health officer on US Army Corps of Engineers (USACE) projects, or other DoD projects which follow the provisions of EM 385-1-1 (USACE Safety and Health Requirements Manual).		
Asbestos Inspector	Y	Annual	You perform asbestos sampling tasks.	☐	
Asbestos Planner	Y	Annual	You serve as the project asbestos planner.	☐	
Automated External Defibrillator (AED)	Y	As established by the training provider	You are designated to be an AED user at an office or project site.	☐	
Bloodborne Pathogens	Y	Annual	Required for employees designated as a first aid responder or others who have a potential bloodborne pathogen exposure.	☐	May be included in first aid or CPR class.
Cardiac Pulmonary Resuscitation (CPR)	Y	As established by the training provider – typically biennial	Required for 1) employees who are designated as first aid responders, 2) employees who are performing high hazard activities (e.g., potential for falls, suffocation, electrocution, amputation) and medical attention is more than 4 minutes away, or 3) required by client contract.	☐	Acquire training from recognized source (e.g., Red Cross, American Heart).
Confined Space Entry	Y	Once	You perform confined space entry/authorizer/attendant duties (including anyone performing non-entry rescue activities).	☐	

Course Title	Regulatory	Frequency	Should You Attend?	Check if Required ☒	Comments
Confined Space Refresher	N	As needed	Recommended if you perform entry activities.	☐	
Confined Space Rescuer	Y	Once	You may have to enter a confined space to perform a rescue.	☐	
Emergency Preparedness Plan/ Emergency Action Plan	Y	Once	Required for all employees.	☐	For office personnel, this information is covered in employee orientation. For field/site personnel, this is covered in project/site safety training.
Excavations/Trenching	Y	Once and as required by client or training provider	You are or may be involved in excavation or trenching operations	☐	Frequency may be established by an applicable standard (e.g., Gold Shovel Standard - annual)
Experienced Miner Training	Y	Once, followed by annual refreshers	You meet the US Mine Safety and Health Administration (MSHA) definition of an "Experienced Miner."	☐	See Surface Miner and Underground Miner training for information on annual refreshers.
Fall Prevention/Protection	Y	Once	You supervise tasks or perform tasks at heights (on roofs, scaffolding, ladders, unfinished flooring).	☐	May be included in OSHA 10 or other classes
Fire Extinguisher	Y	Annual	You may be expected to use fire extinguishers (fixed facilities and project sites).	☐	
First Aid	Y	As established by the training provider - typically biennial	Required for 1) employees who are designated as first aid responders, 2) employees who are performing high hazard activities (e.g., potential for falls, suffocation, electrocution, amputation) and medical attention is more than 4 minutes away, or 3) required by client contract.	☐	Acquire training from recognized source (e.g., Red Cross, American Heart).
Hazard Communication	Y	Initially and if hazards change	Required for anyone who is potentially exposed to/works with hazardous chemicals.	☐	Training must occur before any work with hazardous chemicals. Included (as needed) in safety orientation. After the initial training, required updates will typically be handled as part of project-specific safety training.
Hazardous Materials Shipping	Y	Biennial	Required for anyone who packages, labels, transports, completes paperwork for, or offers for shipment, hazardous materials/dangerous goods.	☐	

Course Title	Regulatory	Frequency	Should You Attend?	Check if Required ☒	Comments
Hazardous Waste Operations (40-hours)	Y	Once	Anyone performing work or expected to perform at hazardous waste sites or treatment, storage, and disposal facilities.	☐	Training must have a 'hands-on' component (i.e., donning/doffing PPE). Any exceptions must be approved by a Regional SH&E Manager.
Hazardous Waste Operations – Refresher (8 hours)	Y	Annual	(See Hazardous Waste Operations.)	☐	When offered as a combination of online modules and classroom instruction, online modules must be completed prior to the classroom portion for participants to receive credit. Both portions (online and classroom) need to be completed within the same calendar year.
Hazardous Waste Operations – Supervisor (8 hours)	Y	Once	Required for anyone serving as the site supervisor or overseeing subcontractor activities at a hazardous waste site.	☐	When offered as a combination of online modules and classroom instruction, online modules must be completed prior to the classroom portion for participants to receive credit. Both portions (online and classroom) need to be completed within the same calendar year.
Hearing Conservation	Y	Annual	Employees exposed to noise ≥ 85 decibels averaged over an 8-hour day, or who otherwise utilize hearing protectors.	☐	May be included in OSHA 10 or other classes
Injury/Illness Prevention	Y	Once	You are assigned to California offices or job sites.	☐	Covered in California office/project Safety Orientation.
Laboratory Safety	Y	Once	You work in a fixed or mobile wet chemistry lab.	☐	Completed as part of site or project orientation.
Lead Project Designer	Y	Every 3 years	You are a lead project designer.	☐	
Lead Risk Assessor	Y	Every 3 years	You are a project lead risk assessor inspector.	☐	
Lockout/Tagout Awareness – Affected Person	Y	Once; follow-up as required by regulations	You work with and around equipment that may need to be locked out/tagged out. (You are not responsible for applying tags/locks).	☐	May be included in OSHA 10 or other classes
Lockout/Tagout – Authorized Person	Y	Once; follow-up as required by regulations	You lock out or tag out machines or equipment in order to perform servicing or maintenance on that machine or equipment.	☐	Specific to individual machines.

Course Title	Regulatory	Frequency	Should You Attend?	Check if Required ☒	Comments
Marine Trash and Debris Awareness and Limitation	Y	Annual	You work on contract operations for lessees and/or operators of oil and gas operations in the Gulf of Mexico.	☐	Provided by lessee or operator.
Nuclear Density Gauge Operator	Y	Once; follow-up as required by regulations	You operate nuclear density gauges / densometers.	☐	Troxler or equivalent training.
Nuclear Density Gauge Transporter	Y	Every 3 years	You transport nuclear density gauges / densometers.	☐	Hazardous Materials shipping.
Orientation Video	N	Within one week of starting at AECOM	Required for all employees.	☐	Training will set the expectations of the AECOM Safety for Life program
Powered Industrial Trucks (Forklifts)	Y	Once	Your job assignments include operating a powered industrial truck (forklift).	☐	Required more frequently if assessments indicate the need.
Radiation Worker	Y	Once; follow-up as required by regulations	You may require non-routine or short-term unescorted access to radiological controlled areas (excluding Radiation Areas and Airborne Radiation Areas), or you work in areas where radioactive materials are stored.	☐	Public dose limits apply. Additional training required when public dose limits may be exceeded.
Radiation Safety Officer	Y	Once	You are designated as a Radiation Safety Officer.	☐	
Respiratory Protection	Y	Annual	Required for any employee who may be required to wear a respirator.	☐	May be included in HAZWOPER refresher training
Safety Trained Supervisor (STS) or Safety Qualified Supervisor (SQS)	N	Once	Any manager directly overseeing revenue generating projects with any aspect of work conducted outside of an AECOM office	☐	Schedule for the associated Business Group established by the applicable VP SH&E or designee..
Self-Contained Breathing Apparatus (SCBA)/Cascade Systems	Y	Once	Required for any employee required to wear SCBAs or to operate a supplied air system.	☐	Part of Project Safety training as needed.
Shipping Specialist	Y	Once	You are designated as a Shipping Specialist.	☐	Updates are required as regulations change.
Substance Specific	Y	Once	Any U.S. employee potentially exposed to a substance covered by the 29 CFR substance specific regulations.	☐	Includes lead, asbestos, benzene, etc. Offered as part of project-specific training.
Surface Miner Training – New (24 hours)	Y	Once	You perform work at surface mine sites regulated by MSHA.	☐	Training is conducted by MSHA-approved instructors under MSHA-approved training plan.

Course Title	Regulatory	Frequency	Should You Attend?	Check if Required ☒	Comments
Surface Miner Training – Annual Refresher (8 hours)	Y	Annual	You perform work at surface mine sites regulated by MSHA.	☐	Training is conducted by MSHA-approved instructors under MSHA-approved training plan.
Supervisor Training in Accountability and Recognition Techniques (START)	N	Once	Required for all supervisors	☐	
Underground Miner Training – New (40 hours)	Y	Once	You perform work in underground mine sites regulated by MSHA.	☐	Training is conducted by MSHA-approved instructors under MSHA-approved training plan.
Underground Miner Training – Annual Refresher (8 hours)	Y	Annual	You perform work in underground mine sites regulated by MSHA.	☐	Training is conducted by MSHA-approved instructors under MSHA-approved training plan.
Waste Specialist	Y	Once with Annual Refresher	You are responsible for waste management at a small or large quantity generator facility.	☐	
Welding/Brazing/Cutting	Y	Once	You job duties include these activities.	☐	May be included in OSHA 10 or other classes
Workplace Hazardous Materials Information System (WHMIS)	Y	Annual	You are assigned to a Canadian facility and work with or around hazardous materials.	☐	Canadian Hazard Communications

Table 2 – Applicable to Energy, Infrastructure and Industrial Construction (EIC) Group

In addition to the courses in Table 1, the following courses may be applicable.

Course Title	Regulatory	Frequency	Should You Attend?	Check if Required ☒	Comments
Defensive Driving	N	Once, followed by refresher as required	Required for all employees who are Authorized Drivers. Recommended for other staff that drive on behalf of AECOM.	☐	
Reasonable Suspicion for Substance Abuse	N	Once upon assignment as responsible supervisor	For project and office supervisors with responsibility for administering the Substance Abuse Program (SAP).	☐	On line training provided by the SAP Program Administrator.
New Employee Safety Orientation Training	N	Once and at each new project assignment	Required for new employees and employees assigned to project sites per site requirements	☐	New employees receive orientation per HR program; project employees per site requirements.
First Aid/CPR/AED/BBP	N	Once plus annual refreshers, or as required by regulations	Recommended for office and project safety floor wardens.	☐	Provided by authorized trainers both internal and external as available

Table 3 – Applicable to Management Services Group

In addition to the courses in Table 1, the following courses may be applicable.

Course Title	Regulatory	Frequency	Should You Attend?	Check if Required ☒	Comments
New Employee Safety Orientation Training (Approx. 1 hour)	N	Once	Required for new employees.	☐	Access through Vision
Standards of Safety Performance (Approx. 1 Hour)	N	Annual	Required for all employees.	☐	Specific content will depend on the site and the employees' expected work.
Site Safety Training (up to 4 hours)	N	Biennial	Site specific training based on site specific work and safety processes (e.g., warehouses, laboratories, vehicle maintenance, and aircraft maintenance).	☐	Specific content will depend on the site and the employees' expected work.
Site Supervisor Safety Training	N	Once	Expected for all Supervisors in the pursuit of STS certification.	☐	

Table 4 – Applicable to Design & Consulting Services (DCS) Group

In addition to the courses in Table 1, the following courses may be applicable.

Course Title	Regulatory	Frequency	Should You Attend?	Check if Required ☒	Comments
10 Hour Outreach Course (OSHA – General Industry or Construction)	Y (as per jurisdiction)	Once	You perform work that exposes you to construction or industrial hazards	☐	
30 Hour Outreach Course (OSHA – General Industry or Construction)	Y (as per jurisdiction)	Once	You manage work with some safety responsibility that exposes you and/or other workers to construction or industrial hazards	☐	
New Employee Orientation	Y	Once	All new employees.	☐	Accomplished via a combination of AECOM University modules and location-specific training.
Vehicle / Driver Safety	N	Once	Required for all employees who drive on behalf of AECOM.	☐	Generally completed upon hire by employees who may become authorized drivers. Available online through the AECOM University.
Ergonomics	N	Once	Required for all employees with significant ergonomic risk.	☐	Generally completed upon hire or change in assignment. Available online through the AECOM University.
Confined Space Entry Awareness	N	As needed	Employees who work around confined spaces but are not responsible for performing entry/authorizer/attendant duties.	☐	Available online through AECOM Univerisity.
Defensive Driving	N	Once, followed by refresher every three years	Required for all DCS employees who drive on behalf of AECOM.	☐	National Safety Council, Alert Driving, Smith System or equivalent.
Excavations/Trenching Awareness	N	As needed	Employees who work at sites where excavation/trenching tasks are performed.	☐	Available online through AECOM University.
Field Safety Training (2 hours)	N	Annual	Required for all employees performing field work who are not in the hazardous waste or mine safety training programs. This training is also required for any DCS Project Manager that manages projects where field work is performed. The 10-Hour OSHA course is an acceptable alternative to Field Safety Training.	☐	Specific content and delivery method will depend on the office and the employees' expected work. The Field Safety requirement (every year) continues to apply after the completion of the 10-hr course.

Americas

SH&E Training Sign-In Sheet

S3AM-003-FM2

Course Name:					
Region:		**District/Area:**			
Business Line:		**Dept #:**			
Office:		**Address:**			
Date:		**Start Time:**		**Stop Time:**	

Certification Level (Check One): **Awareness** ☐ **Performance** ☐ **Competent Person** ☐

Lead Instructor:	**Instructor 1:**	**Instructor 2:**

	Employee Name: (PRINT LEGIBLY)	**Employee Signature**	**Region/Office Company (if not AECOM)**	**Employee ID #:**	**Instructor Initials verifying completion**
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					
16.					
17.					

By my signature I certify that the individual(s) beside whom I have initialled on this roster have

Lead Instructor Signature **Date**

attended and successfully passed the course (assessment).

Americas

Fitness for Duty

S3AM-008-PR1

1.0 Purpose and Scope

1.1 AECOM is committed to providing a safe workplace for its employees, clients and others. In order to provide a safe work environment, employees must be fit for work, be able to perform their job duties in a safe, secure, productive, and effective manner, and remain able to do so throughout the entire time they are working.

1.2 This procedure applies to to all AECOM Americas-based employees and any other entity and its personnel contractually required to comply with this document's content.

1.3 Fit for duty means an individual is in a state (physical, mental, and emotional) that enables them to perform assignments competently and in a manner that does not threaten the health and safety of themselves or others.

1.4 Fitness for duty expectations can vary with specific job tasks, location and regulatory requirements. Fitness for duty may be affected by significant fatigue, stress, emotional issues, illness, injury, or the effects of drugs and alcohol. Employees who are not fit for duty may present a safety hazard to themselves, to other employees, to the Company, or to the public.

1.5 The decision to request a fitness for duty examination (and repeat examinations as necessary) can be made by Operations, Safety, Health and Environment (SH&E) and Human Resources (HR). The decision will be based on the need to protect the employee and co-workers when there is concern about an employee's ability to perform his or her job safely, based on the observations of a supervisor, manager, or medical personnel.

1.6 Should AECOM require a fitness for duty examination, it shall be performed at no expense to the employee and will be performed by an occupational specialist, physician or other medical specialist designated by the Company or Employee Assistance Program (EAP). Employees awaiting a fitness for duty examination may be temporarily relieved of any work duties or may have their work duties modified.

1.7 The purpose of this policy is to establish consistent procedures by which AECOM will evaluate an employee's fitness for duty when an employee is:

1.7.1 Having observable difficulty performing work duties in a manner that is safe for the employee, for the employee's co-workers, for the Company, or for the public, as determined by the supervisor;

1.7.2 Posing an imminent and serious safety threat to self or others; or

1.7.3 Involved in the event of a workplace incident or accident.

2.0 Terms and Definitions

2.1 None

3.0 References

3.1 None

4.0 Procedure

4.1 It is the responsibility of all employees to:

4.1.1 Maintain a safe workplace;

4.1.2 Manage their health in a manner that allows them to safely perform their job responsibilities;

4.1.3 Arrive to work fit for duty and capable to perform their job responsibilities in a safe, secure, productive, and effective manner during the entire time they are working and refraining from behavior which could impair safety in the workplace;

4.1.4 Notify their supervisor or HR when they are not fit for duty and to declare any medication side effects and/or situations/concerns which may have an impact on their ability to perform work; and

4.1.5 Notify a supervisor when they observe a co-worker acting in a manner that indicates the co-worker may be unfit for duty. If the supervisor's behavior is the focus of concern, an employee may inform a senior manager and a HR representative.

4.2 The Company will not tolerate retaliation against any employee for filing a complaint or concern or for participating in any way in an investigation. It is the responsibility of AECOM management and supervisors to:

4.2.1 Communicate to all employees the content of this procedure and other applicable safety policies and procedures

4.2.2 Observe (and record when necessary) the attendance, performance, and behavior of the employees they supervise;

4.2.3 Fairly and consistently follow this procedure when presented with circumstances or knowledge that indicate that an employee may be unfit for duty by contacting SH&E and HR as appropriate;

4.2.4 Consider an employee's personal assessment of their own fitness for duty; and

4.2.5 Keep any information of medical conditions or records strictly confidential at all times.

4.3 HR and SH&E will assist in the administration of this program, ensuring that the requirements of the procedure are implemented by all responsible departments.

4.4 The supervisor who believes they have received reliable information that an employee may be unfit for duty, or through personal observation believes an employee may be unfit for duty, will validate and document the information or observations as soon as is practical and contact SH&E and HR immediately. While there is a great variety and range of acceptable behavior among employees, dramatic or sudden changes in any particular employee's customary behavior may be a cause for concern. Atypical behavior that may trigger the need to evaluate an employee's fitness for duty include, but is not limited to, problems with dexterity, coordination, concentration, memory, alertness, vision, speech, inappropriate interactions with co-workers or supervisors, inappropriate reactions to criticism, or suicidal or threatening statements. Though the mere presence of any one factor or sign of behavior may not be sufficient to require an evaluation, it should not be ignored and may lead to the ordering of an evaluation.

4.5 The supervisor will present the information or observations to the employee at the earliest possible time in order to validate them and will allow the employee to explain his or her actions, or to correct any mistakes of fact contained in the description of those actions. An employee is not required to disclose a disability to a supervisor; however, a supervisor may inquire regarding the conduct, behavior or circumstances that give rise to his or her concerns. The supervisor will then determine whether the employee should leave the workplace immediately for safety reasons. Where possible, discussion and meetings with any employee should occur with SH&E and/or HR staff present.

4.6 Depending on the severity of the situation or event and the type of behavior, possible actions may include the following:

- Documenting and noting the event or behaviour.
- Encouraging the employee to use the EAP (if applicable) or to seek medical treatment.
- Placing the employee on a paid leave of absence (Paid Time Off (PTO)) or paid administrative leave, depending on the situation).
- Arranging for the employee's safe transportation home.
- Making a management referral to the EAP or other local assistance agencies.

- Taking disciplinary action, if appropriate.
- Calling 911 or local emergency authorities.

4.7 If there is a basis for thinking that a crime may have been committed and/or the employee is making threats to harm himself or herself or others, or is acting in a manner that is immediately dangerous to himself or herself or others, contact 911 or local emergency authorities directly. HR and the EAP should be consulted regarding the fitness for duty procedure after the immediate safety issue has been addressed.

4.8 In all other circumstances, the supervisor shall take appropriate action, including contacting HR. If it is not immediately practicable to contact HR, managers have the authority and ability to contact the EAP when they receive reports and validate or personally observe an employee's unfit behavior. Depending on circumstances, such as when an employee's conduct immediately or directly threatens safety, a supervisor may immediately relieve the employee of duty pending further evaluation.

4.9 The Company will rely on the EAP or occupational specialist, physician or other medical specialist (which may include a registered psychologist or psychiatrist) to assist with the evaluation process. Each case will be evaluated on a case-by-case basis. In all instances, it is imperative that the EAP or medical professional be provided complete and accurate information on the employee's job duties, responsibilities and expectations in order to make a fully informed decision. Please refer to *S3AM-008-FM1 Description of Job Duties*.

4.10 The employee must comply and cooperate with all aspects of the fitness for duty and evaluation procedures, including furnishing necessary consent and release forms to the health service provider. Noncompliance (including delayed compliance) may be grounds for disciplinary action up to and including termination. Information will be requested from the health service provider regarding work restrictions and/or accommodations that may be required upon the employee's return to work.

4.11 If it is determined that a fitness for duty evaluation is necessary, the employee will be asked to leave the workplace until the evaluation is completed. A recommendation is provided by the occupational specialist, physician or other medical specialist to HR. When it is determined that the employee can return to work safely, a HR manager will contact that employee with the date and conditions of their return to work. If there are conditions that the employee will need to comply with in order to ensure continued safe working habits, they will be required to sign an acknowledgement that they will comply with those conditions.

4.12 This procedure is not intended as a substitute for other Company policies or procedures related to performance nor is intended as a substitute for discipline. Situations involving violations of Company policies or practices may result in disciplinary action being taken.

5.0 Records

5.1 None

6.0 Attachments

6.1 S3AM-008-FM1 Description of Job Duties

Americas

Fatigue Management

S3AM-009-PR1

1.0 Purpose and Scope

1.1 The purpose of this procedure is to reduce the potential for employee fatigue by providing criteria for recognition, treatment, and management.

1.2 This procedure applies to AECOM Americas-based employees and operations, and any other entity and its personnel contractually required to comply with this document's content, where fatigue can be a factor impacting an employee's fitness for duty. Fatigue is mental or physical exhaustion that stops a person from being able to function normally.

- Fatigue is mainly caused by a lack of sleep, but may also be associated with prolonged periods of physical and/or mental exertion without sufficient time to recover.
- Fatigue can be caused by work-related stresses, non–work-related stresses, or a combination of both. Work-related stress may be due to items such as pace of work schedule, location of work, environmental conditions of the work area (e.g., noise, lighting, tasks), and degree and duration of concentration required to perform a task.
- Non–work-related fatigue is influenced by personal lifestyle, health issues, and family and relationship responsibilities.
- Long-distance travel causes fatigue primarily by disruption of natural biological rhythms through both external factors and internal factors.
- Acute Mountain Sickness (AMS) is a group of symptoms including fatigue that jeopardizes the well-being and the work capacity of people who are not acclimated when exposing themselves to altitudes above 3,000 meters. It appears in the first hours after exposure, declining after 1 or 2 days because of acclimatization. Its prevalence is directly related to high-altitude work, ascent speed, and personal susceptibility.

2.0 Terms and Definitions

2.1 None

3.0 References

3.1 None

4.0 Procedure

4.1 Implementation of this procedure is the responsibility of the manager directing activities of the facility, site, or project location.

4.2 Fatigue, and the level to which it impacts an employee, is associated with a number of factors including:

4.2.1 The quantity and quality of rest obtained before and after a working day.

4.2.2 The time of day in which work takes place.

4.2.3 The length of time spent at work and on work-related activities (including travel time to and from work).

4.2.4 The type and duration of a work task and the environment in which it is performed.

4.2.5 The physical and mental demands of work.

4.2.6 Activities outside the workplace, such as sports, family commitments, or second jobs.

4.2.7 Disruption of normal circadian rhythms (human clock, bio-rhythms).

4.2.8 Individual factors, including existing medical conditions, illnesses, or sleep disorders.

4.2.9 Extreme alcohol intake or sleep deprivation.

4.2.10 Travel requirements, including daily commute distances and long- distance air travel.

4.3 Fatigue Recognition

4.3.1 Employees are expected to carry out their work activities in a manner that does not risk the health and safety of themselves, their fellow employees, or any other personnel on the site (e.g., contractors, clients, the public, etc.). If an employee feels that they are unable to perform their work activities safely due to the effects of fatigue, they are required to stop work immediately and notify their supervisor. If this occurs while an employee is driving a vehicle, the employee is required to stop driving and find a suitable location to rest.

4.3.2 Similarly, if an employee suspects a co-worker (including contractors or clients working with the employee) of suffering from the effects of fatigue, they are required to intervene on behalf of the affected person, stopping work and notifying their supervisor.

4.3.3 Characteristics that may assist in the identification of fatigue may include, but are not limited to:

- Physical Symptoms
  - Bloodshot eyes
  - Poor coordination
  - Slower movements
  - Slower-than-normal response time (e.g., response to commands or radio signals)
- Cognitive Function Symptoms
  - Distraction from task
  - Poor concentration or lapses in concentration
  - Inability to complete tasks
  - Short-term memory loss
  - Nodding off momentarily
  - Fixed gaze
  - Reports of blurred vision
- Emotional/Behavioral Symptoms
  - Appears depressed
  - Does not care about work
  - Easily frustrated with task/irritability
  - Increased or noticeable level of unexplained or unusual absenteeism

4.4 Fatigue Treatment

4.4.1 Where fatigue has been identified, employees are suggested to take action to treat the underlying causes of the fatigue. Suggestions include:

- Getting adequate, undisturbed, regular and consistent amounts of sleep each night. A minimum of 7 hours is recommended.
- Eating well-balanced and nutritious meals at regular intervals.
- Ensuring adequate consumption of water throughout the day.

- Exercising or stretching regularly.
- Maintaining a reasonable work and personal schedule.
- Avoiding alcohol, smoking, and drugs. Note that stimulants, including caffeine, may provide temporary relief from certain types of fatigue, but can increase the problem when the effect wears off.
- Changing stressful circumstances through vacation or personal leave.

4.5 Fatigue Management – Managers and Supervisors

4.5.1 Identify factors in the work place that may contribute to fatigue. Inform employees of potential fatigue-producing activities and how to manage them. Re-evaluate work tasks periodically to control fatigue.

4.5.2 Monitor employees for the signs and symptoms of fatigue.

4.5.3 Provide employees with sufficient breaks for food, water, and rest throughout the work day. Calling for unscheduled breaks/meals where fatigue factors are evident may be necessary.

4.5.4 Consult with employees regarding fatigue factors when extended work periods or shift work is anticipated.

- When possible and apart from shift work, minimize early morning starts before 6:00 AM local time, because early start times give employees less time to get adequate sleep.
- When possible and apart from shift work, minimize late-evening work after 9:00 PM local time (except where shift work is required), because employee alertness tends to decline after this time.
- Limit extended work days to a maximum of 14 hours, and extended work weeks to 60 hours. Where this is not feasible, develop project-specific fatigue management guidelines for inclusion in site-specific SH&E plans.
- For emergency work, a single shift should be limited to 16 hours, and an employee should be off work for at least 12 hours before the next shift start.
- Project-specific extended work schedules shall be reviewed and approved prior to implementation.
- Shift lengths longer than 12 hours should have two or more long breaks (at least 20 minutes) to allow time for meals.
- If shift work is required, employees should be given sufficient time to get a continuous 7- to 8-hour period of sleep in each 24 hours, and at least 50 hours every 7 days.
- At the end of extended night shifts, there should be a minimum of 36 hours or two sleep periods prior to transition to day shift.

4.5.5 Project industrial hygienists must consider extended work shifts in personal monitoring, and permissible exposure limits for acute chemical hazard exposures.

4.5.6 Review safety observations, near misses, injuries, and incidents that have occurred which may have resulted due to fatigue. Use the findings of these documents to revise project-specific fatigue management procedures, as necessary.

4.5.7 Supply adequate supervision for jobs that are physically or mentally demanding, repetitive, or require a high level of vigilance.

4.5.8 Develop job rotation and cross-training strategies for repetitive or monotonous work.

4.5.9 Consider providing ergonomic equipment such as anti- fatigue mats in areas of prolonged standing and lift assist devices for repetitive lifting tasks.

4.5.10 Remove obviously fatigued workers from activities where there is a risk to safety and health. These employees may be rotated to a task that creates a much lower immediate risk, or advised to go home. Where driving presents a further fatigue risk, provide transportation to ensure the employee reaches their destination safely.

4.5.11 Encourage employees to take adequate time away from work through vacations and personal leave. There should be at least one personal weekend in every 4 weeks of work.

4.5.12 Train employees on how to recognize fatigue, control fatigue through appropriate work and personal habits, and reporting of fatigue to a supervisor.

4.5.13 Where fatigue issues recur with an employee, consider referring the employee to the Employee Assistance Program (EAP) for help in the self-management of fatigue or other issues that may have a bearing on fatigue at work. Review working arrangements to assist employees in managing non–work-related fatigue causes.

4.5.14 Provide training to all employees as required by project- specific conditions or client-specific requirements (e.g., project startup training, onset of schedule changes, annual refresher training, etc.).

4.6 Fatigue Management – Employees

4.6.1 Employees are responsible for managing personal fatigue in the work place. This may include the following:

4.6.2 Report to work well-rested and mentally alert. Manage non– work-related choices that enable fitness for duty, including getting sufficient rest and sleep to recover from prior work duties, and managing personal, commuting, medical, and health issues.

4.6.3 Seek medical advice for any personal conditions affecting sleep, such as apnea or insomnia.

4.6.4 Advise your physician of any changes in your regular work schedule if you are taking daily prescriptions. Many medications exhibit important differences in the time course and effects depending on when the medication is administered.

4.6.5 Notify your manager or supervisor when you are feeling fatigued.

4.6.6 Take adequate rest and meal breaks for the working conditions.

4.6.7 Do not operate machinery or perform high-risk activities for at least 24 hours if you travel over 6 or more time zones or if you are required to work at elevations above 3,000 meters without adequate acclimatization.

4.6.8 Inform managers or supervisors when you suspect a co- worker of being fatigued or if you feel fatigued to a point of increased risk of an incident or error.

4.6.9 Consider seeking assistance from the Employee Assistance Program (EAP) for help in the self-management of fatigue or other issues that may have a bearing on fatigue at work.

5.0 Records

5.1 The following documentation will be maintained in the project file:

5.1.1 Safety observations, near misses, injuries, and incidents that have occurred as a possible result of fatigue.

5.1.2 Records of site-specific training in fatigue identification and management issues.

6.0 Attachments

6.1 None

Americas

Substance Abuse Prevention

S3AM-019-PR1

1.0 Purpose and Scope

1.1 This policy and procedure is consistent with the U.S. Drug-Free Workplace Act of 1988 and in accordance with federal, state / provincial / territorial, and local laws and regulations. It sets out practices for a drug-free, healthy, productive, safe and secure workplace and provides guidance for employees and supervisors with respect to their responsibilities. Drug and alcohol abuse pose a serious threat to the health and safety of employees, clients, and the general public as well as the security of our job sites, equipment and facilities. The Company is committed to the elimination of illegal drug use and alcohol abuse in its workplace and regards any misuse of drugs or alcohol by employees to be unacceptable.

1.2 This policy and procedure apply to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

1.3 AECOM prohibits the use, possession, presence in the body, distribution, manufacture, concealment, transportation, promotion or sale of the following items or substances on company premises:

- Illegal drugs (or their metabolites), designer and synthetic drugs, mood- or mind-altering substances and drug use related paraphernalia unless authorized for administering currently prescribed medication;
- Controlled substances that are not used in accordance with physician instructions or non-prescribed controlled substances;
- Alcoholic beverages while at work or while on any customer or AECOM controlled property. This prohibition on alcohol applies whenever an employee is on-duty, including during meal or break periods, while on Company premises, or while representing AECOM. AECOM may make exceptions and permit the consumption of alcohol beverages at work-related events, such as Company-sponsored or approved business meals, conferences, or holiday events. Employees who choose to consume alcohol on approved occasions are expected to exercise good judgment and to refrain from becoming intoxicated or impaired. If an employee has consumed alcohol and needs transportation home, the Company will reimburse the cost of a taxicab or other reasonable costs of transportation so that the employee may avoid driving.
- This policy does not prohibit lawful use and possession of current medication prescribed in the employee's name or over-the-counter medications. Employees shall consult with their health care provider about any prescribed medication's effect on their ability to perform work safely. An employee who has work restrictions due to his or her consumption of a prescribed medication shall disclose these restrictions to their supervisor.

1.4 Substance abuse testing procedures shall meet requirements of various U.S. regulatory agencies and / or those of the applicable jurisdiction, with regard to testing employees for the possession and use of illegal drugs (and their metabolites), mood- or mind-altering substances, synthetic and designer drugs, unauthorized use of prescription drugs and the unauthorized use of alcohol on AECOM or client premises or during working hours. The procedures will also comply with applicable laws and regulations by federal, state / provincial / territorial, and local law. If the law of a particular location differs from the practices expressed in this policy and procedure, AECOM will implement this policy and procedure in accordance with applicable law.

1.5 Although some states may pass laws legalizing medical or recreational marijuana use, the use, sale, distribution and possession of marijuana are violations of federal law. Similarly, the use sale, distribution, presence in the body and possession of marijuana or the presence of marijuana on company premises or while on duty including during lunch and breaks violates the *S3AM-019-ATT1 Substance Abuse Policy Statement* (policy) and will subject an employee to disciplinary action up to and including termination in accordance with controlling law.

1.6 This policy and procedure have been developed to provide employees, managers, supervisors and administrative support personnel with guidelines and procedures for the implementation, administration, and enforcement of this policy and procedure. The company policy statement for substance abuse prevention is included as Attachment 1 of this document and a copy of the included policy statement shall be posted on employee information boards. New employees shall receive and sign *S3AM-019-FM1 Acknowledgement and Consent Form* upon hire or transfer between sites or clients as acknowledgement of the program requirements. A signed or electronic copy of this form should be kept as part of the employee personnel file.

1.7 This policy and procedure do not prohibit employees from the lawful use and possession of current legally prescribed or over-the-counter medications. Employees shall consult with their health care providers about any prescribed medication's effect on their ability to perform work safely. Employees shall disclose any relevant work duty restrictions to their supervisor. Employees are required only to provide information necessary for the Company to make an informed decision regarding the ability to perform required work safely, and to evaluate whether the employee may be entitled to a reasonable accommodation. Employees who shall bring current prescribed medications to work shall carry the medication in the original packaging bearing a current label from a licensed pharmacist for the person in possession of the drugs.

1.8 Compliance with this policy is a condition of initial and continued employment. Failure to comply with these requirements will be grounds for disciplinary action, up to and including termination of employment.

1.9 This procedure will be administered by the Business Group Substance Abuse Prevention (SAP) Program Administrator in conjunction with Safety, Health & Environment (SH&E) and Human Resources (HR).

1.10 This procedure may be further supplemented by Business Group specific and/or client specific Substance Abuse Prevention procedures. These supplementary programs shall either meet or exceed the requirements contained in this document.

2.0 Terms and Definitions

2.1 **Adulterated Sample** – A urine sample provided by an applicant, employee or contractor that has been intentionally altered to mask the analysis for illegal substance use. Any applicant or employee who knowingly provides a false sample or attempts to adulterate a sample will be terminated or disqualified from employment.

2.2 **Confidentiality** – The principle that the information associated with an individual's participation in the AECOM Substance Abuse Prevention program is private and has limits on how and when it can be disclosed.

2.3 **Designated Employer Representative (DER)** – Another name for the drug and alcohol program administrator. The DER provides oversight and manages the applicable Business Group's Substance Abuse Prevention Program(s) in coordination with the requirements of this document.

2.4 **Employees/Applicants** – The SAP program will apply to all individuals who may be: regular full-time, part-time, probationary, temporary, craft (direct hires), casual, contract or leased employees, and applicants of employment as permitted by applicable laws

2.5 **Employee Assistance Program (EAP)** – All AECOM employees, eligible dependents and family members living in the same household are eligible to utilize the EAP in accordance with Human Resources policy. Check with your HR manager for eligibility for EAP.

2.6 **Illegal Drugs, Controlled Substances and Unauthorized Items** – Illegal drugs, designer and synthetic drugs, substances that impair job performance or safety and drug-related paraphernalia: Controlled substances such as medications when usage is abused; Unauthorized alcoholic beverages

2.7 **Medical Review Officer (MRO)** – The MRO is a designated Medical Doctor (MD) with experience and certification in the interpretation of urinalysis test results for drug testing. The MRO examines the positive test results with consideration of whether there is a legitimate medical reason for the result. This is accomplished by telephone interviews with the donor and also with their prescribing physician or pharmacist when prescription or over the counter medications are possibly involved.

2.8 **Negative Test** – A personal sample (urine, blood, hair, breath, saliva or other permitted by law) that indicates a concentration(s) of any drug on the panel which is below the cut-off limit and also meets all quality control requirements (e.g., temperature, pH) and no evidence of adulterants.

2.9 **Positive Test Result** – A personal sample (urine, blood, hair, breath, saliva or other permitted by law) that indicates a concentration(s) of any drug on the panel which is above the cut-off limit and/or the gas chromatography – mass spectrometry (GCMS) confirmation level of that applicable regulation or requirement.

2.10 **Prohibited Substances** – Illegal or unprescribed drugs (or their metabolites), controlled substances and mood or mind-altering substances (i.e. any synthetic derivative/product that produces a marijuana-type high and any herbal products not intended for human consumption); or any prescribed drugs used in a manner inconsistent with the prescription, and alcoholic beverages.

2.11 **Reasonable Suspicion** – Suspicion based upon the observation of objective facts or specific and articulable behavior. Supervisor should complete a Reasonable Suspicion training course and be able to document the process and observations.

2.12 **Refusal to Test** – Refusing to provide a sample, refusing to cooperate, leaving the testing area, or refusing to accept and sign the testing consent form, is considered a breach of company policy and subject to disciplinary action up to termination of employment.

2.13 **Safety Sensitive** – A task or position is designated as safety sensitive when the task or position is such that an action would endanger the life of the employee and/or the lives of others. AECOM Business Groups may further define safety sensitive as it applies to their applicable line of work or to a specific project. When identifying safety-sensitive tasks or positions, consideration shall be given to applicable factors such as, but not limited to, the relevant industry (e.g., transportation, railroad, pipeline, etc.), regulatory requirements (e.g., covered tasks) of the given jurisdiction, an employee's direct involvement in the task or position's responsibilities, level of supervision, etc. Examples, but not a complete list, of positions that may be determined to be "safety-sensitive" based upon the applicable factors include:

- Drivers of Commercial Motor Vehicles (CMV)
- Workers on pipelines carrying fuels or toxic or corrosive substances
    - Example – US requirements: *S4AM(US)-019-ATT1 PHMSA Covered Tasks Flowchart* provides additional guidance for tasks related to pipeline or liquified natural gas (LNG) facilities.
- Workers at nuclear power plants
- Employees that operate -regulated devices (e.g., nuclear density gauges)
- Operators of industrial mobile equipment
- Workers handling hazardous substances.

2.14 **Substance Abuse Prevention Program Administrator (SAP Administrator)** – a person that administers policies for the company and acts as the Designated Employer Representative (DER).

3.0 References

3.1 None

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **SAP Administrator**

- Engage and coordinate appropriate parties as necessary to execute the SAP Program.
- Receive test results and other Substance Abuse Prevention related communications for AECOM.
- Function as DER

- The DER is authorized by AECOM to take immediate action(s) to remove employees from safety sensitive duties, or cause employees to be removed from these covered duties, and to make decisions required in the testing and evaluation process, such as in the case of a shy bladder or shy lung situation.
- The DER will also refer employees to the Substance Abuse Professional and facilitate the return to duty process of employees who have successfully completed the Substance Abuse Professional's recommendations or identified program, as permitted by AECOM, and as applicable, the client.
- All Service Agents (TPAs, MRO's Labs and Collection Agencies) shall know who the DER is so that they may speak to them if problems arise and/or to include the DER name on the testing forms. A Service Agent may not be a DER for a company.
- The DER is the person that will work with directly with auditors during an inspection, including providing all the information about the program and any compliance issues. Therefore, the DER shall be someone who carries some authority and has access to needed resources and is familiar with the company's operation.

- Provide SAP Program related guidance concerning AECOM requirements and report as appropriate on SAP Program status to the applicable party. Refer to *S3AM-019-ATT2 Substance Abuse Prevention Communication Guidelines*.

4.1.2 **Supervisors and Managers**

- Obtain any client - specific SAP Program related requirements associated with the project as early in the project lifecycle as possible (e.g., contract negotiations).
- Provide SAP Program related guidance and requirements applicable to the respective client and/or project(s) to the SAP administrator as soon as received. Refer to *S3AM-019-ATT2 Substance Abuse Prevention Communication Guidelines*.
- Has received the required and approved Supervisor Reasonable Suspicion training and: knows the signs and symptoms of abuse, knows the required documentation, understands procedures regarding confrontation of the individual, and the importance of confidentiality and has authority to refer an employee for drug and alcohol testing as required.
- Observe and document employee behavior which appears to violate this policy and procedure and refer employees for drug and alcohol testing as required.
- Ensure all employees have been orientated to this procedure and are knowledgeable about, and in compliance with this procedure, associated policy and applicable programs.
- Make appropriate referrals for a drug and/or alcohol test as per this procedure as well as any client contractual agreements or governmental regulation.
- Be current with the Employee and Supervisor Training and education programs so as to be knowledgeable about the use of alcohol and drugs and be able to recognize the signs and effects of alcohol and drug uses.
- Alert and involve Human Resources (HR), the Corporate Safety, Health and Environment (SH&E) Occupational Health Director and the Substance Abuse Program Administrator when an employee is believed to be unfit for duty due to drugs or alcohol use in violation of this policy and/or if an employee is tested for a reasonable suspicion use of drugs or alcohol.
- If any illegal drugs or drug paraphernalia are located on company premises, do not handle the items and immediately notify the following as necessary: HR, Resilience Group, the police department and the applicable Substance Abuse Program Administrator.
- Guide employees who voluntarily seek assistance for a personal substance abuse problem to appropriate resources such as the EAP or other local resource.

4.1.3 **Employees**

- Commit to a safe and drug-free workplace by complying with this policy and procedure and understanding their responsibilities.
- Read and understand the *S3AM-019-ATT1 Substance Abuse Policy Statement* detailing the Company's commitment to a drug free workplace. The signed *S3AM-019-FM1 Acknowledgement and Consent Form* attests that they have reviewed and are familiar with this procedure and understand that compliance is a condition of employment. Any questions should be directed to the Substance Abuse Administrator.
- Follow the instructions of their supervisor or Substance Abuse Administrator when informed that they have been chosen for a random or client drug test as allowed by federal, state / provincial / territorial, or local law and regulations. Failure to do so may result in discipline up to and including termination.
- Participate in substance abuse training programs as directed.
- Report for work Fit for Duty and remain Fit for Duty while on Company premises and worksites and adhere to the standards set out in this procedure and any applicable program.
- Notify your supervisor, HR or SH&E representative if you believe another employee or subcontractor is not Fit for Duty or exhibits conduct suggesting substance abuse.
- If having a valid driver's license is a condition of employment, report any loss of license related to drug or alcohol use immediately (no later than 24 hours after losing the license) to your supervisor.
- Consult with health care provider about any prescribed medication's effect on the ability to perform work safely and disclose work restrictions due to consumption of prescribed medications to their supervisor to determine if reasonable accommodation is needed.
- Bring legally prescribed medicine in the original packaging bearing a current label in the employee's name from a licensed pharmacist if the employee carries more than a single day of prescribed medications to work.
- An employee who has been convicted of a felony under a criminal drug statue for a violation occurring on Company property or during the employee's working hours shall notify Human Resources no later than five (5) calendar days after the felony conviction becomes final under the law.

4.2 Confidentiality

4.2.1 Information and records relating to drug screen test results, drug and alcohol dependencies and medical information shared with the Company in the course of administering this Policy and Procedure shall be treated as confidential and shared with HR and managers on a need-to-know basis. Information will not be released to third parties except with the consent of the individual or where relevant to a grievance, charge, claim, or other legal proceeding initiated by or on behalf of an employee or applicant, or as may be required by law or legal process.

4.3 Types of Testing

4.3.1 Employees undertaking Safety-Sensitive tasks or in a Safety Sensitive position may be required to undergo drug and alcohol testing.

4.3.2 Pre-employment Testing - Applicants extended a conditional offer of employment may be required to take, and pass, a pre-hire drug test before beginning work. Individuals who test positive or refuse the test will not be hired and will be ineligible to reapply for a minimum period of six months or longer as defined by the applicable Business Group. Employees who transfer from one company Business Group or project to another are not required to take a pre-employment drug test if their employment is without interruption, they are not subject to client testing or safety sensitive testing requirements, and they would have been expected to have taken a pre-hire or client mandated drug test.

4.3.3 Random and Annual Testing - Employees may be subject to random drug and/or alcohol testing in accordance with federal, state / provincial / territorial, and local laws. In addition, employees may be subject to random or annual drug tests to meet contract requirements.

- Selections for random testing will be made by the Substance Abuse Program Administer or a Certified Third Party Administrator using employee identification numbers and a random selection process. They will be unannounced and once selected for testing, an individual may not be waived from the testing process unless approved by the Substance Abuse Prevention program administrator.
- Employees will be notified to report for random tests at a time when they should be able to stop working and report immediately to the collection site. Failure to report for a test promptly when instructed to do so may be considered a refusal to test.
- Employees who may be required to submit to random or annual tests will be so notified at the time that they are hired into an applicable position, when they transfer into such a position, or when random or scheduled testing becomes applicable to their position.

4.3.4 Reasonable Suspicion Testing - Employees are subject to drug and/or alcohol testing whenever AECOM supervision has reason to believe that the employee may have violated this policy and procedure. Requests for tests will be based upon contemporaneous, articulable observations from supervisors suggesting that the employee may be under the influence of illegal drugs, controlled substances, or alcohol.

- Examples of observations that may lead or further substantiate reasonable suspicion testing can include the employee's appearance, behavior, speech, body odors, absenteeism, job performance, tardiness, etc. The SAP administrator should be consulted when guidance is required, who will engage HR as necessary. Observations shall be documented before the individual is asked to submit to a test.
- An employee asked to take a drug and/or alcohol test will be suspended without pay until test results are received. They may use Paid Time Off (PTO) time during this period. An employee who has negative test results will be returned to work status and the employee will then be paid or have their PTO restored for any lost time during that period.

4.3.5 Post Incident/Accident Testing - Employees may be subject to drug and alcohol testing in accordance with federal, state / provincial / territorial, and local law whenever:

- An employee is subject to post-incident testing in accordance with applicable client requirements and/or regulations or laws that contain specific requirements for testing (e.g., Department of Transportation, state / provincial / territorial, workers' compensation laws);
- An employee sustained or potentially caused or contributed to an injury or illness requiring off-site medical treatment beyond first aid, and there is a reasonable possibility the employees' drug or alcohol use may have contributed to the incident. Employees will not be tested post-incident if management determines that potential drug and/or alcohol use likely did not contribute to the incident such as in the cases or animal or insect bites, repetitive strain injury, poison ivy, etc;
- An employee may have caused or contributed to property damage estimated (including to Company vehicles or equipment) of $2,500 or more (a lower cost of damage requiring testing may be identified in Business Group specific programs); and
- An employee may have caused or contributed to an incident or serious near miss, whether or not they sustained an injury or illness, or whether property damage resulted. Testing may be appropriate in these circumstances if there is a reasonable possibility the employees' drug or alcohol use may have contributed to the incident and results may provide insight to the root causes of the incident.

In either of these instances, the investigation and substance abuse testing shall take place immediately following the incident and at a minimum within 8 hours for alcohol and 36 for drug testing, except that no investigation or request for test will delay the provision of urgent medical

care to any person in need of assistance. Employees will not be allowed to return to work until a negative drug/alcohol test result is received.

4.3.6 Return-to-Work and Follow-up Testing - Employees who test positive for drugs or alcohol or who have otherwise violated this Policy and Procedure are subject to discipline, up to and including discharge. Depending on the eligibility, the Company may offer an employee who violates this Policy and Procedure the opportunity to seek assistance in lieu of termination through an approved counseling program as per Business Group policy. Employees offered this opportunity will be required to be evaluated by a substance abuse professional, and to complete any course of education or treatment prescribed before returning to work. In addition, employees shall have a negative drug/alcohol test prior to their return to work and follow-up drug and/or alcohol testing may be required as a condition of continued employment, for a period of up to two years following the return to work. If subject to a client-specific substance abuse policy, employees who have had a positive test result will not be permitted to return to work on the client site or facility. Return-to-Work Agreements will be tailored to the individual's circumstances and job responsibilities.

4.4 Collection and Testing

4.4.1 Consent and Refusals to Test: No sample will be collected, or test conducted on any sample, without the consent of the person being tested. AECOM will pay the costs of all drug and/or alcohol tests it requires. A refusal to submit to a test will be treated as an admission of a policy violation and will usually result in termination of employment. Job applicants who refuse a test will have their job offers withdrawn.

- Attempts to tamper with, substitute, adulterate, dilute or otherwise falsify a test sample are considered refusals to submit to a test, as is a refusal to accept transportation to the testing facility, failure to appear at the testing location promptly after being asked to submit to a test, or other conduct that has the effect of hindering the testing process.

4.4.2 Test Methods: Drug test samples may include urine, hair, swab or saliva (oral fluids). All drug test samples will be screened and all presumptive positive drug tests will be confirmed using gas chromatography/ mass spectrometry (GC/MS) (or an equally accurate methodology). Drug tests will be performed by a laboratory certified by the U.S. Substance Abuse and Mental Health Services Administration for federal workplace testing, or as required by the applicable jurisdiction. Breath, blood, swab or urine tests may be used to detect the presence of alcohol. An alcohol test will be considered positive if it shows the presence of .04 percent or more alcohol in a person's system.

- Dilute or invalid results may require a recollection, and the Company may require the individual to provide an alternative test specimen as may be available and consistent with the underlying purpose of the test.

4.4.3 Collection and Chain-of-Custody: Persons being tested will be asked to provide a test sample to a trained collector. Procedures for the collection of specimens will allow for reasonable individual privacy. Urine specimens will be tested for temperature and may be subject to other validation procedures as appropriate. The collector and the person being tested will follow chain-of-custody procedures for specimens at all times. Tests will seek only information about the presence of drugs and alcohol in an individual's specimen and will not test for any medical condition.

4.4.4 Notification and Medical Review: Any individual whose test sample is confirmed positive for a drug or drugs will be contacted by a Medical Review Officer ("MRO") (a medical professional with an expertise in toxicology) and offered an opportunity to explain in confidence any legitimate reasons he or she may have that would explain the positive test (such as, for example, evidence that the individual holds a valid prescription for the substance detected). The MRO may also review suspected adulterated, substituted, and dilute specimens and make determinations about their validity.

- If the individual provides an explanation acceptable to the MRO that a drug test result is due to factors other than the consumption of illegal drugs, the MRO will order the positive test result

to be disregarded and will report the test as negative to AECOM. Otherwise, the MRO will verify the test as positive and report that test result.

4.4.5 Right to Explain and Retest: Within three working days after notice of a verified positive drug or alcohol test result on a confirmatory test conducted under this Policy, the tested individual may submit information to the MRO to explain the positive result. An individual who tests positive for drugs also may ask to have his or her remaining or split test sample sent to an independent certified laboratory for a second confirmatory test, at the individual's expense, and provided that a written request is made within five business days of the date the individual of the positive test result. the MRO will notify the original testing laboratory that the employee or applicant has requested that the laboratory conduct a confirmatory retest or arrange for transfer of the sample to the laboratory selected by the individual to perform the confirmatory retest. Tested individuals will be required to pay the testing laboratory for any confirmatory retest they request. AECOM may suspend, transfer, or take other appropriate employment action against an employee pending the results of any such re-test. However, if the re-test fails to confirm as positive the individual will be reimbursed for the cost of the re-test and the prior test results disregarded.

4.4.6 The Company will provide drug and alcohol tests results to candidates and employees automatically, where applicable law so requires, and otherwise upon written request as may be required by law or as approved by legal counsel.

4.5 Workplace Searches and Inspections

4.5.1 The Company reserves the right to inspect and search all portions of its premises for drugs and other contraband. All employees, contract workers, and visitors may be asked to cooperate in inspections of their persons, work areas, and property brought on site in connection with an inspection. Testing may be warranted based on search or disclosure of evidence obtained on a work site or company controlled property. Employees who refuse to cooperate in any such inspections are subject to discipline, up to and including discharge**.**

4.6 Employee Assistance Program and Drug Free Awareness

4.6.1 Illegal drug use and alcohol misuse result in a number of adverse health and safety consequences. Information about those consequences and source of help for drug/alcohol problems is available from HR representatives who can also refer employees to the EAP for assistance with drug/alcohol related problems. Information about the EAP program is available on the Company intranet.

4.6.2 The Company will provide support to employees who voluntarily seek help for drug or alcohol problems. Depending upon the eligibility, the employee may be referred for evaluation and allowed to use accrued paid time off or be placed on leave as may be necessary to complete any prescribed education and/or treatment. Employees also may be required to document that they are successfully following a prescribed education and/or treatment plan and pass return to duty and follow-up drug and/or alcohol testing. A request for assistance will be considered voluntary only if made before the employee becomes subject to disciplinary action for violating this or another Company policy, and cannot excuse substandard performance, so AECOM encourages employees who may need assistance to seek it promptly:

4.6.3 In conjunction with the EAP, the Company will promote a drug-free workplace and provide awareness concerning the AECOM SAP program to inform employees about:

- The dangers of substance abuse in the workplace.
- Available counseling, rehabilitation, and EAPs (both for self-referral or supervisory referral).
- The penalties that may be imposed for violations of this procedure.
- The Company's commitment to promoting a drug-free workplace.

5.0 Records

5.1 None.

6.0 Attachments

6.1 S3AM-019-ATT1 Substance Abuse Policy Statement

6.2 S3AM-019-ATT2 Substance Abuse Prevention Communication Guidelines

6.3 S3AM-019-FM1 Acknowledgement & Consent Form

6.4 S4AM(US)-019-ATT1 Pipeline & Hazardous Materials Safety Administration (PHMSA) Covered Tasks Flowchart

1.0 Purpose and Scope

1.1 This procedure applies to all AECOM Americas based employees and operations and any other entity and its personnel contractually required to comply with this document's content where the potential for hand injuries is present.

1.2 This procedure is intended to protect employees from activities that may expose them to hand injury. This procedure provides information on recognizing those conditions that require personal protective equipment (PPE) or specific work practices to reduce the risk of hand injury.

1.3 All personnel shall have gloves in their immediate possession 100% of the time when in a shop or on a work site. Appropriate gloves shall be worn when employees work with or near any materials or equipment that present the potential for hand injury due to sharp edges, corrosives, flammable and irritating materials, extreme temperatures, splinters, etc.

2.0 Terms and Definitions

2.1 None

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-208-PR1 – Personal Protective Equipment

3.3 S3AM-209-PR1 – Risk Assessment & Management

3.4 S3AM-325-PR1 – Lockout Tagout

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager / Supervisor**

- Implementation of this standard for the applicable facility, site, or project location.
- Confirm employees are familiar with this procedure and have appropriate training.
- Confirm the appropriate hand protection is available on site as necessary.

4.1.2 **Employees**

- Recognize hazards to hands.
- Comply with this procedure as well as client or work location requirements.

4.1.3 **SH&E Manager**

- Advise supervisors and site personnel on matters relating to hand safety.
- Work with the manager / supervisor to confirm that sufficient PPE and equipment are available.
- Maintain contact with manager / supervisor to regularly evaluate site conditions and new information that might require modifications to this procedure.
- Conduct training or briefings, when necessary, and to explain the content of this procedure and site hazards to employees.

- Assist in investigation of incidents that resulted or could have resulted in an injury.

4.2 Hazard Assessment

4.2.1 Perform hazard assessments for those work activities likely to require Personal Protective Equipment (PPE).

- Use the Task Hazard Assessment (THA) to perform the hazard assessment (in accordance with *S3AM-209-PR1 Risk Assessment & Management*). The THA will accompany AECOM personnel at jobsites for use in the event of a job or task change, or
- Use the *Gloves Needs Assessment – S3AM-317-FM1* or equivalent to perform the assessment.
- Re-evaluate completed hazard assessments when the job or task changes.

4.2.2 The hierarchy of controls should be considered during the THA process to minimize or eliminate the need for hand protection PPE or material handling tools. Examples of controls are chemical substitution, machine guarding, and use of different tools.

4.2.3 Select PPE that will protect employees if hazards cannot be eliminated.

- Review Safety Data Sheets for project or task-specific chemicals to determine appropriate PPE. If needed, consult with a SH&E Manager for assistance.
- Review glove manufacturer recommendations for both physical and chemical protection.
- Obtain gloves of the correct size for the employees.
- When both chemical and physical protection is of concern, wear the chemical protection gloves (e.g., nitrile) inside the physical protection gloves (e.g., leather, Kevlar®).
- Nitrile gloves or equivalent chemical resistant shall always be used for protection from hazardous fluids or non-corrosive chemicals.
- Do not wear metal or metal-reinforced gloves when working with electrical equipment or on electrical services. Proper leather and/or rubber gloves designed and tested for this purpose shall be used.
- Refer to *S3AM-208-PR1 – Personal Protective Equipment* for additional information.

4.2.4 Follow glove requirements in the applicable SH&E plan.

4.3 Guidelines for Working With and Around Equipment (Hand Tools, Portable Powered Equipment)

4.3.1 General

- As applicable, employees shall be trained in the use of all tools. Refer to *S3AM-003-PR1 SH&E Training*.
- Keep hand and power tools in good repair and use them only for the task for which they were designed.
- Inspect tools before use and remove damaged or defective tools from service.
- Operate tools in accordance with manufacturer's instructions.
- Do not remove or bypass a guarding device for any reason.
- Keep surfaces and handles clean and free of excess oil to prevent slipping.
- Do not carry sharp tools in pockets.
- Clean tools and return to the toolbox or storage area upon completion of a job.

- Confirm that the wrench is in full contact (fully seated, "flat", not tilted) with the nut or bolt before applying pressure.
    - Place the body in the proper position for optimal balance and bracing to prevent falls if the tool slips.
    - Make sure hands and fingers have sufficient clearance in the event the tool slips.
    - Whenever possible, pull on a wrench and avoid pushing.
- When working with tools overhead, place tools in a holding receptacle when not in use.
- Do not throw tools from place to place or from person to person, or drop tools from heights.
- Inspect all tools prior to start-up or use to identify any defects.
- Powered hand tools shall not be capable of being locked in the ON position.
- Require that all power-fastening devices be equipped with a safety interlock capable of activation only when in contact with the work surface.
- Do not allow loose clothing, long hair, loose jewelry, rings, and chains to be worn while working with power tools or rotating equipment.
- Do not increase the leverage by adding sleeved additions (e.g. a pipe or snipe) to increase tool handle length.
- Make provisions to prevent machines from restarting through proper lockout/tagout (refer to *S3AM-325-PR1 – Lockout Tagout*).

4.3.2 Cutting Tools

- Always use the specific tool designed for the task. Tubing cutters, snips, self-retracting knives, concealed blade cutters, and related tools are task specific and minimize the risk of hand injury. For more information about cutting tools, see *S3AM-317-ATT1 Safe Alternative Tools.*
- Fixed open-blade knives (FOBK) are prohibited from use during the course of AECOM work.
    - Examples of fixed open-blade knives include pocket knives, multi-tools, hunting knives, and standard utility knives.
    - Any exception to this requirement shall require approval of the Manager / Supervisor and SH&E Manager.
- When utilizing cutting tools, personnel will observe the following precautions to the fullest extent possible:
    - Use the correct tool and correct size tool for the job.
    - Cut in a direction away from yourself and not toward other workers in the area.
    - Maintain the noncutting hand and arm toward the body and out of the direction of the cutting tool if it were to slip out of the material being cut.
    - Ensure that the tool is sharp and clean; dirty and dull tools typically cause poor cuts and more hazard than a sharp, clean cutting tool.
    - Store these tools correctly with covers in place or blades retracted, as provided by the manufacturer.
    - On tasks where cutting may be very frequent or last all day (e.g., liner samples), consider Kevlar® gloves in the PPE evaluation for the project.
    - Do not remove guards on paper cutters.
    - In office locations, paper cutters must always be kept in a locked position when not in use.

4.3.3 Moving/Rotating Equipment

- General Requirements for Rotating Equipment (feed augers, chippers, conveyors, etc.)

- Never place hands, fingers, or extremities near hoppers and operational areas of machinery.
- When the equipment is rotating, stay clear of the rotating components and only operate equipment with proper machine guarding in place.
- Never clean a jammed piece of equipment unless the transmission is in neutral and the power source or the engine is off, locked out, and the moving parts of the equipment have stopped rotating. Refer to *S3AM-325-PR1 – Lockout Tagout*.

4.3.4 Other Physical Hazards

- Activities such as drum handling, fencing, work near razor wire, manhole cover removal, and demolition also pose hazards to hands. Use tools instead of hands for high hazard tasks whenever possible.
- Plan work to avoid pinch points for hands when moving drums, moving manhole covers into position, and handling other heavy objects.
- Work handling scrap metal, glass or other sharp edges requires proper hand PPE (Kevlar® or leather gloves).
- Activities involving hoisting, lifting and landing of a load shall be done "hands-free" when possible. Refer to *S3AM-317-ATT2 – Safe Hands-Free Lifting Guidelines*.

4.4 Ergonomics – Hand and Wrist Care

4.4.1 Keep your wrist in neutral. Avoid using your wrist in a bent (flexed), extended, or twisted position for long periods of time. Instead try to maintain a neutral (straight) wrist position. Ergonomic tools may be needed for long-term work.

4.4.2 Watch your grip. Gripping, grasping, or lifting with the thumb and index finger can put stress on your wrist. When practical, use the whole hand and all the fingers to grasp an object.

4.4.3 Minimize repetition. Even simple, light tasks may eventually cause injury. If possible, avoid repetitive movements or holding an object in the same way for extended periods of time.

4.4.4 Reduce speed and force. Reducing the speed with which you do a forceful, repetitive movement gives your wrist time to recover from the effort. Using power tools helps reduce the force.

4.4.5 Rest your hands. Periodically give your hands a break by letting them rest briefly. Or you may be able to alternate easy and hard tasks, switch hands, or rotate work activities.

4.4.6 Consider low vibration or anti- vibration hand power tools when possible.

4.5 Cleaning Hands

4.5.1 Avoid contamination of hands by proper use of gloves when contact with physical, chemical, or biological hazards is possible.

4.5.2 Use soap and water for normal hand cleaning. Do not use solvents for cleaning as they remove essential oils in the skin and may cause dermatitis. Do not use pressure washers for hand cleaning.

4.5.3 If the hands contact a corrosive (e.g., nitric acid), wash the area with water for fifteen minutes and then seek medical attention.

4.5.4 Use antibiotic ointment and skin protection on minor breaks/scratches of the skin.

4.5.5 In some cases barrier creams may be used to provide limited protection for hands exposed to greases and oils.

4.6 Safe Hands Observation Tool

4.6.1 The *Safe Hand Task Review Card S3AM-317-FM2* may be used to supplement and reinforce safe work practices and the requirements of this procedure.

4.6.2 The observer's responsibilities include:

- Two-way conversation with the employees being observed.
- Completing the card and mark the applicable fields on the back of the card.
- Submitting the completed cards to the supervisor.

4.6.3 The supervisor's responsibilities include:

- Reviewing the completed cards.
- Identifying best work practices and any improvements.
- Communicating any changes back the employee(s).

5.0 Records

The following documentation will be maintained:

5.1 Hand tool training records, as applicable.

6.0 Attachments

6.1 S3AM-317-FM1 Glove Needs Assessment

6.2 S3AM-317-FM2 Safe Hands Task Review Card

6.3 S3AM-317-ATT1 Safe Alternative Tools

6.4 S3AM-317-ATT2 Safe Hands-Free Lifting Guidelines

Americas

Glove Needs Assessment

S3AM-317-FM1

Mgr. / Supervisor Name: Work Area Name:

Task/Operation Being Evaluated: Date:

1.0 Using the Protection and Performance Needs Assessment Table Below

1.1 Function and performance needs must be evaluated thoroughly. If employees have a strong need for dexterity, tactility, and/or grip this should be identified as a priority. Rank properties in the table below with 1 being the highest priority. Do not assign the same priority more than once. It is only necessary to rank the applicable properties. If all properties are ranked, the lowest priority would be ranked 12.

Protection and Performance Needs Assessment			
Category	**Properties**	**Protection and Performance Needs**	**Priority** (1=Top Priority)
Mechanical	Cut Resistance	Protection from sharp edges, blades, and other cutting hazards	
	Puncture Resistance	Protection from sharp objects like nails, pins, needles, wire	
	Abrasion Resistance	Durability and resistance to abrasive objects or materials	
	Shielding	Protection from impact, ricochet, small projectiles.	
Chemical	Degradation & Absorption Resistance	Durability and resistance to breaking down and/or permeating the glove from exposure to chemicals. Refer to the chemical's Safety Data Sheet for the appropriate glove choice.	
Thermal	Heat Resistance	Thermal protection from hot objects or materials	
	Cold Resistance	Thermal protection from cold weather, objects, or materials	
Vibration	Anti-Vibration	Vibration reduction from operating certain tools and equipment	
Electrical	Insulation	If performing work on electrical equipment, this must be the top priority	
Function	Dexterity	Ability to manipulate objects and control hands in the desired manner	
	Tactility	Ability to sense objects by touch	
	Grip	Ability to exert pressure on an object when holding it	

1.2 Identify a glove that meets the top protection and performance priorities.

In most cases there are trade-offs between hazard protection and functional performance of a glove. These factors are equally important. The higher the severity of the hazard, the more important hazard protection is. The table below offers additional guidance on key considerations when selecting a glove for certain protection and performance properties.

<table>
<tr><th>Category</th><th>Properties</th><th>Key Considerations and Selection Criteria</th></tr>
<tr><td rowspan="4">Mechanical</td><td>Cut Resistance</td><td>Testing Standard: ASTM F1790 and ASTM F1970-05
There are 5 levels of cut resistance. 5 is the highest.</td></tr>
<tr><td>Puncture Resistance</td><td>Testing Standard: EN 388:2003
This testing measures the force required to pierce the sample with a standard sized point.</td></tr>
<tr><td>Abrasion Resistance</td><td>Testing Standard: ASTM D3389-05 and ASTM D3884-09
Abrasion resistance testing measures how well the glove material resists loss of material from rubbing on rough surfaces.</td></tr>
<tr><td>Shielding</td><td>Some gloves offer thick padding or hard guards around the back of the hand or knuckles. These can offer good protection against impact.</td></tr>
<tr><td>Chemical</td><td>Degradation & Absorption Resistance</td><td>Identify products / chemicals that present potential exposures. Refer to the chemical’s Safety Data Sheet and glove manufacturer’s specifications for the appropriate glove choice.</td></tr>
<tr><td rowspan="2">Thermal</td><td>Heat Resistance</td><td>Testing Standard: ASTM F1060-08
This testing measures the insulation provided by the glove when contacting a hot surface. Higher temperatures reported indicate a glove with greater insulation.</td></tr>
<tr><td>Cold Resistance</td><td>Testing Standard: EN 511:1994 (for ambient temperature)
Testing Standard: ISO 5085:1989-1 (for cold surfaces)
Choosing the right glove depends on whether protection is needed from cold weather or cold surfaces.</td></tr>
<tr><td>Vibration</td><td>Anti-Vibration</td><td>Testing Standard: ANSI S2.73-2002 (R2007)
This testing method measures the vibration transmission of the glove.</td></tr>
<tr><td>Electrical</td><td>Insulation</td><td>Testing Standard: ASTM D120-09
Glove protection depends on the maximum voltage of energized components.
<table>
<tr><td>50 – 480V</td><td>Class 00 with Leather Protectors</td></tr>
<tr><td>480 – 600V</td><td>Class 0 with Leather Protectors</td></tr>
<tr><td>600V and above</td><td>Class 0 or higher (depending on maximum voltage) with Leather Protectors</td></tr>
</table></td></tr>
<tr><td rowspan="3">Function</td><td>Dexterity</td><td>Testing Method: EN 420:2003
Ability to manipulate objects and control hands in the desired manner. This testing method assesses the wearer’s ability to pick up small diameter pins lying on a flat surface with their thumb and forefinger.
If high dexterity is needed, and the hazards are relatively low to the forefinger and thumb, consider a glove that is tip less for those two digits.</td></tr>
<tr><td>Tactility</td><td>Ability to sense objects by touch. There is no standard test. However, a common field test is to determine if the wearer can feel a pulse while wearing the glove. This is affected by the thickness of the glove, presence of liners, glove surface characteristics, and properties of the coating material.</td></tr>
<tr><td>Grip</td><td>Testing Standard: NFPA 1971 (Grip)
Ability to exert pressure on an object when holding it.</td></tr>
</table>

Safe Alternative Tools

S3AM-317-ATT1

1.0 Types of Safety Knives or Alternative Cutting Tools

1.1 Self-retracting utility knives (brands – OLFA, Martor, Allway Tools)



1.2 Guarded utility knives (brands – The Safety Knife Co., Martor)





1.3 Shears, snips, scissors (brands – Ridgid, Craftsman, Wolfcraft)





1.4 Concealed blade cutters (brands – The Safety Knife Co., Martor)







1.5 Pipe cutters (brands – Ridgid, Empire)







1.6 Specialty cutter (brand – Geoprobe)



Americas

Hazardous Materials Communication

S3AM-115-PR1

1.0 Purpose and Scope

1.1 Provides a Hazard Communication Program so that AECOM employees are informed of the hazards of the chemicals to which they may be exposed in the course of their work by way of container labeling and other forms of warning, safety data sheets (SDS), and employee training.

1.2 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

1.3 The program applies to the use of any hazardous substances which are known to be present in the workplace in such a manner that employees may be exposed under normal conditions of use or in a foreseeable emergency.

1.4 The program does not apply to general consumer products, for example, cleaners, printer toner, white out, etc.

2.0 Terms and Definitions

2.1 **Acute Effect** – An adverse effect on the human body with immediate onset of symptoms.

2.2 **Article** – A manufactured item: (1) which is formed to a specific shape or design during manufacture; (2) which has end use function(s) dependent in whole or in part upon its shape or design during end use; and, (3) which does not release or otherwise result in exposure to, a hazardous chemical, under normal conditions of use.

2.3 **Carcinogen –** Those chemicals appearing in any of the following reference sources are established as carcinogens for hazard communication purposes:

- National Toxicology Program (NTP) Annual Report on Carcinogens.
- International Agency for Research on Cancer (IARC) Monographs, Volumes 1-34. Note: The Registry of Toxic Effects of Chemical Substances published by NIOSH indicates whether a substance has been found by NTP or IARC to be a potential carcinogen.

2.4 **Chemical Name –** The scientific designation of a substance in accordance with the nomenclature system developed by the International Union of Pure and Applied Chemistry or the system developed by the Chemical Abstracts Service.

2.5 **Chronic Effect –** An adverse effect on the human body with symptoms which develop slowly over a long period of time or which frequently recur.

2.6 **Combustible Liquid –** Any liquid having a flash point at or above 100°F (37.8°C) but below 200°F (93.3°C), except any mixture having components with flash points of 200°F (93.3°C), or higher, the total volume of which makes up 99% or more of the total volume of the mixture.

2.7 **Common Name –** Any designation or identification such as code name, code number, trade name or brand name used to identify a substance other than by its chemical name.

2.8 **Container –** Any bag, barrel, bottle, box, can, cylinder, drum, reaction vessel, storage tank or the like that contains a hazardous chemical. For purposes of this procedure, pipes or piping systems, and engines, fuel tanks, or other operating systems in a vehicle are not considered to be containers.

2.9 **Location –** Any separate and distinct AECOM office, laboratory or other company facility.

2.10 **Exposure –** Any situation arising from work operations where an employee may ingest, inhale, absorb through the skin or eyes or otherwise come into contact with a hazardous substance.

2.11 **Flammable –** A substance that falls into one of the following categories:

2.11.1 **Flammable Aerosol** – An aerosol that when tested by the method described in 16 CFR 1500.45, yields a flame projection exceeding 18 inches at full valve opening or flashback (a flame extending back to the valve) at any degree of valve opening.

2.11.2 **Flammable Gas** – A gas that at ambient temperature and pressure:

- Forms a flammable mixture with air at a concentration of 13% of volume or less; or
- Forms a range of flammable mixtures with air wider than 12% by volume, regardless of the lower limit.

2.11.3 **Flammable Liquid** – Any liquid having a flash point below 100°F (37.8°C), except any mixture having components with flash points of 100°F (37.8°C) or higher, the total of which make up 99% or more of the total volume of the mixture**.**

2.11.4 **Flammable Solid** – A solid, including a powdered, granular or pasty mixture of a substance that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change or retained heat from manufacturing or processing or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard**.**

Flammable Solids do not include blasting agents or explosives as defined in 8 CCR 5237(a).

2.12 **Flash Point –** Minimum temperature of a liquid at which it gives off sufficient vapors to form an ignitable mixture with the air near the surface of the liquid or within the container used.

2.13 **GHS** – The Globally Harmonized System of Classification and Labelling of Chemicals developed by the United Nations with the goal of an international system to define and classify the hazards of chemical products, and communicate health and safety information on labels and safety data sheets.

2.14 **Hazardous Chemical –** Those chemicals appearing in any of the following reference sources are established as hazardous chemicals for hazard communication purposes.

- 29 CFR Part 1910, Subpart Z, Toxic and Hazardous Substances, OSHA.
- Hazardous Products Act, R.C.S. 1985, c. H-3, section 2, Canada.
- For operations within the state of California, the list of hazardous substances prepared by the California Director of Industrial Relations pursuant to Labor Code Section 6382. The concentrations and footnotes, which are applicable to the list, shall be understood to modify the same substance on all other source lists or hazard determinations set forth in § 8 CCR 5194(d)(3)(B) and (d)(5)(D).

2.15 **Hazardous Substance –**A hazardous chemical or carcinogen, or a product or mixture containing a hazardous chemical or carcinogen provided that:

2.15.1 The hazardous chemical is 1% or more of the mixture or product or 2% if the hazardous chemical exists as an impurity in the mixture; or

2.15.2 The carcinogen is 0.1% or more of the mixture or product;

2.15.3 Manufacturers, importers and distributors will be relied upon to perform the appropriate hazard determination for the substances they produce or sell.

2.15.4 The following materials are not covered by the Hazard Communication Standard:

- Any hazardous waste as defined by the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, as amended (42 USC 6901 et seq.) when subject to regulations issued under that act by the Environmental Protection Agency.
- Tobacco or tobacco products;
- Wood or wood products. Note: Wood dust is not exempt since the hazards of wood dust are not “self-evident” as are the hazards of wood or wood products;
- Consumer products (including pens, pencils, adhesive tape) used in the work place under typical consumer usage;
- Articles (i.e. plastic chairs);

- Foods, drugs, or cosmetics intended for personal consumption by employees while in the work place;
- Foods, drugs, cosmetics in retail store packaged for retail sale; and
- Any drug in solid form used for direct administration to the patient (i.e., tablets or pills).

Hazardous substance shall be considered the equivalent term to 'controlled substance'.

2.16 **Hazardous Substance Inventory (HSI) / WHMIS Log –** A listing of all chemicals stored or used at an office or project site. Note that the list may be imbedded in a project Health and Safety Plan.

2.17 **Immediate Use –** Means that the hazardous chemical will be under the control of and used only by the person who transfers it from a labeled container and only within the work shift in which it is transferred.

2.18 **National Fire Protection Association (NFPA)** – The NFPA is a trade association that issues standards and codes concerning risks associated with fire. A system of categories has been established by NFPA standard 704; colors and numbers, to provide basic hazard information concerning hazardous materials. It enables firefighters and other emergency personnel to easily decide whether or not to evacuate an area or proceed with emergency control operations. The three principal categories of identification are Health, Flammability and Instability. A numerical range of "0 to 4" indicates the severity of the hazard. A "4" indicates the most severe and a "0" indicates a minimal hazard. Refer to *S3AM-115-ATT1 Pictograms &Sample Labels* for an example.

2.19 **Mixture –** Any solution or intimate admixture of two or more substances which do not react chemically with each other.

2.20 **Reactivity** – A measure of the tendency of a substance to undergo chemical reaction with the release of energy.

2.21 **SDS –** A Safety Data Sheet prepared pursuant to state and federal regulations, OSHA Form 174 and Canada regulations (Hazardous Products Act & Regulation).

2.22 **SDS Administrator –** The individual or group designated by the Office Manager (Operations) or Project Manager to maintain the location-specific inventory list or log and the SDS binder required if that location uses or stores hazardous substances.

2.23 **Solubility –** The ability of substance to blend and mix uniformly with another.

2.24 **Specific Gravity (density) –** Ratio of the weight of a substance to the weight of the same volume of another substance. As used in this directive, specific gravity or density refers to the weight of substance as compared to the weight of an equal volume of water.

2.25 **Vapor Density –** The weight of a vapor-air mixture resulting from the vaporization of a volatile liquid at equilibrium temperature and pressure conditions, as compared with the weight of an equal volume of air under the same conditions.

2.26 **WHMIS –** The Workplace Hazardous Materials Information System (WHMIS) is Canada's national hazard communication standard. The key elements of the system are cautionary labeling of containers of WHMIS "controlled products", the provision of safety data sheets (SDSs) and worker education and training programs.

3.0 References

3.1 Additional definitions can be found in the Globally Harmonized System of Classification and Labelling of Chemicals (GHS), Hazardous Material Regulations (HMR), the Transportation of Dangerous Goods (TDG) Regulations, and the International Air Transport Association (IATA) Dangerous Goods Regulation (DGR).

3.2 S3AM-003-PR1 SH&E Training

3.3 S3AM-117-PR1 Hazardous Waste Operations

3.4 S3AM-208-PR1 Personal Protective Equipment

3.5 S3AM-209-PR1 Risk Assessment & Management

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **SH&E Manager / SH&E Department**

- Audit their regional offices to confirm that they maintain a location-specific Hazardous Substance Inventory (HSI).
- Audit their regional offices to confirm that if a location-specific HSI is required, that current SDSs are available for each substance listed on the HSI.
- Provide interpretation of SDSs and hazard information for GHS labels/WHMIS labels/NFPA labels and other information to assist in training employees.
- Provide hazard communication training to AECOM employees and file documentation related to this training (e.g. trainer name, date trained, brief description of training, etc.).
- Review SDS for adequacy of completion to meet the OSHA and Canadian standard and returning them to supplier, if necessary.

4.1.2 **Manager / Site Safety Officer (SSO) / Supervisor**

- Have an operations-specific, written hazard communication program which at least describes how the requirements of this Procedure and the US OSHA and Canadian Hazard Communication requirements for labels and other forms of warning, safety data sheets, and employee information and training will be met.
- Appoint an SDS administrator for their location if they store or use hazardous substances.
- Confirm, if required, that the SDS Administrator maintains an HSI for their location.
- Confirm that a copy of this Procedure and the site-specific SDS are available to all employees (and/or their designated representative). Employees shall be instructed in the location of this Procedure and the SDSs.
- Confirm that all employees (including new employees) under their supervision have received the appropriate training required by this procedure prior to assigning employees to tasks involving the use of, or potential exposure to, hazardous substances.
- Notify employees of hazardous substances covered by this procedure that are used in their work area.
- Determine the potential fire, toxic, or reactivity hazards which are likely to be encountered in the handling or utilization of a hazardous substance and will communicate this information to their affected employees, before any are permitted to work with it.
- Confirm that a current SDS (is replaced as new versions are issued) is available for each hazardous substance used, or potentially encountered, in the work areas or on the projects that are under their supervision.
- Confirm hazardous substances are properly labelled.
- Notify subcontractors (working for AECOM) of any hazardous substances that are used or stored by AECOM to which the subcontractor’s employees may be exposed.
- Notify clients or property owner/operators of chemicals brought onto their property by AECOM or AECOM’s subcontractors.
- Request SDSs from all subcontractor organization for the relevant chemicals they bring onto an AECOM controlled site.
- Access or obtain, and maintain copies of SDS from:

- The product manufacturer or supplier;
- All AECOM subcontractors bringing chemicals onto the project site; and
- The client, for all of the client's chemicals to which AECOM or AECOM subcontract employees are potentially exposed.

4.1.3 **Employee**

- Confirm that they have received appropriate hazard communication training prior to working with materials that fall under the procedure.
- Only work with materials for which they have been instructed on how to find an SDS and how to work with that material safely.
- Utilize the appropriate Personal Protective Equipment (PPE) and spill containment materials as per the SDS.
- Provide a copy of all SDSs received to the SDS Administrator at their facility.
- Verify that an SDS is available in their work area for each hazardous substance that they use.

4.2 General Procedure

4.2.1 Confirm that containers of hazardous substances that they use are properly labelled. All employees have a right to, and should, know the properties and potential hazards of substances to which they may be exposed.

4.2.2 Should AECOM assign employees that do not read and speak English to tasks with chemical exposures, communications will be provided in the language understood by that employee.

4.3 Employee Information and Training

4.3.1 Training of employees on hazardous substances in their work area shall be conducted:

- At the time of their initial assignment;
- Whenever a new hazardous substance is introduced into their work area; and
- According to jurisdictional requirements (e.g., GHS, WHMIS, etc.).

4.3.2 As a minimum, the training requirements apply to employees in the following job categories:

- All employees who perform field work that involves the use of, shipping / receiving of, or potential exposure to, hazardous substances covered under the OSHA Hazard Communication Standard and WHMIS; and
- Laboratory Employees.

4.3.3 The Initial Training will provide instruction in the following:

- Methods and observations that may be used to detect the presence or release of a hazardous substance in the work area (such as personal monitoring, visual appearance or odor of hazardous substances being released, etc.);
- The physical and health hazards of substances in the work area and measures and procedures AECOM has implemented to protect employees; and
- The details of this hazard communication program, including an explanation of the labelling system and the SDS, and how he/she can obtain and use appropriate hazard information;
- Any operations in their work area in which hazardous substances are present;
- Location and availability of this written hazard communications program (this procedure);
- Their right to personally receive information regarding hazardous substances to which they may be exposed;

- Their right to have their physician receive information regarding hazardous substances to which they may be exposed; and
- Any relevant jurisdictional regulation, such as an employee's right against discharge or other discrimination (in California) due to the employee's exercise of rights afforded pursuant to provisions of the California Hazardous Substances Information and Training Act.

4.3.4 Periodic Training and Training for Non-Routine Tasks

Additional training will be provided to employees who have received initial training whenever:

- A new hazardous substance is introduced into their work area;
- A new or significantly increased risk has been identified related to an existing hazardous substance (e.g. as identified in an updated SDS); and
- Non-routine tasks are performed, which will potentially result in exposure to hazardous substances, or exposure under circumstances, which were not addressed during initial training.

Supervisors, in coordination with their SH&E Manager, shall provide such training through an explanation of the information on the contents of the SDS for that substance.

When training their employees, supervisors shall explain:

- Any health hazards associated with use of the substance or mixture;
- Proper precautions for handling;
- Necessary personal protective equipment or other safety precautions to prevent or minimize exposure; and
- Emergency procedures for spills, fire, disposal, and first aid.

For most projects involving field work, this periodic training requirement will be facilitated through the implementation of the site specific SH&E Plan that has been developed for the project.

4.3.5 Documentation of Initial and Periodic Training

- All training required shall be documented at the time it is performed by having the employee sign a copy of a training attendance sheet.

4.4 Hazardous Waste Exemption

4.4.1 In the U.S., hazardous wastes are excluded from the state and federal Hazard Communication standards. AECOM employees who handle or are otherwise exposed to hazardous wastes are covered by the requirements of the Resource Conservation and Recovery Act (RCRA) and other local waste related laws and regulations and the OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) standard at 29 CFR 1910.120 and *S3AM-117-PR1 Hazardous Waste Operations.*

4.5 Hazardous Substance Inventory and Chemical Usage

Establishment of a Specific Hazardous Substance Inventory (HSI) or WHMIS Log, as referenced or contained within the safe to work plan, refer *S3AM-209-PR1 Risk Assessment & Management*, shall include:

4.5.1 If an AECOM location uses or stores additional hazardous substances, a location-specific HSI or WHMIS Log shall be maintained at that location.

4.5.2 If it is determined that an office-specific HSI is needed, the Manager shall confirm that one is developed and maintained by someone appointed as the location's SDS Administrator.

4.5.3 The HSI or WHMIS Log may be hard copy or managed through an electronic SDS management system.

4.5.4 The content of the HSI or WHMIS Log shall be updated as new hazardous substances are procured for, or removed from the location, and shall be verified by the SH&E Manager through regular inspections of the location.

4.5.5 In order to meet the 30-years-after-employment-termination record retention requirement, the office or project specific HSIs shall be managed as a permanent record.

Prior to using any chemical, a Task Hazard Analysis (THA) shall be completed by the employees assigned to use the chemical. The analysis will identify the hazards associated with the chemical (e.g. review the SDS to identify carcinogens or extremely hazardous chemicals), the tasks to be performed, and prescribe the Personal Protective Equipment (PPE) to be used, refer to *S3AM-208-PR1 Personal Protective Equipment.*

4.6 Safety Data Sheets (SDS)

4.6.1 Location-Specific SDS Inventory

- If it is determined that an AECOM location is required to maintain a location-specific inventory SDSs for the specific hazardous substances shall be maintained on file at that location.
- The SH&E Manager shall audit the local office or project for SDS request and maintenance and report deficiencies to the appropriate management level, as necessary, to confirm compliance with this procedure.

4.6.2 Field Project Sites and Client Facilities

- The Project Manager and/or the Site Safety Officer shall access or obtain, and maintain copies of SDS from:
  - The product manufacturer or supplier;
  - All AECOM subcontractors bringing chemicals onto the project site; and
  - The client, for all of the client's chemicals to which AECOM or AECOM subcontract employees are potentially exposed.

4.6.3 Employee Access to SDSs

SDSs should be maintained at the local location that uses that hazardous substance. Copies of this program and the SDS should be made available to the employee upon request to the office's SDS Administrator.

4.6.4 Field Access to SDSs

When hazardous substances are brought into the field, the user shall confirm that a copy of the SDS for that substance accompanies it and is available at the field location where it is to be used.

4.6.5 SDSs for AECOM Products

It is unlikely that AECOM activities would create a chemical for which a new SDS were needed. If such a chemical were created, the SH&E Department shall work with the appropriate operations groups to draft, review, and publish the new SDS.

4.6.6 Content of the SDS:

- Safety Data Sheets, previously referred to as Material Safety Data Sheets, will now require a 16-section format that is essentially the same as the ANSI standard for Hazardous Workplace Chemicals-Hazard Evaluation and Safety Data Sheets and Precautionary Labeling Preparation (ANSI Z400.1 & Z129.1 – 2010).
- Section 1, Identification includes product identifier; manufacturer or distributor name, address, phone number; emergency phone number; recommended use; restrictions on use.
- Section 2, Hazard(s) identification includes all information regarding the hazards of the chemical and the appropriate warning information associated with the hazards including classification, signal word, hazard statement, pictograms, and precautionary statement.

- Section 3, Composition/information on ingredients includes information on chemical ingredients; trade secret claims.
- Section 4, First-aid measures includes important symptoms/ effects, acute, delayed; required treatment.
- Section 5, Fire-fighting measures lists suitable extinguishing techniques, equipment; chemical hazards from fire.
- Section 6, Accidental release measures lists emergency procedures; protective equipment; proper methods of containment and cleanup.
- Section 7, Handling and storage lists precautions for safe handling and storage, including incompatibilities.
- Section 8, Exposure controls/personal protection lists OSHA's Permissible Exposure Limits (PELs); Threshold Limit Values (TLVs); appropriate engineering controls; personal protective equipment (PPE).
- Section 9, lists the physical and chemical properties of the hazardous substance.
- Section 10, Stability and reactivity lists chemical stability and possibility of hazardous reactions.
- Section 11, Toxicological information includes routes of exposure; related symptoms, acute and chronic effects; numerical measures of toxicity.
- Section 12, Ecological information
- Section 13, Disposal considerations
- Section 14, Transport information
- Section 15, Regulatory information
- Section 16, Other information, includes the date of preparation or last revision.

SDSs that do not contain this information shall be returned to the distributor or manufacturer to be updated.

4.6.7 Trade Secrets

Some hazardous substance suppliers may claim the information requested on SDSs is proprietary and not provide the information to AECOM.

When SDSs supplied to the SH&E Manager indicate that proprietary information has been withheld, the SH&E Manager will either obtain the necessary information to make a hazard assessment or reject the material for use within AECOM.

4.6.8 For Canadian operations, all relevant SDS shall be current (no more than 3 years old) and readily available (in French and English) for all hazardous materials.

4.7 Labeling

4.7.1 Containers of hazardous substances used or stored in each AECOM location shall be labeled, tagged or marked with the following information:

- Product name or Identifier;
- Hazard Pictogram;
- Signal Word;
- Physical, Health, Environmental Statements;
- Supplemental Information;
- Precautionary Measures and Pictograms;

- First Aid Statements;
- Name and Address of Company; and
- Telephone Number.

4.7.2 Refer to *S3AM-115-ATT1 Pictograms & Sample Labels*.

4.7.3 Labels on containers shall not be removed or defaced. Labels or other forms of warning shall be legible, in English and French (Canada), and prominently displayed on the container.

4.7.4 Formal and informal inspections shall include observing that hazardous materials are properly labeled.

4.7.5 Immediately replace lost or illegible labels provided the product can be conclusively identified. Any failure to have the appropriate labeling information on a container at any time, or illegible or missing labels will be cause to suspend use of the product until the product is conclusively identified and is properly labeled.

4.7.6 Carcinogen Labeling

Chemicals which have been indicated as positive or suspect carcinogens by either OSHA, ACGIH, the International Agency for Research on Cancer (IARC) (World Health Organization), or the National Toxicology Program (NTP) will be considered to be carcinogenic for purpose of the HCS.

4.7.7 Stationary Process Containers

If there is stationary process equipment within a work area (e.g., vessels, piping systems, etc.), signs, placards, pictograms, process sheets, batch tickets, operating procedures, or other such written materials may be used in lieu of fixed labels on the containers, as long as the alternative method conveys the appropriate hazard information. The written materials shall be readily accessible to the employees in the work area.

4.7.8 Portable Containers

Portable containers of hazardous substances need not be labelled when the substance is transferred from labelled containers and will be used immediately by the employee who performs the transfer, however the container shall still contain the product identifier (name). Immediate use means the container will remain in the employee's immediate possession and direct oversight until the container is fully emptied or contents are returned to a labelled container.

Containers of hazardous substances transferred from labelled containers and not intended for the immediate use of the employee performing the transfer shall be labelled with the chemical name and a hazard warning label meeting workplace label requirements in accordance with the OSHA Hazard Communication Standard or WHMIS (as applicable to the given jurisdiction).

4.8 Chemical Storage

4.8.1 Hazardous chemicals are to be stored in labeled containers with the lids securely closed using appropriate undamaged caps or lids. Confirm liners are in place if used.

4.8.2 Flammable and combustible materials shall be stored in fire impervious cabinets in designated stockroom areas. Chemicals shall be stored in compliance with instructions provided on their labels, SDS, or the manufacturer's specifications (e.g. compatibility with other substances, environmental conditions, etc.).

NOTE: Flammable gases or other compressed gases should not be stored in flammable material cabinets as these cabinets are not designed for containment of pressurized gases.

4.8.3 All hazardous chemicals shall be stored in a manner that prevents spillage and leakage from exposing people or the environment to the chemical.

4.8.4 Hazardous chemicals shall not be stored with foods or beverages. Food and beverages shall not be consumed in areas where hazardous chemicals are used or stored.

4.9 Chemical Use in Offices

4.9.1 In general, hazardous substances should not be taken into office areas, conference rooms, or break areas, contact the SH&E Manager for guidance if this general requirement is infeasible.

4.9.2 General exceptions to this rule are the following:

- Liquid paper;
- Toner;
- Cleaners;
- Isobutylene calibration gas; and
- pH calibration solutions for instruments.

4.9.3 Each office or location using or storing hazardous materials will develop a written office/ location-specific Hazard Communication/WHMIS Program.

4.9.4 If the local office decides to implement the requirements of the standard in any way that differs from this procedure, they shall verify the changes with the SH&E Manager, document the changes, and communicate the differences to all affected employees.

4.10 Canada-specific

4.10.1 Consumer products are exempt from supplier labels and SDS requirements. Some cleaning solvents may be packaged as consumer products and these shall be labeled in accordance with the Consumer Product Act requirements.

4.10.2 In addition to the labelling of storage containers in the workplace, the contents of process piping (including valves), process vessels and reaction vessels are required to be identified through the use of colour coding, labels, placards or other modes of identifications that shall be communicated to workers through training programs. It is important for employees to be aware of and understand Client labelling requirements for these types of process systems.

5.0 Records

5.1 HSI or WHMIS Logs shall be retained in project or office files for a minimum of 30 years or according to jurisdictional requirements.

5.2 Training documentation shall be retained in accordance with *S3AM-003-PR SH&E Training*.

6.0 Attachments

6.1 S3AM-115-ATT1 Pictograms & Sample Labels

Americas

Stop Work Authority

S3AM-002-PR1

1.0 Purpose and Scope

1.1 This procedure establishes the requirements for AECOM personnel to stop any task or company operation if they believe there is an imminent safety, health, or environmental risk as described within this document.

1.2 The AECOM Safety Red Card is a key component in the Stop Work Authority for Unsafe Work procedure. The Safety Red Card is derived from its use in football (soccer), where circumstances are such that a referee has to stop the play, similar to an imminently dangerous situation on a project site. The Safety Red Card is a physical tool that reinforces the Stop Work Authority Procedure.

1.3 This procedure applies to all Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content..

2.0 Terms and Definitions

2.1 **Contractor** – For the purposes of this procedure, a person or business whose contract to provide work or services is not with AECOM. AECOM may have the responsibility of safety oversight for Contractor-controlled work on a particular project or construction site if specified in the associated contract.

2.2 **Direct Subcontractor** – For the purposes of this procedure, a person or business which has a contract directly with AECOM to provide work or services.

2.3 **Imminent Danger –** For the purposes of this procedure, an immediately dangerous situation that, if left uncorrected, is likely to result in serious injury, loss of life, or environmental impairment.

2.4 **Project Management / Construction Management (PM-CM)** – AECOM has contractually agreed with the client to the specified roles and responsibilities of oversight of Contractor-controlled work for the given project.

2.5 **Safety Red Card** - A tangible reminder of stop work authority for all AECOM employees that can be presented when stopping work. The intent is for every employee to have or have access to their own Safety Red Card.

2.6 **Stop Work Order – AECOM and Direct Subcontractors -** A directive to cease AECOM-directed work, issued for failure to follow procedures, Imminent Danger situations/conditions, accumulation of safety violations, etc. The Stop Work Order will also be completed when there is disagreement between those affected or involved regarding the validity of the stop work issue or adequacy of the resolution actions. The Stop Work Order will apply to AECOM employees and AECOM Direct Subcontractors placed at risk by the identified situations or conditions. Refer to *S3AM-002-FM1 Stop Work Order – AECOM Employees and Direct Subcontractors*.

2.7 **Stop Work Order – Project Management / Construction Management** – Applies to Contractor-controlled work for which AECOM Project Management / Construction Management (PM-CM) has contractually agreed to the responsibility of safety oversight of Contractors for the given project. A directive served to the Contractor to cease Contractor-controlled work, issued for failure to follow procedures, Imminent Danger situations / conditions, accumulation of safety violations, etc. Refer to *S3AM-002-FM2 Stop Work Order-Project Management / Construction Management.* Note: If PM-CM has not contractually agreed specifically to oversight of safety, this form does not apply.

3.0 References

3.1.1 S3AM-004-PR1 Incident Reporting, Notifications & Investigation

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Employees**

- Any time an employee identifies a condition or act that is likely to cause an Imminent Danger situation:
- Responsible for stopping associated AECOM-directed work and that of Direct Subcontractors, and for bringing it to the attention of the appropriate supervisor, manager, SH&E Representative, and/or Contractor representative.
- Where Employees are working alongside Contractors for which AECOM has contractual Project Management / Construction Management (PM-CM) safety oversight of the Contractor, employees shall be responsible for stopping associated Contractor-controlled work and for bringing it to the attention of the appropriate supervisor, manager, SH&E representative, and/or Contractor representative.
- Where employees are working alongside Contractors for which AECOM PM-CM has not contractually agreed to the responsibility of safety oversight of Contractors for the given project, employees can, as applicable, report unsafe conditions/acts to the Contractor's site representative (supervisor, foreman, etc.) for resolution. Employees shall promptly report the situation to AECOM management.
- Where no contract exists between AECOM and the party presenting the situation, employees can, as applicable, and report unsafe conditions/acts to the parties' site representative (supervisor, foreman, etc.) for resolution. Employees shall promptly report the situation to AECOM management.
- Where Employees are working under the direction of client / customer supervisors and/or working on a task with a client / customer employee, Employees shall be trained, as is applicable, to communicate directly with the worker involved, report the unsafe conditions/acts to their client / customer supervisor and/or point-of-contact for resolution and subsequently report it to AECOM management.
- Decline to participate in client / customer-directed work under unsafe conditions or acts and immediately report the situation to AECOM management.
- Employees shall retain their individual Safety Red Card. An Employee may or may not physically present a Safety Red Card when stopping work.

4.1.2 **SH&E Manager**

- Review all Stop Work Orders applicable to their scope.
- Provide technical guidance for the development and implementation of corrective actions.
- Training of AECOM Employees should include how to exercise stop work authority and the measures AECOM management will take as a result of the work stoppage.
- Honor any worker refusals of unsafe work. Assist in resolving issues before operations resume, and that all stop work actions are properly resolved with required follow-up completed.

4.1.3 **Manager**

- Establish a safety culture where the stop work authority is embraced by the workforce as a tool so that all AECOM employees share the responsibility for safe working conditions.
- Training of AECOM Employees should include how to exercise stop work authority and the measures AECOM management will take as a result of the work stoppage.
- AECOM Employees have or have access to their own Safety Red Card and understand its meaning.

- Contractors for which AECOM PM-CM has contractual safety oversight, and Direct Subcontractors are informed of the stop work authority of AECOM and its Employees as a regulatory and Company requirement, as well as the intent of the program, which is to empower employees to work safe and prevent injuries.
- Clients / customers understand stop work authority of Employees is a regulatory and Company requirement, as well as the intent of the program, which is to empower Employees to work safe and prevent injuries.
- Honor any worker refusals of unsafe work, Resolve issues before operations resume, and that all stop work actions are properly resolved with required follow-up completed.
- Confirm reporting is completed any time an Employee exercises stop work authority
- Review so that Reporting is appropriate to the stop work situation, using inspection and observations programs (e.g. LifeGuard, Office Inspections, etc.) and IndustrySafe. Refer to *S3AM-004-PR1 Incident Reporting, Notifications & Investigation* for additional direction.
- Maintain and track reports associated with the stop work situation until resolved/closed.
- Stop work interventions that include a near miss or incident shall be reported as such.
- Review for Stop Work Orders completed when AECOM Employees or Direct Subcontractors completing AECOM-directed work fail to provide resolution to the stop work situation, or if at any time the actions or failure to act of those involved in the Stop Work Order cause Imminent Danger to the health and safety of Employees, any other person at the place of employment, or the environment. Refer to *S3AM-002-FM1 Stop Work Order – AECOM Employees and Direct Subcontractors*.
- Review Stop Work Orders – Project Management / Construction Management are completed when Contractors performing Contractor-controlled work, subject to AECOM contractual safety oversight, fail to provide resolution to the stop work situation, or if at any time the actions or failure to act of those involved in the Stop Work Order cause Imminent Danger to the health and safety of Employees, any other person at the place of employment, or the environment. Refer to *S3AM-002-FM2 Stop Work Order – Project Management / Construction Management*.
- When an unsafe condition or act has been reported by an AECOM Employee of a Contractor for which AECOM does not have specific contractual safety oversight, communicate promptly with client representative(s).
- Review corrective actions have appropriately addressed the conditions leading to the stoppage of work or the Stop Work Order.
- If AECOM has control over the circumstance that led to the condition, initiate additional corrective actions necessary to correct the conditions leading to the Stop Work Order. Otherwise, remain in communication with the persons or entities that are taking the corrective measures.
- Communicate such corrective actions and the effects of such corrective actions on the project / location / office to the client and/or next level of AECOM Management.
- Work activities of AECOM-directed work should not resume until the stop work situation has been resolved to the satisfaction of all involved and/or the appropriate approvals received to resume work.
- Monitor that work activities of Contractors subject to AECOM contractual safety oversight do not resume work until the unsafe situation has been resolved.
- Documentation related to the Stop Work Order and corrective actions is placed in the project / location / office file.

4.2 Requirements

4.2.1 Employees shall be trained in how to exercise stop work authority, the use of the Safety Red Card and in the measures AECOM management will take as a result of the work stoppage.

4.2.2 Employees will each be provided a Safety Red Card for their own use.

4.2.3 It is AECOM's policy and firm commitment that Employees are expected to stop their work to prevent unacceptable exposure to workplace hazards, including unsafe conditions or worker behaviors, without fear of reprimand or reprisal.

- "Stopping work" for AECOM-directed work may include stabilizing an Imminent Danger situation, as is safely possible, to the extent that it can be left unattended for a prolonged period of time until the issue is resolved.
- Stop work interventions to correct some unsafe situations that do not present an Imminent Danger (e.g., to remind workers to put on their hard hats, safety glasses, etc.) may not require formal stop work notification but should be appropriately reported (e.g. LifeGuard, Inspection Report).

4.2.4 There will be no retribution or any form of intimidation directed against an employee for good faith reporting of SH&E issues or the good faith stopping of work due to unsafe conditions.

4.2.5 Where Employees identify an unsafe act or condition related to a Contractor or worker for which AECOM does not have specific contractual safety oversight , as applicable, Employees should report the situation to the Contractor or worker's site representative (supervisor, foreman). Employees shall immediately report the situation to AECOM management who, in turn, shall promptly communicate with the client representative(s).

- While Employees may not be authorized to stop client / customer-directed work, Employees shall decline to participate in work under the Imminently Dangerous situation and immediately report the situation to the client / customer representative and AECOM management.

4.2.6 AECOM's stop work authority applies to all work AECOM-directed work and to Contractor-controlled work for which AECOM PM-CM has contractually agreed to the responsibility of safety oversight of Contractors for the given project.

- When an Employee identifies an Imminent Danger situation, the Employee shall immediately stop work and notify the affected co-worker(s) and supervisor, manager, SH&E representative and/or Contractor representative.
- If the supervisor / manager / representative is not readily available and/or the affected person(s) are in an Imminent Danger situation, the stop work intervention should be initiated directly with the Employee(s) at risk. The supervisor / manager / representative shall be informed as soon as possible.
- The supervisor / manager / representative shall communicate the stop work situation with any other affected personnel and the applicable client / customer representative(s).
- Managers, and/or SH&E Managers may issue a formal Stop Work Order for AECOM-directed work in the following situations:
    - Imminent Danger exists involving an employee's safety and health, that of any other person at the place of employment or damage to the environment, facilities, or property.
    - A project, or any segment of the project, is executed improperly or is out of compliance with applicable regulations or standards.

4.2.7 Stop Work Order – Project Management / Construction Management

Applies to Contractor-controlled work for which AECOM Project Management / Construction Management (PM-CM) has contractually agreed to the responsibility of safety oversight of Contractors for the given project. Refer to *S3AM-002-FM2 Stop Work Order- Project Management / Construction Management.*

- With a stop work situation related to Contractor- controlled work for which AECOM has contractually specified safety oversight, the Contractor is expected to immediately resolve the stop work situation. A Stop Work Order – Project Management / Construction Management form must be completed if:

- Imminent Danger exists involving the Employees' safety & health, the environment, facilities, or property.
- There is a discrepancy, deficiency, or potentially dangerous condition or act that is likely to cause an unsafe or unhealthy situation or an Imminent Danger situation.

- When a Stop Work Order – Project Management / Construction Management is issued by AECOM, the Contractor is expected to establish and document corrective actions and provide items (e.g. pictures, documents, etc.) related to the stop work situation and related corrective actions. AECOM will monitor the Contractor's corrective actions.

4.2.8 Stop Work Order – AECOM Employees and Direct Subcontractors

With a stop work situation related to AECOM-directed work, the appropriate parties (e.g. affected personnel, supervision, SH&E representative, management, client / customer representative, etc.) shall discuss and gain agreement on the stop work issue.

- If determined and agreed by all involved that the task or operation is cleared to safely proceed, the affected persons shall immediately resume work.
- If determined and agreed that the stop work issue is valid, then every attempt must be made to resolve the issue for the safety of Employees, Contractors, any other person at the place of employment, and the environment.
- If the stop work issue cannot be resolved immediately, work shall be suspended until proper resolution can be achieved to the satisfaction of all involved.
- If all affected by the stop work issue cannot agree that work can be resumed safely (opinions differ regarding the validity of the stop work issue or adequacy of the resolution actions), a Stop Work Order must be completed. Refer to *S3AM-002-FM1 Stop Work Order – AECOM Employees and Direct Subcontractors*.
    - In order for work to resume, the completed Stop Work Order must be reviewed by the Manager, the applicable SH&E Manager and any other parties necessary (this may include the Employee who initiated the stoppage of work) to determine whether work can be resumed safely.
- If it is determined work can be resumed safely but the disagreement remains, work will only commence with the written approval to return to work by the Vice President of the applicable business group and, as applicable, the client representative. Refer to *S3AM-002-FM1 Stop Work Order – AECOM Employees and Direct Subcontractors.*
- If the responsible organization fails to provide resolution, or if at any time the responsible organization's acts or failure to act cause Imminent Danger to the health and safety of **Employees**, that of any other person at the place of employment, or the environment, AECOM may issue a Stop Work Order. Refer to *S3AM-002-FM1 Stop Work Order – AECOM Employees and Direct Subcontractors*.

4.2.9 In most cases, a Stop Work Order affects only those areas immediately involved in the hazardous situation. The Stop Work Order will apply to AECOM – directed work, its **Employees** and its Direct Subcontractors placed at risk by the situations or conditions. The Stop Work Order – Project Management / Construction Management will apply to Contractor-controlled work and its employees for which AECOM PM-CM has contractually agreed to the responsibility of safety monitoring of Contractors for the given project.

4.2.10 AECOM may issue a Stop Work Order for a portion of the work area(s) or for an entire work area when unacceptable risks exist.

4.2.11 The Stop Work Order will remain in effect until the responsible organization resolves the problem(s) and brings the work area(s) to satisfactory conformance with established AECOM SH&E requirements. Corrective actions taken and preventative measures put in place must be communicated to all affected by the Stop Work Order.

4.2.12 Work will not resume until appropriate corrective actions have been completed. The “Return to Work” portion of the Stop Work Order must be completed.

4.2.13 An AECOM Employee’s failure to comply with any Stop Work Order in whole or in part may result in disciplinary action, and/or termination of employment. An AECOM Direct Subcontractor Employee’s failure to comply with any Stop Work Order may result in immediate removal from the project, location and/or office.

5.0 Records

5.1 The completed Stop Work Order and any corrective action reports generated will be maintained at the project site for the duration of the project and placed in the closed project file.

6.0 Attachments

6.1 S3AM-002-FM1 Stop Work Order – AECOM Employees and Direct Subcontractors

6.2 S3AM-002-FM2 Stop Work Order – Project Management / Construction Management

6.3 S3AM-002 ATT1 Stop Work Order – Authority Table

Americas

Subcontractor Management

S3AM-213-PR1

1.0 Purpose and Scope

1.1 This procedure applies to all AECOM Americas based employees and operations and to subcontractors of any tier. A subcontractor is a person or business which has a contract (and is not an employee) with AECOM to provide some portion of the work or services on a project which AECOM has agreed to perform for the client.

1.2 This procedure does not apply to vendors. For the purposes of this procedure, a vendor is a service provider and, is a person or business which performs services. Examples of a vendor could be a food machine vendor supplier for a site canteen; a portable toilet delivery company; an office equipment repair service; etc.

1.3 This procedure does not apply to third-party contractor operations where there is no subcontract relationship between the contractor and AECOM. Safety issues regarding third-party contractor operations are governed by project-specific contracts, and are not covered by this procedure.

1.4 This procedure provides requirements on the evaluation of subcontractor safety, health, and environmental programs; contractual risk management; subcontractor safety performance on the job site; and the responsibilities of the Manager with respect to subcontractor jobsite performance.

1.5 Each AECOM subcontractor must be evaluated at least annually using *S3AM-213-FM1 Subcontractor SH&E Evaluation Form*, or equivalent process (e.g., third-party qualification vendor, internal pre-qualification databases), in order to perform work on any AECOM projects.

2.0 Terms and Definitions

2.1 Subcontractor - For the purposes of this procedure, a person or business which has a contract directly with AECOM to provide work or services related to AECOM or client work scopes beyond delivery or basic repairs. Examples of a subcontractor could be an engineer; a sign installer; a welding company; an office renovation company; etc. A person or business with a contract directly with AECOM that does not fall clearly within this definition may also be required by the applicable business group to comply with this procedure.

3.0 References

3.1 S3AM-015-PR1 Newly Hired or Transferred Employees

3.2 S3AM-209-PR1 Risk Assessment & Management

4.0 Procedure

4.1 Implementation of this procedure is the responsibility of the AECOM manager (Manager) directing activities of the facility, site, or project location.

4.2 The AECOM manager shall ensure appropriate training of AECOM personnel responsible for overseeing subcontractor work.

4.3 Subcontractors shall be appropriately trained, competent, and capable to perform their activities in a safe, healthful, and environmentally responsible manner.

- As applicable, verification of subcontractor training or competency, or medical clearance may be required.

4.4 AECOM direction shall be provided to the subcontractor's management (foreman, supervisor, Site Safety Representative, etc.). Direction of subcontractor employees shall be the responsibility of the subcontractor's management.

4.5 Pre-qualification of Subcontractor – The Manager shall complete the following procedures for all subcontractors proposed for projects covered by this procedure unless an equivalent process (e.g., third-party prequalification vendor, internal pre-qualification databases and procurement processes, etc.) is used. The Manager shall also require subcontractors to follow these procedures with respect to pre-qualification of sub-subcontractors of any tier.

4.5.1 Request all subcontractor candidates to complete the attached *S3AM-213-FM1 Subcontractor SH&E Evaluation Form* or equivalent (e.g., third-party prequalification vendors, internal pre-qualification databases).

4.5.2 Conduct an assessment of each subcontractor's qualifications with respect to the Subcontractor Evaluation Criteria contained in *S3AM-213-ATT1 Subcontractor Evaluation Criteria.*

4.5.3 If the subcontractor does not meet criteria outlined in *S3AM-213-ATT1 Subcontractor Evaluation Criteria*, the decision shall be that the subcontractor shall not be used. However, if a unique business need exists (e.g., subcontractor is a specialty subcontractor, only bid, client required, small business/minority set asides), the Manager shall initiate *S3AM-213-FM2 Subcontractor Variance Form* (or equivalent vendor/database approval).

- Subcontractor Variance documentation shall clearly identify how the risk of the unmet criteria will be managed, including expectations and requirements of the subcontractor in managing the risk. Examples may include, but are not limited to requiring the subcontractor to:
  - Submit a detailed safety mitigation plan associated with the unmet criteria.
  - Utilize the AECOM Safety Management System in place of the subcontractor system.
  - Utilize specific programs associated with the AECOM Safety Management system.
  - Provide disclosures of specific criteria or engage in inspections at greater frequency.
- Potential risk and liability impact of variance content can vary considerably based on contract, type of subcontractor, and workplace activities. Legal counsel should be consulted to ensure that the proposed variance for the subcontractor does not impose undue risk and liability for AECOM.
- Variance requirements shall be acknowledged and agreed to by the subcontractor prior to work commencing and compliance with the variance requirements shall be monitored by the Manager.
- Failure to comply with the variance requirements shall be grounds for termination (this shall be specified in the subcontract).

4.5.4 If the subcontractor has been successfully evaluated within the last 12 months, the successful evaluation may be substituted for the pre-qualification evaluation.

4.5.5 For long-term operations, update this evaluation within 12 months of the previous evaluation.

4.6 Contractual and Risk Management Requirements of Subcontractors

4.6.1 Ensure that the subcontractor is contractually bound to comply with applicable client and AECOM SH&E Program requirements (e.g. alcohol and drug policies, procedures, insurance, licenses, registrations, etc.).

4.6.2 The AECOM SH&E Plan does not, nor is it intended to, address procedures of subcontractors during their site activities.

4.6.3 The subcontractor shall maintain appropriate SH&E procedures, that at a minimum comply with client and AECOM requirements and those procedures applicable to work that is exclusive to their activities on the site, and for which they may have superior knowledge.

- Depending upon the contractual agreement between AECOM and the subcontractor, the subcontractor may be required to develop a project SH&E Plan. Subcontractors' SH&E Plans shall, at a minimum, conform to the requirements of the AECOM SH&E Plan
- AECOM's scope of work under the client contract and the contract with the subcontractor can determine to what extent AECOM is required to review subcontractor plans and procedures. If in doubt consult legal counsel. In general, concerning subcontractors contracted to AECOM:
    - AECOM can be expected to review subcontractor plans and/or procedures in which AECOM can reasonably be expected to have adequate knowledge (e.g., Fitness for Duty, Hazard Assessment & Risk Management, Stop Work Authority, etc.).
    - AECOM can be expected to verify documentation and general adequacy of relevant subcontractor SH&E plans and/or procedures for which the subcontractor has superior knowledge.

4.6.4 Ensure that AECOM has the right in its subcontract, without liability to AECOM, to stop the subcontractor's work in the event of any violations of the applicable safety requirements.

4.6.5 Managers shall require subcontractors to follow pre-qualification procedures for lower-tiered subcontractors.

4.7 Subcontractor Safety Representative

4.7.1 Require each subcontractor to appoint a Subcontractor Safety Representative (SSR) who:

- Is knowledgeable of the subcontractor's activities.
- Understands the safety requirements of the subcontractor's activities.
- Has the ability to recognize and the authority to correct safety deficiencies and execute a stop work order should an imminent danger arise.
- Has the responsibility for the administration of the subcontractor safety program.
- Will serve as the direct contact with AECOM regarding resolution of SH&E issues
- Will report work-related injuries/illnesses/incidents, environmental incidents and regulatory inspections/violations to AECOM according to AECOM procedures and/or client requirements.

4.8 Communication

4.8.1 Provide the SSR with information regarding site safety program including but not limited to:

- Client Requirements
- Project SH&E Plan
- AECOM SH&E Program
- Site Hazard Communication Program
- Site Emergency Plan
- Any additional safety information from other contractors or subcontractors working on the site.

4.8.2 Subcontractors and their employees shall engage in a hazard assessment and risk management process equivalent to or exceeding that of AECOM. Refer to *S3AM-209-PR1 Risk Assessment & Management*.

- If the subcontractor process is deficient, the subcontractor management shall utilize AECOM's process to supplement for the deficiency and train their employees appropriately.

4.8.3 Subcontractors shall participate in site safety briefings including, and as applicable, orientations, project kick-off meetings, hazard assessments, inspections, tailgate / toolbox meetings, and post-job meetings.

4.8.4 Subcontractors shall comply with all safety directives and/or stop work orders issued by the AECOM representatives.

4.8.5 Subcontractors shall notify the AECOM manager when they will utilize short service employees (SSE) to perform on-site activities. The AECOM manager approval of any SSE shall be obtained by the subcontractor prior to mobilization. Subcontractor site management will interact with the short service employee to verify their level of competency and manage the subcontractor SSE in accordance with *S3AM-015-PR1 Newly Hired or Transferred Employees* or an equivalent process.

4.8.6 Prior to the start of work, roles, responsibilities, communication chain-of-command, and emergency preparedness procedures shall be established.

4.9 Subcontractor Performance

4.9.1 To the extent reasonable in light of AECOM's scope of work under the client contract, the AECOM Manager (or designee) should visit the site and periodically observe subcontractor's operations (e.g., conduct spot checks) to assess whether subcontractor appears to be conducting their operations in accordance with applicable safety requirements. Periodically review any required subcontractor health and safety performance and written documentation for compliance with applicable requirements. *S3AM-213-FM4 Subcontractor SH&E Data Submission* may be used to obtain monthly SH&E metrics from the subcontractor.

4.9.2 Information shall be compiled and subcontractor performance assessment should be documented using *S3AM-FM3 Subcontractor SH&E Performance Assessment* or equivalent.

4.9.3 In the event that unsafe acts or unsafe conditions are observed, immediately stop work, and bring them to the attention of the SSR for resolution.

4.9.4 The AECOM Manager shall ensure incidents and significant near misses related to subcontractor operations are investigated to identify causes and corrective actions.

4.9.5 In the event of serious and/or continuing subcontractor breaches of applicable requirements, contact legal counsel to assess whether formal contractual action is appropriate under the subcontract.

4.9.6 Once a job is completed, a subcontractor's performance should be reviewed and feedback provided to subcontractor management. This should be documented using *S3AM-FM3 Subcontractor SH&E Performance Assessment* or equivalent.

5.0 Records

The following documentation will be maintained in the project file:

5.1 S3AM-213-FM1 Subcontractor SH&E Evaluation Form or equivalent.

5.2 S3AM-213-FM2 Subcontractor Variance Form or equivalent, if applicable.

5.3 S3AM-213-FM3 Subcontractor SH&E Performance Assessment or equivalent.

5.4 S3AM-213-FM4 Subcontractor SH&E Data Submission, if applicable.

5.5 Identified safety deficiencies as applicable for subcontractors and verification of correction of conditions.

5.6 All other safety-related subcontractor documentation (e.g., training certifications, incident reports, etc.

6.0 Attachments

6.1 S3AM-213-ATT1 Subcontractor Evaluation Criteria

6.2 S3AM-213-FM1 Subcontractor SH&E Evaluation Form

6.3 S3AM-213-FM2 Subcontractor Variance Form

6.4 S3AM-213-FM3 Subcontractor SH&E Performance Assessment

6.5 S3AM-213-FM4 Subcontractor SH&E Data Submission

Americas

Medical Screening & Surveillance

S3AM-128-PR1

1.0 Purpose and Scope

1.1 Provides a streamlined process to determine if employees meet the physical requirements to perform assigned duties as defined by applicable regulations.

1.2 Designed to provide a means to collect data relevant to exposure to chemical and physical agents for the protection of the workers and to confirm the effectiveness of health and safety programs.

1.3 Applies to all AECOM Americas employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 **Employee Exposure Record** - A record containing any of the following kinds of information:

- Environmental (workplace) monitoring or measuring of a toxic substance or harmful physical agent, including personal, area, grab, wipe or other form of sampling, as well as related collection and analytical methodologies, calculations and other background data relevant to interpretation of the results obtained.
- Biological monitoring results which directly assess the absorption of a toxic substance or harmful physical agent by body systems (e.g., the level of a chemical in the blood, urine, breath, etc.), but not including results which assess the biological effect of a substance or agent or which assess an employee's use of alcohol or drugs.
- Safety data sheets indicating that the material may pose a hazard to human health.
- In the absence of the above, a chemical inventory or any other record which reveals where and when used and the identity (e.g., chemical, common, or trade name) of a toxic substance of harmful physical agent

2.2 **Medical Director –** A physician, board-certified in occupational medicine, employed by the Medical Services Provider (MSP). The Medical Director manages the services provided by the MSP and provides to AECOM guidance on medical matters.

2.3 **Medical Services Provider (MSP) –** Manages all occupational medical services, including medical surveillance programs, travel medicine, documentation, and injury intervention for first aid support for employees with occupational injuries or illnesses.

2.4 **Participating Employee** – Those employees required to participate in the medical screening and surveillance program will be identified by the Supervisor, Operations and SH&E Manager. Medical surveillance is required for employees who are or may be:

- Exposed to substances at or above the occupational exposure limits.
- Required to participate by regulatory provisions (e.g., asbestos, lead OSHA standards, designated substances).
- Fit-tested for or wearing a respirator in the field.
- Working on sites/projects with specific state, provincial/territorial or federal medical surveillance requirements.
- Driving a commercial motor vehicle.
- Performing safety sensitive tasks.

2.5 **Physical Activity Restriction –** To prevent aggravation of an existing condition, the Medical Doctor recommends a physical activity restriction to limit exposure to a chemical or class of chemicals (e.g., benzene, lead), a physical agent (e.g., noise), or an activity (e.g., heavy lifting).

3.0 References

3.1 S3AM-214-PR1 International Travel

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Employees**

- Ensuring that he/she maintains a current work clearance as required for the performance of assigned work duties.
- All employees designated to participate, called Participating Employees, in the medical surveillance program as a condition of employment or participate voluntarily and will be notified in advance if they will be assigned to a location, project or client which requires a Medical Surveillance and Surveillance program.
- If employee knows or suspects that he/she may have an adverse reaction to completing elements of the physical, (such as blood draws, physical limitation, etc.) then the employee should notify the MSP at the time they schedule the physical so that appropriate safeguards may be taken to protect the health of the employee.
- Communicate any change in medical condition (e.g. medications, pregnancy), to MSP to allow for evaluation of the need for additional precautions.

4.1.2 **Supervisors and Operations Managers**

- Evaluates the duties of each employee and prospective employee reporting to him or her for potential participation in the medical screening and surveillance program.
- Responsible for ensuring that the employee is enrolled in the medical screening and surveillance program if the employee's position requires participation. Consult with a SH&E Manager if assistance is needed in determining if an employee is required to participate in the program.
- Assures employees in positions that require medical surveillance in order to meet their job description may not be on site until they have satisfactorily completed the baseline or pre-employment medical examination.

4.1.3 **Safety, Health, & Environment (SH&E) Department**

- Serves as the primary point of contact between the employee, employee's supervisor, the MSP and the SH&E Department.
- Provides information regarding medical surveillance documentation, forms, and scheduling of services.
- Maintains a medical surveillance database and other associated documents (medical records are maintained by the MSP).
- Assists employees with scheduling of exams with the MSP.
- Participates in initial SH&E training and subsequent reviews and updates that will provide guidance on exam protocols.

4.1.4 **SH&E Manager**

- Reviews employee assignments with managers to ensure that all employees who should be participating in the medical surveillance program have been enrolled.
- Provides all assistance necessary to ensure all required information is provided to the Medical

Director.

- Report any change in requirements, protocols or concerns with the MSP to the Occupational Health Manager.

4.1.5 **Occupational Health Manager**

- Provide the MSP with appropriate references (e.g., a copy of this procedure, regulations).
- Designate other employees to participate in certain parameters of the medical screening and surveillance program after consultation with the Medical Director.

4.1.6 **Medical Director**

- Requires an exposure-specific examination when he/she has reason.
- Determine the frequency of the exposure-specific medical examinations.
- Consults with the Occupational Health Manager.

4.2 General Requirements

4.2.1 All AECOM employees whose work assignments involve potential exposure to harmful chemical and/or physical agents should participate in the medical surveillance program. Guidance as to harmful potential exposures is presented in *S3AM-128-FM1 Medical Surveillance Evaluation (MSE).* The form provides the primary guidance for determining whether medical screening is required for an employee and the frequency of periodic exams. The MSE is to be completed by the employee and his/her supervisor at the time of hire for any employee who may work outside an office environment. At each annual performance review, the MSE is to be reviewed for accuracy. Other reviews are required whenever there is a change in job tasks.

4.2.2 In addition, employees may be requested to participate in the medical surveillance program if they perform a task that requires an assessment for fitness for duty (e.g., lifting, climbing, etc.). The Supervisor, Operations Manager and SH&E Manager will identify activities/tasks that will require fit-for-duty assessments.

4.2.3 Medical screening and surveillance will only be performed were required by regulatory requirements or this procedure. Screening and surveillance provided at no cost to employees.

4.2.4 For medical screening and surveillance related to international travel, refer to *S3AM-214-PR1 International Travel*.

4.3 Types of Medical Examinations

The medical surveillance program consists of the following types of examinations:

- Baseline (initial)
  - The baseline medical examination is used to identify physical capabilities and medical limitations that may have an impact on the candidate's ability to perform in the position for which he/she is being considered and to provide a baseline against which periodic or project-specific monitoring can be compared. The baseline medical examination is used to determine the suitability of an existing employee for a new assignment (pre-placement) or a candidate's suitability to be hired (pre-employment) for a particular position.
- Periodic (annual or biennial)
  - The periodic medical examination is used to evaluate an employee's continued fitness for duty and to assess any impact occupational exposures may have on his/her health status. The periodic examination includes an update to the medical and work history, results of any occupational exposure assessments and a detailed medical examination tailored to the job description.
  - The SH&E Manager will assist in determining the frequency of the periodic medical examinations based on regulatory requirements, the position held by the employee, and the level of exposure to physical, chemical, and biological agents.

- Employees performing work activities on HAZWOPER sites will receive exams based on the following schedule:

Annual	Working in an exclusion zone and the regulatory required exposure limit is exceeded for 30 or more days a year.
Biennial	Working in an exclusion zone more than 30 days a year and the regulatory required exposure limit is not exceeded.

- Exposure-specific
  - The exposure-specific examination consists of medical tests to assess the impact of occupational exposures associated with a particular activity or project. The Medical Director or SH&E Manager will require an exposure-specific examination when he/she has reason to believe occupational exposures are impacting or may be impacting the health of an employee.
- Exit/termination
  - Employees currently participating in an examination program will receive exit exams when they leave their work assignment as identified in *S3AM-128-ATT1 Exit Exam Determination.* In the event an employee declines the exit exam, the employee will be requested to sign *S3AM-128-FM2 Waiver of Exit Medical Surveillance Exam*.
  - An exit medical examination is offered when an employee leaves the medical surveillance program, either because of termination of employment with AECOM or because of reassignment to a position not designated to participate in the medical surveillance program or if conditions in the workplace no longer constitutes the need for the medical surveillance (e.g., change in product).
  - The exit examination assesses any impact occupational exposures may have had on the employee's health status.

4.4 Exam Protocols

4.4.1 *S3AM-128-ATT2 Exam Protocol* identifies the medical exam components of exam.

4.4.2 The evaluation will be confidential and provided during normal business hours. Employees will be offered the opportunity to discuss the results of the evaluation with the MSP. All exam results are considered personal and confidential information, and will not be stored in any unsecured records not transmitted without the employee's permission.

4.5 Participating Employee Guidance and Documentation

4.5.1 When necessary, based on the position being filled, the hiring Supervisor and Human Resources Representative informs the candidate that the offer of employment is contingent on the candidate being physically and medically qualified to perform the duties of the position for which he/she is being hired. The hiring Supervisor and Human Resources Representative may not allow the candidate to begin employment until the conditions of the offer letter have been satisfied.

4.5.2 When designated to participate in the medical surveillance program, the Employee completes and signs the following documents:

- Medical and Work History Questionnaire (provided by the MSP).
- Medical Records Release authorizing MSP to receive the work clearance certificate.

4.5.3 Any Employee that has not completed the required medical evaluation after 30 days of an expiration date will be issued a non-qualified statement. The Employee is not permitted to perform the associated task and/or work until the required medical evaluation is completed and a qualified statement is issued by the Medical Director.

4.5.4 If an exam becomes due during an employee's pregnancy, it is advised to defer the exam until after delivery and the employee returns to work from family/medical leave status.

4.5.5 Human Resources Representative

- Notifies the SH&E Manager or designee to arrange for exit medical examination, upon notification of termination or impending termination from the Supervisor. In the event an employee declines the exit exam, the employee will be requested to sign *S3AM-128-FM2 Waiver of Exit Medical Surveillance Exam*.
- Place the original waiver in the employee's Human Resources personnel file and send a copy the MSP.

4.5.6 Medical Services Provider (MSP)

- Provides notification approximately 30 days before subsequent periodic or exposure-specific medical examination is due.
- Notify the employee 30 days before the periodic or exposure-specific medical examination is due.
- Provides notification of delinquent medical examinations.

4.5.7 Operations Manager

- Facilitate the management and exchange of documentation regarding the medical screening and surveillance program between AECOM (typically employee's supervisor) and MSP using the *S3AM-128-FM3 Scheduling Request Form*. If exams for multiple employees is required, the information from page 1 of the Scheduling Request Form and the requested exams can be placed in a spreadsheet and sent to the MSP.
- Schedule the initial exam for newly hired or re-assigned employees as needed. Special requests should be coordinated with the SH&E Manager, prior to contacting MSP to schedule.
- Assist employees with scheduling examinations as necessary.
- Coordinate medical surveillance program information exchange between Human Resources Representative and the MSP as necessary.
- Notify the candidate's manager and Human Resources upon receipt of the work clearance.
- Provide information from previous examinations that may not be readily available.

4.5.8 SH&E Manager

- Provides such assistance as is requested by the hiring Supervisor to ensure the job description for the position being filled adequately describes the physical, chemical, and biological stresses of the position, and the PPE used or which may be used, including respiratory protection.
- Provides all necessary assistance to ensure that required and appropriate information is provided with the request and authorization for medical examination.
- Provides assistance to the hiring Supervisor to interpret physical activity restrictions if such restrictions are noted on the work clearance certificate.
- Confirms that all relevant exposure assessments have been appropriately annotated to show the applicability to the employee and forwarded to the MSP.
- Confirms that employees on the delinquent medical examination list have been removed from designated assignments.
- Provides assistance to ensure that terminating and reassigned employees are offered the opportunity to take an exit medical examination.

4.5.9 Supervisor

- Arranges work assignments so that the employee is available to take the medical examination before the work clearance certificate expires.

- Removes the employee from the work assignment before the work clearance certificate expires until the medical evaluation is completed and a qualified statement is issued by the Medical Director.
- Contacts the Human Resources Representative, upon notification of termination or reassignment and requests they arrange for the MSP to perform an exit medical examination.
- Releases the terminating or reassigned employee from duties as necessary to complete the exit medical examination.

4.6 Reports

4.6.1 Report of Examination

- The MSP provides AECOM and the employee with a copy of the work clearance certificate, which will include any medical restrictions and address the employee's ability to use personal protective equipment. AECOM requires the employee to preserve the work clearance certificate in a safe place and provide copies to AECOM managers and clients when requested.
- The MSP will mail a confidential letter detailing the results of the exam to the employee's home address within 30 days of the exam date.

4.6.2 Examinations Due Report

- The MSP produces a list by organization code of employees due to be examined 30 days before the expiration of their work clearance certificate. This list is provided to SH&E Department, who ensures each Supervisor is notified of the employees in his/her charge who are due examinations so they may be scheduled appropriately.
- The MSP notifies each employee via email or phone to the office of record 30 days before the periodic or exposure-specific medical examination is due.

4.6.3 Delinquent Examinations Report

- The MSP distributes a report of delinquent medical examinations to the SH&E Department.
- When an employee's name appears on the delinquent examination report for two consecutive months, the SH&E Department must notify the SH&E Manager, who will bring this to the attention of the employee's Supervisor for resolution. If the delinquency issue is not resolved, the employee's regional management will be notified for final resolution.

4.6.4 Physical Activity Restriction Report

- The Supervisor maintains a list of employees who have physical activity restrictions.
- The SH&E Manager shall evaluate locations and projects periodically to ensure employees with physical activity restrictions are not exceeding their limitations. Concerns of an employee exceeding his/her physical activity restriction is brought to the attention of the employee's Supervisor for resolution.

4.6.5 Annual Reports

- The MSP provides annual reports of utilization, medical trends, and statistical analyses. These reports are prepared to improve the service, manage trends, and reduce the cost of the medical screening and surveillance program.

5.0 Records

5.1 Employees who participate in a medical surveillance or physical examination program or had exposure monitoring conducted will have access to all employee exposure and medical records maintained for that employee by AECOM and the MSP.

5.2 Upon an employee entering into a medical surveillance or physical examination program, the employee shall be informed of the following:

- The existence, location and availability of any records covered by this procedure
- The MSP responsible for maintaining and providing access to records and
- The employee's right of access to these confidential records.

5.3 Employees in medical monitoring programs are notified initially and annually thereafter, of the existence, location and ability to access medical records maintained by the MSP. Upon request, each employee (or designated representative) will have access to the employee's medical records. Prior to the release of health information to the employee (or designated representative), a specific written consent must be signed by the employee. Records will be provided in a reasonable time and manner at no cost to the employee.

5.4 Medical records must be preserved and protected in accordance with applicable legislative requirements for the duration of employment plus 30 years, verify local, state of federal regulations to confirm time period. Medical records contain information that is protected by the Privacy Act. To meet the obligations of preserving the medical records and protecting the information they contain, AECOM has arranged for the MSP to manage the medical records.

5.5 An employee or designated representative may request to review his/her medical. Such a request must be in writing and be signed and dated. The SH&E Manager or the SH&E Department will forward the request to the MSP, who will provide the employee with a copy of the medical records.

The MSP provides employees with a copy of their results after each physical. If employee would like a copy of their historical records, the MSP will supply the copy within 15 days after the request has been submitted by the employee or designated representative.

5.6 MSP performs quality control checks on all medical records to ensure examining physicians appropriately record the findings of the examination and tests.

The MSP has access to all medical records to perform quality assurance checks to ensure proper recording and preservation

5.7 Projects that use local clinics or employer/client clinics may store records at that site, but at the termination of the project, all employee medical records must be transferred to long-term record retention.

5.8 If in the event AECOM ceases operations, medical records will be transferred to the successor employer. If no successor employer is available, records will be transferred to the National Institute for Occupational Safety and Health.

6.0 Attachments

6.1 S3AM-128-ATT1 Exit Exam Determination

6.2 S3AM-128-ATT2 Exam Protocols

6.3 S3AM-128-FM1 Medical Surveillance Evaluation

6.4 S3AM-128-FM2 Waiver of Exit Medical Surveillance Exam

6.5 S3AM-128-FM3 Scheduling Request Form

6.6 S3AM-128-FM4 Waiver of Medical Screening & Surveillance Program

Americas

Competent Person Designation

S3AM-202-PR1

1.0 Purpose and Scope

1.1 Outlines the process and minimum requirements necessary for classifying an AECOM employee as a "Competent Person" to oversee and/or self-perform activities involved with tasks listed in this procedure. Employee competency to perform work activities is addressed elsewhere.

1.2 This procedure applies to all AECOM Americas-based employees and operations where AECOM is self-performing the identified activities and where AECOM controls projects performing activities requiring a Competent Person. This procedure also applies to any other entity and its personnel contractually required to comply with this document's content. Client-mandated requirements may apply on a project-specific basis and shall be addressed in supplemental documents (e.g. Task Hazard Assessment, SH&E Plan, etc.).

1.3 It is recognized that local regulations and legislation may contain alternate definitions for Competent Person and it will be the responsibility of the manager responsible for the work (e.g. Manager, Superintendent) in conjunction with the local SH&E Manager to determine if conflicts exist between AECOM and applicable regulatory/legislative definitions and resolve the conflict.

1.4 When a qualified employee within AECOM is not available to be designated as the AECOM Competent Person, the Manager in coordination with their SH&E Manager may designate an appropriately qualified and trained Contractor employee as the Competent Person for the AECOM operations.

2.0 Terms and Definitions

2.1 **Competent Person –** An employee, through education, training and experience who has knowledge of applicable regulatory requirements, is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

3.0 References

3.1 S3AM--213-PR1 Subcontractor Management

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 M**anager**

- Confirm that all assigned personnel, including personnel utilized from other offices to support their operations, comply with the requirements of this procedure. The manager responsible for the work shall:
  - Identify the need for a designated Competent Person or persons based on anticipated work activities.
  - Communicate competent person training/experience requirements with the employee and documenting completion of these requirements using *S3AM-202-FM-1 Competent Person Designation* or equivalent.
  - Identify supplemental employee training needs based on local/client requirements.
- For projects controlled by AECOM, when these activities are contracted to another party:
  - Confirm and secure the identity of the Contractor's Competent Person(s) for its activities. Refer to *S3AM-213-PR1 Subcontractor Management*.

- *S3AM-202-FM1 Competent Person Designation* or equivalent may be used for this purpose.
- Provide the Contractor with a copy of this SH&E Procedure to verify the Contractor's capability to comply with the requirements within, and obtain documentation to support the designation of the Contractor employee as a Competent Person for AECOM.

- Verify the designation of the Competent Person for a specific activity is documented and effectively communicated to field personnel on site during daily tailgate safety meetings.

4.1.2 **Safety, Health and Environment (SH&E) Manager**

- Assist the Manager responsible for the work in assessing the competency of all designated persons based on specific requirements outlined in this procedure.
- Assist the Manager in:
  - Establishing competent person training/experience requirements and communicating these requirements to the supervisor.
  - Monitoring the overall implementation of this SH&E Procedure.
  - Monitoring field compliance of this procedure.
  - Providing technical assistance/support as requested.
  - Coordinating internal safety training classes as requested.
- Support the Manager in establishing minimum competent person requirements for regulated job activities based on individual job descriptions, applicable regulatory requirements, operational considerations, and management directives.
- Review as requested by designated operations representatives the Competent Person's qualifications for AECOM employees.

4.1.3 **Competent Person**

- Predict, identify, and control hazards when either AECOM self-performs associated field work or oversees and directs the work of subcontractors.
  - For operations where AECOM is providing oversight of subcontractors (e.g. drilling services), it is the subcontractor's employee who shall be designated as the Competent Person.
- Contractor Competent Persons - Unless AECOM is self-performing, the Contractor shall:
  - Determine the safe means and methods of its work activities.
  - Designate its Competent Person(s) for each category of work the Contractor undertakes and/or controls as required by this procedure.
  - If the contractor is unable to designate a Competent Person, AECOM may designate an appropriate AECOM employee as the contractor's Competent Person only if AECOM is contractually responsible for safety oversight of the contractor's activities.
- The Contractor's Competent Person shall:
  - Technically support the Contractor's site operations for the safe execution of its activities. Identify and remove any field hazards
  - Maintain appropriate knowledge about the work activities, the Contractor's work practices and procedures and compliance with the associated safety and health regulations.

4.2 General Requirements

4.2.1 The AECOM Competent Person project or worksite functions are dependent on the project activities and AECOM's project or worksite function.

4.2.2 Refer to each SH&E Procedure for the activities listed below and the associated legislative standards to determine the details of responsibility.

4.2.3 The following activities require an individual to be designated as a Competent Person:

- Asbestos
- Assured Equipment Grounding Conductor
- Blasting & Explosives
- Concrete & Masonry Construction
- Confined Spaces
- Control of Hazardous Energy (Lockout-Tagout)
- Cranes & Derricks
- Crane Assembly / Disassembly
- Demolition
- Electrical Wiring Design & Protections
- Elevated Work Platforms & Aerial Lifts
- Fall Protection
- Hearing Protection
- Heavy Equipment
- Ionizing Radiation
- Lead
- Material Hoists & Personnel Hoists
- Stairways & Ladders
- Respiratory Protection
- Rigging Equipment
- Scaffolds
- Steel Erection
- Trench & Excavations
- Underground Construction
- Welding & Cutting

4.2.4 Generally, it is the responsibility of the Competent Person(s) to be on site at all times when respective staff (AECOM, subcontractor) are performing work governed by this procedure, make daily inspections of the conditions and work activities, and take actions to control any hazards associated with those activities.

4.2.5 The *S3AM-202-FM1 Competent Person Designation* or equivalent shall be used for all programs or on all projects for documenting Competent Person designations. Documentation shall be filled out completely and updated as necessary.

4.2.6 *S3AM-202-ATT1 Competent Persons in General Industry (29 CFR 1910)* and *S3AM-202-ATT2 Competent Persons in Construction (29 CFR 1926)* include descriptions of various U.S. Occupational Safety and Health Administration requirements for competent persons. The list is not comprehensive and as such 29 CFR 1910 and 1926 shall be consulted for any additional competent person requirements.

5.0 Records

5.1 AECOM Competent Person Designation forms shall be maintained in the program / project file.

5.2 Documentation as to daily inspections and corrective measures by the AECOM Competent Person shall be maintained in the program / project file.

6.0 Attachments

6.1 S3AM-202-FM1 Competent Person Designation

6.2 S3AM-202-ATT1 Competent Persons in General Industry (29 CFR 1910)

6.3 S3AM-202-ATT2 Competent Persons in Construction (29 CFR 1926)

Americas

Exposure Monitoring

S3AM-127-PR1

1.0 Purpose and Scope

1.1 This procedure applies to the operations of AECOM and its subsidiary companies, and any other entity and its personnel contractually required to comply with this document's content, where employees may be exposed to airborne concentrations of hazardous air contaminants potentially exceeding permissible limits. Note that this standard does not cover monitoring for asbestos operations (S3AM-109-PR1), toxic and hazardous substances (S3AM-110-PR1), radiation (S3AM-120-PR1), non-ionizing radiation (S3AM-121-PR1), confined spaces (S3AM-301-PR1), heat stress (S3AM-113-PR1), or noise (S3AM-118-PR1).

1.2 The purpose of this procedure is to assist and provide guidance to AECOM personnel who need to conduct personal industrial hygiene monitoring and to control employee exposures to toxic or hazardous substances to the lowest level practicable, including those specified under applicable jurisdictional legislation. Monitoring will be conducted to evaluate the potential exposure of AECOM employees to airborne concentrations of hazardous particulates, fibers, gases, vapors, mists, pathogens, hazardous biological agents, or to oxygen-deficient atmospheres.

1.3 Personal monitoring shall be conducted under the following conditions:

1.3.1 Where directed by a facility or site-specific health and safety plan.

1.3.2 Where employees are exposed to known or suspected human carcinogens (e.g., beryllium, vinyl chloride, etc.).

1.3.3 Where regulations require "initial exposure assessments" (e.g., lead, asbestos, methylene chloride, hexavalent chromium). Certain regulations allow for an exemption to initial exposure assessments when exposure monitoring of similar exposure groups has been conducted under the same site conditions and for equivalent tasks within 1 year prior to the start of work on the current project or site.

1.3.4 When directed by a client or required by contract.

1.3.5 At the direction of a Safety Manager in response to employee concerns or incidents involving chemical exposure.

1.3.6 Co-sampling during regulatory inspections.

1.3.7 Routine monitoring in compliance with regulatory requirements.

2.0 Terms and Definitions

2.1 **Action Level (AL)** – An airborne concentration of a potentially toxic or hazardous substance, measured in parts per million by volume (ppm), microgram per cubic meter (µg/m^3) milligram per cubic meter (mg/m^3) or fibres per cubic centimetre (f/cc), that triggers certain provisions as required by the applicable jurisdictional legislation. In many cases the action level is 50% of the established exposure limit.

2.2 **Established Exposure Limit** – The maximum regulatory exposure concentration to which an individual may be exposed to for an 8- hour time weighted average (TWA).

- This limit is referred to by different terminology depending upon the given jurisdiction (e.g. Permissible Exposure Limit (PEL), Contamination Limit, Occupational Exposure Limit (OEL), Threshold Limit Value (TLV), etc.).

Acceptable methods of adjusting this limit to correspond to a different exposure period (e.g. 10 hours) vary by jurisdiction and substance.

3.0 References

3.1 S3AM-109-PR1 Asbestos

3.2 S3AM-301-PR1 Confined Spaces

3.3 S3AM-113-PR1 Heat Stress

3.4 S3AM-118-PR1 Hearing Conservation

3.5 S3AM-123-PR1 Respiratory Protection

3.6 S3AM-110-PR1 Toxic & Hazardous Substances

4.0 Procedure

4.1 Implementation of this standard is the responsibility of the AECOM manager directing activities of the facility, site, or project location.

4.2 Hazard assessments shall be completed to identify potential employee exposure to toxic or hazardous substances. Industrial hygiene monitoring conducted and prioritized as appropriate to the potential risk and in accordance with regulatory requirements.

4.3 Procedures for Personal Industrial Hygiene Monitoring

4.3.1 Personal industrial hygiene monitoring documentation shall include accurate and detailed descriptions of the work environment and of the work activities of each employee being monitored to evidence monitoring results are tied to the work operations conducted. This permits demonstration that suggested corrective actions are appropriate or adequate to control the exposure.

4.3.2 Individuals responsible for equipment maintenance and collection shall be appropriately trained. Engage applicable subject matter experts as necessary (e.g., industrial hygienists / technicians).

4.3.3 Maintain, service, and calibrate sampling equipment in accordance with the manufacturer's recommendations and, as applicable, the approved sampling methodology (may include both pre- and post-calibration to confirm consistent flow rates).

4.3.4 Collect samples using current applicable methodologies established by the National Institute for Occupational Safety and Health (NIOSH) *Manual of Analytical Methods*, U.S. Department of Labor – Occupational Safety and Health Administration (OSHA) *Sampling and Analytical Methods*, American Society for Testing Materials (ASTM), the Environmental Protection Agency (EPA), or applicable guidelines for the host country.

4.3.5 Select an analytical laboratory accredited by the American Industrial Hygiene Association (AIHA), or equivalent host country certification, licensing, or accreditation, to analyze the personal air samples.
Note: There are several programs under which a laboratory may receive AIHA accreditation. The laboratory shall be currently accredited for the specific program, scope category, and field of testing for the analysis that will be performed, not merely hold AIHA accreditation.

4.3.6 Confirm samples are submitted to the laboratory for analysis in a timely manner to confirm sample viability.

4.3.7 Require the selected laboratory to use the applicable analytical methodologies and document quality control procedures.

4.3.8 Confirm equipment is maintained, serviced, and calibrated in accordance with manufacturer's recommendations.

4.3.9 Document personal monitoring activities and work operations using the appropriate AECOM Industrial Hygiene Monitoring Form; require that all laboratory chain-of-custody forms be properly completed; and confirm samples are sealed and secured according to Quality Assurance procedures.

4.3.10 Confirm workers are being protected (e.g., engineering controls, administrative controls, and PPE, including respiratory protection) during the monitoring phase. Refer to *S3AM-123-PR1 Respiratory Protection* and *S3AM-208-PR1 Personal Protective Equipment*.

4.3.11 Reassessment of exposure hazards shall be conducted as appropriate when there are changes in conditions or work processes, and at suitable intervals based on potential risk and regulatory requirements.

4.3.12 Determine whether medical surveillance is required. Refer to jurisdictional requirements and *S3AM-128-PR1 Medical Screening & Surveillance*.

4.4 Evaluation of Personal Monitoring Results

4.4.1 Samples sent out for independent laboratory analysis will follow chain of custody requirements.

4.4.2 An AECOM Certified Industrial Hygienist (CIH) approved by a Safety Manager should evaluate the analytical results when feasible.

4.4.3 Obtain a written evaluation report from the SH&E manager. If exposures exceed the Action Level and/or Established Exposure Limit for the air contaminant(s) of concern, a verbal report is to be made to the senior facility, project, or site manager immediately, and follow up with the written report within any established timeframe. The evaluation report will include required corrective actions.

4.4.4 Complete evaluation reports within 5 working days of the receipt of the analytical results.

4.4.5 Results of all personal exposure monitoring will be provided to the SH&E department for inclusion in the employee medical records, refer to *S3AM-017-PR1 Injury & Illness Recordkeeping.*

4.5 Procedures for Direct-Read Air Monitoring

4.5.1 Direct-read air monitoring instruments are used primarily as screening tools to provide real-time evaluations of hazardous airborne contaminants at a project site.

4.5.2 Select an appropriate air monitor for the air contaminant to be measured.

4.5.3 Calibrate monitor in accordance with manufacturer's recommendations. Dates of full instrument calibration will be recorded on the direct-read instrument and on any associated calibration data sheets. If instrument calibrations are not performed daily, then daily bump tests (exposure to a known concentration of contaminant) will be performed to verify calibration and confirm alarms are working appropriately.

4.5.4 Conduct air monitoring using techniques identified by the instrument manufacturer and according to any identified methods (e.g. NIOSH, EPA, etc.).

4.5.5 Confirm equipment is maintained, serviced, and calibrated in accordance with manufacturer's recommendations.

4.5.6 Document personal monitoring activities using the appropriate AECOM Industrial Hygiene Monitoring Form.

4.5.7 Confirm workers are being protected (e.g., engineering controls, administrative controls, and PPE, including respiratory protection) during the monitoring phase. Determine whether medical surveillance is required.

4.5.8 Where required by client request or by unique or high hazard areas, individual portable direct-read monitors shall be used.

4.6 Evaluation of Personal Monitoring Results

4.6.1 Compare measured results with project-specific Action Levels and/or published Established Exposure Limits. If exposures exceed the Action Level and/or Established Exposure Limit for the air contaminant(s) of concern, take corrective actions as identified in the site-specific SH&E plan. If the SH&E Plan did not account for the identified hazard, or where questions exist about the results, contact the SH&E Manager to evaluate the analytical results for appropriate corrective action (this may involve consultation with a Certified Industrial Hygienist). The SH&E Plan should be updated accordingly.

4.7 Communication of Sample Results and Evaluation

4.7.1 Provide copies of the evaluation report to the employee(s) monitored and to employees working in the area for which the exposures could be representative, within 5 days of receipt of lab results.

4.7.2 Exposure results will be posted on site and explained in a safety briefing.

4.7.3 Provide a copy of the evaluation report and monitoring data to the client, owner, or manager directing activities of the facility or site for filing purposes.

4.7.4 Personal identifiers (e.g., name, address, employee number) or information which could reasonably be used to identify specific employees (e.g., exact age, height, weight, race, sex, date of initial employment, job title), shall be removed from analysis reports before access to the exposure data is provided.

4.8 Corrective Actions

4.8.1 Implement required corrective actions immediately.

4.8.2 If the exposure hazard cannot be eliminated or otherwise controlled through the use of engineering controls, the reason shall be documented and suitable administrative controls and personal protective equipment requirements developed.

4.8.3 Workers who may be exposed above the Established Exposure Limit or Action Limit, shall be appropriately trained and wear respiratory protection in accordance with *S3AM-123-PR1 – Respiratory Protection Program*.

4.9 Exposure Records

4.9.1 Exposure records include work activities / process descriptions, workplace monitoring, biological monitoring, material safety data sheets and chemical inventories. Sampling results, the collection methodology (sampling plan), a description of the analytical and mathematical methods used, and a summary of other background data relevant to interpretation of the results obtained, shall retained for at least thirty (30) years.

5.0 Records

The following documents will be maintained in the project profile:

5.1 Calibration data.

5.2 Completed IH Monitoring Form(s).

5.3 Evaluation Report with sample results (provide copy to affected employee as well).

5.4 Corrective actions, including engineering controls.

5.5 Relevant prior initial exposure assessments.

6.0 Attachments

6.1 S3AM-127-FM1 General Industrial Hygiene Survey

6.2 S3AM-127-FM2 Industrial Hygiene Sample Field Sheet

6.3 S3AM-127-FM3 Total Dust Industrial Hygiene Sample Field Sheet

6.4 S3AM-127-FM4 Respirable Dust Industrial Hygiene Sample Summary

6.5 S3AM-127-FM5 Detector Tube Industrial Hygiene Sample Summary

6.6 S3AM-127-FM6 Gas/Vapor/Fume/Mist Industrial Hygiene Sample Summary

6.7 S3AM-127-FM7 Toxic Gas Monitor Industrial Hygiene Sample Summary

6.8 S3AM-127-FM8 PID/FID Monitoring Report

6.9 S3AM-127-FM9 Industrial Hygiene Evaluation Form

6.10 S3AM-127-FM10 Instrument Calibration Log

Americas

Environmental Compliance

S3AM-204-PR1

1.0 Purpose and Scope

1.1 This procedure establishes a process for assuring compliance with applicable environmental laws and regulations.

1.2 This procedure applies to all AECOM America-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

The terms and definitions relating to environmental compliance and hazardous waste management are included in the respective laws and regulations in Canada, Latin America and the United States.

2.1 **Applicable Environmental and Hazardous Waste Management Laws and Regulations** – The specific legal requirements that apply to an AECOM office or project. Laws and regulations vary considerably throughout the Americas.

2.2 **Compliance Map** – a document defining and detailing the actions necessary to assure compliance with applicable environmental legal requirements.

2.3 **Reportable Quantity (RQ)** – quantities of hazardous substances, which when released to the environment require notification to the appropriate authorities / agencies (e.g., National Response Center, local police, coast guard, state / provincial / territorial reporting agency, etc.). Multiple agencies and regulations have established RQs; RQs may differ by agency.

2.4 **Subject Matter Expert** – a person who is an expert in a particular topic or area based on experience, technical/regulatory knowledge, and/or training.

2.5 **Hazardous Wastes** – Hazardous waste laws and regulations are complex and vary considerably throughout the Americas. For example, based on the Canadian Environmental Protect Act of 1999, in Canada hazardous wastes and hazardous recyclable materials are defined as those with properties such as flammability, corrosiveness or inherent toxicity. According to EPA regulations, a hazardous waste is a waste with properties that make it dangerous or potentially harmful to human health or the environment. Hazardous waste can take many physical forms and may be solid, semi-solid, liquid, or even contained gases. Hazardous wastes fall into the categories of listed wastes and characteristic wastes. The characteristic wastes exhibit one of more of the following characteristics: ignitability, corrosivity, reactivity and toxicity.

2.6 **Generator of Hazardous Wastes** – For example, based on the Resource Conservation and Recovery Act (RCRA) and Environmental Protection Agency (EPA) regulations in the United States, a hazardous waste generator is any person or site whose processes and actions create hazardous waste. Generators are divided into three categories based on the quantity of waste they produce. Large quantity generators generate 1,000 kilograms per month or more of hazardous waste, more than 1 kilogram per month of acutely hazardous waste, or more than 100 kilograms per month of acute spill residue or soil. Small quantity generators generate more than 100 kilograms, but less than 1,000 kilograms, of hazardous waste per month. Very Small Quantity Generators generate 100 kilograms or less per month of hazardous waste, or 1 kilogram or less per month of acutely hazardous waste, or less than 100 kilograms per month of acute spill residue or contaminated soil, water, or other debris.

2.7 **Storage** – Per EPA regulations, storage is defined as the temporary holding of waste before the waste is treated, disposed of or stored somewhere else.

2.8 **Treatment and Disposal** – Per EPA regulations, treatment and disposal is any process that changes the physical, chemical or biological characteristics of a waste to minimize its threat to the environment.

3.0 References

3.1 AECOM Safety, Health and Environment Policy Statement

3.2 S3AM-004-PR1 Incident Reporting, Notifications & Investigation

3.3 S3AM-017-PR1 Injury & Illness Recordkeeping

3.4 S3AM-109-PR1 Asbestos

3.5 S3AM-116-PR1 Hazardous Materials Shipping

3.6 S3AM-119-PR1 Laboratories

3.7 S3AM-209-PR1 Risk Assessment & Management

3.8 S3AM-216-PR1 Compliance Assurance

4.0 Procedure

Subject matter experts knowledgeable in Canada, Latin Americas and the United States environmental and hazardous waste laws and regulations should be consulted for clarification of the requirements. Hazardous waste laws and regulation may vary by provinces in Canada, countries in Latin Americas and states in the United States. It is critical to understand the specific requirements in the various offices and project locations in the Americas.

4.1 Roles and Responsibilities

4.1.1 Managers (Operations) directing activities of the facility, site, or project location

- Ensure the areas they manage are in compliance with applicable environmental and hazardous waste laws and regulations. The SH&E Plan shall identify all applicable SH&E requirements the particular project/location is responsible for meeting.
- Participate in assessing the applicable activities, products or services for associated environmental impacts. Refer to *S3AM-204-ATT2 Aspects and Environmental Impacts Assessment* as a guideline.
- Ensure the necessary resources exist to comply with these requirements and is responsible for working with the SH&E team to audit compliance.
- Consult subject matter experts on an ongoing basis to ensure up-to-date specific requirements of applicable legislation and regulation are met.
- Ensure relevant information and compliance requirements are communicated to all affected personnel. As applicable, refer to *S3AM-204-ATT3 Environmental Management Plan (Sample)*.

4.1.2 Project / Location Manager

- Identifying and implementing the actions necessary to ensure compliance with the project / location's applicable environmental and hazardous waste requirements. As applicable, this may include:
    - Participating in the assessment of applicable activities, products or services for associated environmental impacts. Refer to *S3AM-204-ATT2 Aspects and Environmental Impacts Assessment* as a guideline.
    - Ensuring procedures for conducting any activities that could have a significant environmental impact are established.
    - Ensuring procedures for identification of significant environmental aspects of goods and services used by AECOM are established.
    - Identifying and understanding the applicable legal requirements that apply to the project / location's activities.

- Verifying that staff have the appropriate environmental and hazardous waste management training prior to performing assigned activities.
- Budgeting the necessary resources into each project / location to achieve compliance with applicable legal requirements.
- As applicable, verifying that Legal Counsel and Office of Risk Management (ORM) have reviewed and approved the signed client's Agency Agreement authorizing AECOM to sign a waste manifest or sign shipping papers "as an agent of that client." NOTE: It is AECOM's policy that AECOM personnel will not sign client waste manifests or shipping papers unless authorized to do so by AECOM Legal Counsel and ORM.
- Obtaining all applicable environmental permits prior to the start of any regulatory permitted activity, including those permits held by the client which may impact AECOM's activities.
- Assessing the compliance status of AECOM's activities.
- Implementing any identified corrective actions relative to noted potential environmental compliance deficiencies.
- Identifying environmental regulatory noncompliance or near misses to AECOM's incident report system

- Ensuring project / location-specific environmental compliance plan is developed and documented in the form of Environmental Management Plans (EMP) or equivalent (refer to *S3AM-204-ATT3 Environmental Management Plan (Sample)* as a guideline and to *S3AM-204-ATT1 Environmental Compliance Maps* for examples of Compliance Maps).
- Consult subject matter experts on an ongoing basis to ensure up-to-date specific requirements of environmental legislation and regulation are met.
- Ensure relevant information and compliance requirements are communicated to all affected staff.

4.1.3 SH&E Manager

- Assisting operations personnel in assuring that activities undertaken by Operations are in compliance with environmental legal requirements, including but not limited to:
  - Assisting operations in identifying applicable environmental and hazardous waste laws and regulations and Subject Matter Experts.
  - Supporting compliance assessments of operations activities as needed. Refer to *S3AM-204-ATT2 Aspects and Environmental Impacts Assessment* as a guideline.
  - Reporting regulatory potential noncompliance events that result in a notice of violation, notice of noncompliance, or other indication of noncompliance to both management and region counsel.
  - Reporting to management and legal counsel, as applicable, on the status of identified corrective actions.

4.1.4 Legal Counsel

- Reviewing, commenting on, and approving a client's signed Agency Agreement letter authorizing AECOM to sign a waste manifest or shipping papers "as an agent of the client."
- Taking appropriate action upon notification that AECOM received a notice of violation or any other written notice of noncompliance, or becoming aware of a noncompliance situation.
- Supporting operation's response to notices of violation or any other written notice of noncompliance issued to AECOM from a regulatory agency.

4.1.5 America's Office of Risk Management

- Reviewing, commenting on, and approving a client's signed Agency Agreement letter

authorizing AECOM to sign a waste manifest or shipping papers “as an agent of the client.”

4.1.6 Employees

- Reporting all environmental releases or permit exceedances immediately as per *S3AM-004-PR1 Incident Reporting, Notifications & Investigation*.
- Performing all project-related tasks in compliance with applicable environmental legal requirements.
- Signing waste manifests only if authorized by the Project Manager and Region Counsel. Refer to *S3AM-116-PR1 Hazardous Materials Shipping*.

4.2 Office Compliance

4.2.1 Overall – AECOM offices must comply with the applicable environmental and hazardous waste laws and regulations. This section describes some potential office related activities that can be subject to environmental laws and regulations.

4.2.2 Shipping Materials – The shipping and manifesting of hazardous materials from an AECOM office is subject to *S3AM-116-PR1 Hazardous Materials Shipping* procedure. Employees associated with shipping (such as with Federal Express, UPS and others) must be trained in their responsibilities and ensure they comply with the applicable shipping and manifesting requirements.

4.2.3 Storage of Chemicals and Wastes - Some AECOM offices may store chemicals and wastes. If so, these offices must comply with the applicable laws and regulations governing these activities.

4.2.4 Applicable Permits – Most AECOM offices will not require an air or water permit for discharges. If hazardous wastes are present in AECOM offices, they should be properly managed, stored, and disposed of in compliance with the applicable regulation and permitting requirements (e.g., United States EPA – storage permit required if hazardous waste is to be stored in excess of 90 days without having obtained regulator extension). The off-site disposal of hazardous waste from AECOM offices shall be properly manifested and both the waste hauler and the disposal facility shall be certified / permitted by the applicable environmental agencies.

4.3 Project Compliance

4.3.1 Obtaining Necessary Permits

4.3.1.1 Air Permits – If a project will result in emissions to the air, the project may require an air permit. It is important to work closely with the client as the permit may need to be applied for by the client.

4.3.1.2 Water Permits – For projects that involve discharges to receiving bodies of water (rivers, streams, etc.), storm sewers and sanitary sewers, AECOM needs to work closely with our clients to ensure all water related permits are obtained prior to start-up of the projects.

4.3.1.3 Waste Management and Waste Storage Permits – Federal, state, provincial and local environmental agencies have many regulations related to proper waste management (i.e. approval of spill containment plans, wastes placed in drums and containers must be properly labeled, etc.). Ensure appropriate approvals and permits are in place where required (i.e. British Columbia – approval of Operational Plan; United States – permit required for hazardous wastes stored on sites longer than generator status allowances). This may require working closely with the client to obtain required approvals and/or permits.

4.3.1.4 For projects where a client is authorizing AECOM to manage their waste, AECOM Employees must never sign a waste manifest indicating AECOM is the generator of the waste unless approved to do so by AECOM Legal Counsel and Americas Office of Risk Management.

4.3.2 Incident Reporting – Employees must promptly report to the client and work closely with the client in reporting to regulatory agencies any spills or releases into the environment. This includes: discharges of contaminated groundwater to a sanitary sewer or storm water sewer system unless authorized by the regulatory agencies involved to do so; spills of oil, petroleum products, or other chemicals to the ground or water bodies; and any release of hazardous substances in amounts greater than their "reportable quantities" –as defined by regulations. Employees must also report these incidents into AECOM's incident reporting system.

4.3.3 Laboratory Operations – Where AECOM has laboratory operations, the disposal of laboratory chemicals into laboratory drains is not allowed. Water discharges from laboratory operations must meet applicable environmental legal requirements.

4.3.4 Asbestos Management – There are many regulations governing asbestos management. Regulations may include implementing an Asbestos Management Plan; providing notice to air and other regulatory agencies relating to demolition or asbestos abatement plans within the specified timelines prior to the start of any abatement operations; and the abatement and disposal of asbestos. Refer to *S3AM-109-PR1 Asbestos*.

4.3.5 Environmental Management Plan (EMP) or equivalent – Documented at the site/office and project level, to ensure proper planning of operations with respect to the environment (as determined by the aspects and impacts assessment). Refer to *S3AM-204-ATT3 Environmental Management Plan (Sample).*

- Initial steps in developing the EMP include assessing environmental impacts of the activities, products or services to be undertaken. Refer to *S3AM-204-ATT2 Aspects and Environmental Impacts Assessment* as a guideline. This completed assessment may be included in the EMP.
- As required, each office / project must identify and document applicable environmental regulatory requirements in their EMP, or equivalent.
    - It is advisable to develop a Compliance Map for those projects where AECOM is a permit holder or where AECOM is operating under a client's permit. Compliance maps can indicate the applicable actions, limits, records retention requirements, and applicable submittals to ensure compliance with applicable environmental legal requirements.
    - Refer *to S3AM-204-ATT1 Environmental Compliance Maps* for examples of Compliance Maps.
- EMP (or equivalent) shall include documented procedures for conducting any activities that could have a significant environmental impact (e.g., requirements to maintain segregation of hazardous wastes from other wastes, disposal requirements, remodeling activities, laboratory operations, etc.).
    - If AECOM is responsible for selecting the waste disposal site/facility, the identified disposal site/facility shall meet regulatory requirements of the applicable jurisdiction.
- EMP shall identify required records management with respect to any environmental-related monitoring equipment (e.g., tank monitoring equipment, pH meters used prior to discharge to sanitary sewers, etc.).
- As applicable, the EMP, or equivalent, shall include procedures for identification of significant environmental aspects of goods and services used by AECOM (e.g., office supplies, utilities, subcontractors, commuting, and project- and overhead-related travel).
- If customer, client, or facility owner EMP fully encompasses AECOM operations, it is not necessary to create an AECOM - specific EMP.
- If not already included in SH&E Plans and Emergency Response plans, the EMP or equivalent shall include procedures to identify the potential for and response to upsets, incidents, and emergency situations. These plans also include procedures for preventing and mitigating the negative impacts of any emergencies.
- EMP (or equivalent) shall include provisions for a commitment to conduct (at least annually) an

evaluation of compliance with relevant environmental legislation, as well as opportunities for improvements.

- As applicable, EMP (or equivalent) shall identify opportunities and procedures to prevent and reduce the generation of waste, as well as recycle or reuse waste, both in the execution of activities or services and in the procurement of goods and services used by AECOM.
- *S3AM-204-ATT3 Environmental Management Plan* may be used as a template to prepare an EMP.

4.3.6 Releases/Spills – Where the possibility of an environmental release exists due to AECOM activities, the Reportable Quantity for regulated substances must be identified prior to the start of work. Any release or spill must be immediately reported to the client and depending on the material and quantity of material released or spilled, reported to regulatory agencies.

4.3.7 Subject Matter Experts – When necessary, project teams will consult with Subject Matter Experts to identify the necessary permitting/licensing and/or applicable regulations governing the planned scope of work. Example guiding questions that project teams may use to initially assess their project's environmental compliance needs include, but are not limited to:

- Will AECOM's activities have the potential to discharge any hazardous or other regulated chemicals/materials to the air?
- Is there any equipment on site that has an air permit or similar regulatory requirement governing air discharges to the environment? Note: This should include client-owned equipment that AECOM will operate and have contractual regulatory liability for during the planned scope of work.
- Will AECOM manage characteristic or listed hazardous waste for the client?
- Will AECOM activities generate nonhazardous, universal, or hazardous waste subject to requirements?
- Is this a site or facility where AECOM will perform activities under the Resource Conservation and Recovery Act (RCRA – United States), Canadian Environmental Protection Act (CEPA – Canada), a Consent Order or any other applicable jurisdictional regulatory body?
- Is the site or facility a hazardous waste generator (e.g., large quantity, small quantity, or very small quantity)?
- Will AECOM be required to select a waste disposal facility?
- What oil storage capacity does the site or facility have (count containers/equipment with capacities of 55 gal or greater)?
- Will AECOM's activities create a discharge into a surface water body?
- Will AECOM's activities disturb ≥ 1 acre of land surface area?
- Will AECOM's activities physically disturb or impact a wetland?

4.4 Environmental Compliance Assessments

4.4.1 AECOM will periodically assess its operations (offices and project sites) and activities to verify ongoing activities comply with applicable environmental legal requirements. Assessments shall be conducted, as a minimum, on an annual basis. The frequency of these documented environmental compliance assessments should be based on the complexity of the project/size of the office and the associated environmental compliance risks to AECOM.

4.4.2 The Managers (Operations) or Project/Location Managers will conduct the assessment or designate a qualified individual to conduct the assessment.

4.4.3 The environmental compliance assessment, refer to *S3AM-204-FM1 Office/Project Environmental Compliance Assessment Checklist,* will provide information to AECOM management on the

environmental compliance performance of specific operations.

4.4.4 The assessment can be combined into a periodic, comprehensive audit; typically, a business systems audit incorporating quality assurance, health and safety, and environmental components.

4.5 Environmental Incident or Non-Compliance

4.5.1 Should an assessment identify non-compliance issues or an environmental incident occurs, the severity level must be assessed for appropriate response. Refer to *S3AM-004-PR1 Incident Reporting, Notifications & Investigation*. Ensure the parties appropriate to the severity are contacted and involved with issue resolution (e.g., Legal Counsel).

4.5.2 If a regulatory Notice of Violation (NOV) is received by an AECOM facility or project, Legal Counsel shall be contacted and involved with issue resolution.

4.5.3 The issue or incident must be investigated and will be documented and tracked. Refer to *S3AM-004-PR1 Incident Reporting, Notifications & Investigation.* The documented investigation must:

- Identify the cause (root cause).
- Identify corrective actions.
- Assign responsibility to implement or modify controls to prevent reoccurrences and establish scheduled date of completion.
- Identify methods to inform impacted staff of any revisions to written procedures.

4.5.4 The documentation must be reviewed for actual completion and effectiveness of controls.

4.5.5 Document, review, and communicate appropriate lessons learned for incidents and near misses (including environmental).

5.0 Records

5.1 Comply with *S3AM-017-PR1 Injury & Illness Recordkeeping* requirements.

5.2 Maintain or keep accessible the following additional records/documentation:

5.2.1 Relevant laws and regulations (may be accessed via the web).

5.2.2 Facility and project non-compliance records.

5.2.3 Training records (maintained at the facility level, with the exception of modules tracked in computer-based training).

5.2.4 Required equipment inspections, waste storage area inspections, maintenance, and calibration information (in accordance with site EMP).

5.2.5 Relevant contractor/supplier information (in accordance with the site EMP or project-specific waste management plans) with respect to waste disposal vendors, transportation companies, etc.

5.2.6 Agency citations/Notice of Violations and any supporting information.

5.2.7 Information on emergency preparation and response.

5.2.8 Copies of Environmental Aspect and Impact Assessments (maintained by the safety representative for office locations or in the project files for project-related assessments). Refer to *S3AM-204-ATT2 Aspects and Environmental Impacts Assessment*.

5.2.9 Completed Compliance Assessment checklists and audit results.

6.0 Attachments

6.1 S3AM-204-FM1 Office/Project Environmental Compliance Assessment Checklist

6.2 S3AM-204-ATT1 Environmental Compliance Maps

6.3 S3AM-204-ATT2 Aspects and Environmental Impacts Assessment

6.4 S3AM-204-ATT3 Environmental Management Plan (Sample)

Americas

Personal Protective Equipment

S3AM-208-PR1

1.0 Purpose and Scope

1.1 Provide an effective Personal Protective Equipment (PPE) Program to protect AECOM employees from potential workplace safety and health hazards.

1.2 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

1.3 The proper use of appropriate PPE, in combination with effective engineering and administrative controls, can provide AECOM employees with protection against potential workplace hazards and can reduce the potential for workplace injury and illness.

2.0 Terms and Definitions

2.1 **ANSI** – American National Standards Institute

2.2 **CSA** – Canadian Standards Association

2.3 **PPE** – Personal Protective Equipment

2.4 **SDS** – Safety Data Sheets

2.5 **THA –** Task Hazard Assessment

3.0 References

3.1 S3AM-123-PR1 Respiratory Protection

3.2 S3AM-209-PR1 Risk Assessment & Management

3.3 S3AM-301-PR1 Confined Spaces

3.4 S3AM-304-PR1 Fall Protection

3.5 S3AM-315-PR1 Working On & Near Water

3.6 S3AM-317-PR1 Hand Safety

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Managers** or **Supervisors**

- Confirm the location specific SH&E Plan documents required hazard controls.
- Confirm Task Hazard Assessments (THAs) are conducted and hazards identified are eliminated through substitution, engineering, or administrative controls first before assigning PPE for hazard mitigation.
- Confirm appropriate subject matter experts, manufacturer's specifications, and regulatory requirements are consulted as necessary to assist with proper PPE selection.
- Match the appropriate PPE to those hazards that cannot be eliminated; support employees in exercising Stop Work Authority if the task is too hazardous to be mitigated
- Provide and document employee training on use and care of PPE.
- Determine which staff requires employee-issued PPE.

- Determine PPE requirements for visitors.
- If applicable, manage medical monitoring of employees using PPE (e.g. respirators, hearing protection, radiation, etc.).
- Approve the purchase of company-issued PPE.
- Confirm that appropriate PPE is utilized by employees when required or necessary. This may periodically be documented using *S3AM-208-FM2 Personal Protective Equipment Inspection*.
- Exercise Stop Work Authority if PPE is inadequate to address hazards.

4.1.2 **SH&E Managers**

- Provide guidance to Managers, Supervisors, and staff on the assessment of hazards and the selection of PPE.
- Provide training materials to Managers and Supervisors for employee training

4.1.3 **Employee**

- Review all relevant SH&E Plans, THAs and applicable SDS prior to commencing work.
- Exercise Stop Work Authority if the task is too hazardous.
- In accordance with training and instructions, utilize appropriate PPE that has been issued when required or necessary.
- Inspect PPE prior to and after use to confirm that it is functional, and maintain PPE in a clean and functional condition.
- Follow instructions and manufacturers' guidance on the care, use, and storage of PPE.
- Replace PPE when worn out, expired or damaged.
- Refrain from wearing PPE outside of the work area for which it is required if doing so would constitute a hazard.

4.2 Hazard Assessment

4.2.1 The location specific SH&E plan and THA shall assess the hazards and identify the necessary control measures. Refer to *S3AM-209-PR1Risk Assessment & Management.*

4.2.2 These control measures shall include direction and guidance concerning the appropriate PPE required as the last line of defense to the anticipated hazards of the specific operations and tasks. A PPE specific assessment may assist in identifying PPE requirements. *S3AM-208-FM1 Personal Protective Equipment Assessment* may be completed and included in the SH&E Plan.

4.2.3 Various tasks and operations, including but not limited to, demolition, remediation, spill response, asbestos abatement, and lead removal, may require additional direction concerning selection, use, care, and disposal of PPE from a subject matter expert (e.g. protector manufacturer, industrial hygienist, asbestos professional, etc.).

- Obtained direction shall be included in the SH&E Plan.
- Consultation with subject matters may be limited to the planning phase or they may be retained to provide technical assistance for a portion of or duration of the project.

4.3 Training

4.3.1 All employees shall be informed of their right to Stop Work if the task is too hazardous to mitigate through use of elimination, substitution, engineering controls, administrative controls, and PPE.

4.3.2 Staff will receive adequate instruction on the correct use, limitations, and assigned maintenance duties for the equipment to be used. The following information, at a minimum, will be covered during PPE training:

- What PPE is required.
- When it is required.
- Why it is required.
- How to properly don, doff, adjust, and wear the PPE described.
- The limitations of the PPE, including its expected useful life.
- How to properly care for, maintain, and dispose of the PPE.

4.3.3 Retraining may be required as applicable (e.g., observed non-compliance, changes in procedure, etc.).

4.3.4 Staff are responsible for confirming that they have reviewed the operation manual/instructions for the PPE before work commences.

4.3.5 All staff will receive a location specific orientation to the hazards on the job site as well as appropriate PPE requirements.

4.4 Determining the Need for PPE

4.4.1 Prior to beginning work, the SH&E plan shall be consulted and THAs developed to identify the PPE requirements.

4.4.2 After the hazard assessments have been completed, the manager and/or employee shall select the appropriate PPE for each job category or task, as necessary. PPE will be provided to each employee appropriate for the hazards present.

- All PPE selected, purchased and used by AECOM will meet or exceed the appropriate ANSI/CSA standards or other standards as determined by federal, provincial, territorial, or state legislation.

4.4.3 If the hazard can be mitigated through using appropriate PPE shall:

- Properly fit the employee's body. Reasonable attempts shall be made to procure gender-specific gear / sizing.
- Be selected and used in accordance with recognized standards and provide effective protection.
- Not in itself create a hazard to the wearer (e.g., scratched safety glasses which could cause impaired vision should be replaced with clear safety glasses).
- Be compatible so that one item of PPE does not interfere with other PPE.
- Be maintained in good working order and in a sanitary condition.
- Not be altered in any way.

4.4.4 Prior to entering any controlled or restricted work area, employees shall review the SH&E plan and corresponding THA(s) to confirm that they are equipped with the applicable ANSI/CSA-approved PPE, appropriate to the specific work area's hazards.

4.5 Eye and Face Protection

4.5.1 AECOM employees shall use appropriate eye and face protection when eye or face hazards are present or potential from flying particles, molten metal, liquid chemicals, acid and caustic liquids, chemical gases or vapors, or injurious light radiation.

4.5.2 Safety glasses with side protection is the minimum eye protection requirement. Additional eye protection shall be suitable to the anticipated hazards (e.g. goggles, safety glasses with a face-shield, welder's helmet, etc.). Refer to *S3AM-208-ATT1 Eye & Face Protection*.

4.6 Head Protection

4.6.1 Appropriate protective hardhats are required when employees are working in areas where there is any potential for injury to the head.

4.6.2 Head protection shall be suitable to the anticipated hazards (e.g. working near exposed electrical conductors requires hardhats designed to reduce electrical shock). Refer to *S3AM-208-ATT2 Head Protection.*

4.7 Foot Protection

4.7.1 AECOM employees shall use appropriate foot protection when hazards to feet are present or potential; including impact, puncture, cut, electrical, thermal or chemical hazards.

4.7.2 Refer to *S3AM-208-ATT3 Foot Protection.*

4.8 Hand Protection

4.8.1 Appropriate hand protection is required when employee's hands are exposed to hazards such as those from skin absorption of harmful substances, cuts and lacerations, abrasions, punctures, chemical burns, thermal burns, electricity, or harmful temperature extremes.

4.8.2 Refer to *S3AM-208-ATT4 Hand Protection* and *S3AM-317-PR1 Hand Safety*.

4.9 Chemically Resistant Clothing

4.9.1 Chemically resistant clothing is required when there is significant potential for the employee to come in direct contact with the chemicals being handled. Tasks that involve chemical handling will be evaluated for potential splashing or spilling. Refer to *S3AM-208-ATT5 Limb & Body Protection*.

4.9.2 The process for selecting chemical resistant clothing will be similar for the selection of chemical resistant gloves (refer to *S3AM-208-ATT4-Hand Protection* and *S3AM-317-PR1 Hand Safety*).

4.10 High-Visibility Apparel

4.10.1 “High visibility safety apparel” means personal protective safety clothing that is intended to provide conspicuity during both daytime and nighttime usage and that meets the Performance Class II or III requirements of ANSI/CSA standards. Refer to *S3AM-208-ATT6 High Visibility Safety Apparel.*

4.10.2 Color of apparel (orange or lime) may be client/project-specific. If there is a specific need to be visible to the passing public, to machine operators, or to other crew members, high visibility vests shall be worn (and retro-reflective striping on arms and legs at night).

4.10.3 Work conducted at night may require that the minimum level of apparel worn be, at minimum, ANSI/CSA Class III, and in accordance with the governing legislation.

4.11 Personal Clothing

4.11.1 Employees on a project site shall wear full length trousers and shirts that cover shoulders.

4.11.2 For personal safety on the job site, do not wear

- Loose or unsecured clothing or loose fitting cuffs;
- Greasy or oily clothing, gloves, or boots; or
- Torn or ragged clothing.
- Jewelry (e.g. rings, bracelets, neck chains) when working with moving parts or there is a risk or entanglement.

4.11.3 Long hair shall be tied back or otherwise confined when working with moving parts or there is a risk of entanglement.

4.11.4 Clothing made of synthetic fibers can be readily ignited and melted by electric flash or extreme heat sources. Cotton or wool fabrics are recommended for general use.

4.11.5 Footwear shall be suitable for the site conditions and task requirements. No athletic shoes, sandals, flip flops, permitted on active job sites.

4.11.6 It is recommended to use clothing with sun protection properties when working in high sun UV exposure

4.12 Specialized PPE

4.12.1 In addition to basic PPE, additional specialized PPE may be required to provide appropriate protection to the employee. Refer to applicable legislation and related SH&E procedures for additional information on PPE requirements.

- Fall Protection – Only full-body harnesses with shock-absorbing lanyards will be used for personal fall arrest. Refer to *S3AM-304-PR1 Fall Protection*.
- Respiratory Protection – Respiratory protection shall be selected based on the contaminant and concentration to which the employee will be exposed. Refer to *S3AM-123-PR1 Respiratory Protection*, the task- or project-specific hazard assessments and the applicable SDSs for specific requirements.
- Fire Resistant Clothing (FRC) – Approved fire-resistant outer clothing may be required at work locations with flammable or explosive materials or environments. Refer to *S3AM-208-ATT5 Limb & Body Protection.*
- Other Head Protection – Operators and passengers (if trained and permitted) of all-terrain vehicles and snowmobiles will wear approved helmets. Refer to *S3AM-208-ATT2 Head Protection.*
- Protection from Drowning – Appropriate personal floatation devices shall be worn when work working over and near water. Refer to *S3AM-315 Working On & Near Water*.
- Temperature Extremes – Work in cold environments may require additional layers and insulated clothing, gloves, boots and accessories such as balaclavas, hardhat liners. Confirm these items are approved and do not introduce additional unacceptable hazards (e.g. insufficient visibility, conductivity, etc.).
- Hearing Protection – Noise levels in the work environment that cannot be eliminated or reduced to acceptable levels requires worker be protected from exposure. Refer to *S3AM-118-PR1 Hearing Conservation.*
- Traction Devices – Traction devices applied to the base of work boots may be necessary if the employee may be walking on icy surfaces. Refer to *S3AM-208-ATT3 Foot Protection*.
- Rescue – Confined spaces hazards may necessitate the use of specific harnesses attached to retrieval lines to facilitate rescue. Refer to *S3AM-301-PR1 Confined Spaces*.

4.13 Maintaining PPE Supplies

4.13.1 Employees shall inspect their required PPE prior to use. Defective equipment shall be removed from service and replaced.

4.13.2 Each AECOM location will maintain a supply of safety equipment of appropriate types and sizes, including hard hats, high visibility vests, safety glasses, gloves, hearing protection and chemically resistant clothing based on the nature of their field activities. The Manager or designee will be responsible for maintaining this inventory.

4.13.3 Use of PPE by employees and adequacy of protection should be evaluated on a routine basis. This may periodically be documented using *S3AM-208-FM2 Personal Protective Equipment Inspection.*

4.13.4 At a minimum, locations will review their PPE program annually.

4.14 Obtaining Personalized Safety Gear

4.14.1 Employees are not expected to provide their own general PPE. Most basic PPE will be provided to the employee at no charge (e.g. safety glasses, hard hat, gloves, hearing protection, etc.) with the

exception of the below personalized safety equipment (prescription safety glasses, safety-toed boots, any washable coveralls).

4.14.2 Certain personalized safety gear such as prescription safety glasses, safety-toed (capped) boots, and any washable coveralls will be ordered and sized specifically by the user. A partial cost reimbursement to the employee may be made if their location provides a specialized PPE purchase program.

4.14.3 All specialized PPE (e.g. fall protection equipment, respirators, helmets, etc.) will be provided by AECOM for employee use at no charge to the employee, with the exception of the above personalized safety equipment (prescription safety glasses, safety-toed boots, any washable coveralls).

5.0 Records

5.1 Completed SH&E plans, THAs documenting PPE requirements, and as applicable, PPE assessments and PPE inspections, will be maintained in the location's safety files.

6.0 Attachments

6.1 S3AM-208-ATT1 Eye & Face Protection

6.2 S3AM-208-ATT2 Head Protection

6.3 S3AM-208-ATT3 Foot Protection

6.4 S3AM-208-ATT4 Hand Protection

6.5 S3AM-208-ATT5 Limb & Body Protection

6.6 S3AM-208-ATT6 High Visibility Safety Apparel

6.7 S3AM-208-FM1 Personal Protective Equipment Assessment

6.8 S3AM-208-FM2 Personal Protective Equipment Inspection

Hazard/ Activity (Note: Text in this column links to procedure)	Site Specific Description (Where, What Phase of Work, Frequency, Etc.)	Applicable Procedure
☒ Electrical Safety	Working with generators and batteries	S3AM-302-PR
☐ Excavation & Trenches		S3AM-303-PR
☐ Fall Protection		S3AM-304-PR
☒ Flammable and Combustible Liquids	Gasoline used in cars/trucks; portable generator	S3AM-126-PR
☐ Gauge Source Radiation		S3AM-122-PR
☒ Hand and Power Tools	Drilling; Accessing monitoring wells	S3AM-305-PR
☒ Hazardous Waste Operations	Generating hazardous and remediation-derived waste (RDW)	S3AM-117-PR
☒ Heat Stress	Continuous exposure when ambient air temperature is above 80 °F (26.6 °C) and a standard work uniform is worn **or** when ambient air temperature is above 70 °F (21.1 °C) and impermeable chemical protective clothing is worn.	S3AM-113-PR
☒ Heavy Equipment	Working alongside drilling equipment	S3AM-309-PR
☐ High Altitude		S3AM-124-PR
☒ Highway and Road Work	Working alongside roadways and sidewalks	S3AM-306-PR
☐ Hoists Elevators and Conveyors		S3AM-343-PR
☐ Hot Work		S3AM-332-PR
☐ Ladders		S3AM-312-PR
☐ Lockout Tagout		S3AM-325-PR
☐ Machine Guarding Safe Work Practice		S3AM-326-PR
☐ Marine Safety and Vessel Operations		S3AM-333-PR
☒ Material Storage	Storage of materials in field storage unit	S3AM-316-PR
☐ Mine Site Activities		S3AM-341-PR
☐ Mining Operations		S3AM-345-PR
☐ Noise		S3AM-118-PR
☐ Non-Ionizing Radiation		S3AM-121-PR
☐ Overhead Lines		S3AM-322-PR
☐ Pandemic Virus	Potential exposure during travel and field task(s)	SR1-003-PR2
☐ Powder-Actuated Tools		S3AM-327-PR
☐ Powered Industrial Trucks		S3AM-324-PR
☐ Radiation		S3AM-120-PR
☐ Railroad Safety		S3AM-329-PR
☒ Respiratory Protection	Removing free product from wells. Will be needed if action level is exceeded.	S3AM-123-PR
☐ Scaffolding		S3AM-311-PR
☐ Steel Erection		S3AM-340-PR

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Hazard/ Activity (Note: Text in this column links to procedure)	Site Specific Description (Where, What Phase of Work, Frequency, Etc.)	Applicable Procedure
☐ Temp. Floors, Stairs, Railings, Toe-boards		S3AM-342-PR
☒ Underground Utilities	Manual preclearing prior to drilling	S3AM-331-PR
☐ Underground Work		S3AM-330-PR
☒ Wildlife, Plants and Insects	During fieldwork; Pay particular attention for ticks.	S3AM-313-PR
☒ Working Alone	Groundwater sampling/well maintenance and NAPL gauging and recovery work.	S3AM-314-PR
☐ Working on and Near Water		S3AM-315-PR

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Americas

Personal Protective Equipment Assessment

S3AM-208-FM1

Location: _____ **Job No.:** _____

Date: _____ **Assessment conducted by:** _____

Specific tasks performed at this location: _____

If any of the indicated hazards are present, eliminate the hazard or use the indicated PPE. Include any additional guidance in the available section below each item.

Overhead Hazards

1.	Suspended/elevated loads, beams, or objects that could fall or strike head	☐ **Yes**	☐ **No**	Hard hat, ANSI Z89, Class G, E or C
2.	Flying objects that could strike head	☐ **Yes**	☐ **No**	Hard hat, ANSI Z89, Class G, E or C
3.	Energized wires or equipment that could strike head	☐ **Yes**	☐ **No**	Hard hat, ANZI Z89, Class G or E (dependent on potential voltage)
4.	Sharp objects or corners at head level	☐ **Yes**	☐ **No**	Hard hat, ANSI Z89, Class G, E or C

Eye Hazards

5.	Chemical splashes or irritating mists	☐ **Yes**	☐ **No**	Safety goggles
6.	Excessive dust	☐ **Yes**	☐ **No**	Safety glasses or goggles
7.	Smoke and/or fumes	☐ **Yes**	☐ **No**	Safety goggles
8.	Welding operations	☐ **Yes**	☐ **No**	Welding goggles
9.	Lasers/optical radiation	☐ **Yes**	☐ **No**	Consult subject matter expert for proper selection
10.	Projectiles	☐ **Yes**	☐ **No**	Dual eye protection
11.	Sawing, cutting, chipping, and/or grinding	☐ **Yes**	☐ **No**	Dual eye protection

Face Hazards

12.	Chemical splashes or irritating mists	☐ **Yes**	☐ **No**	Safety goggles
13.	Welding operations	☐ **Yes**	☐ **No**	Welding goggles or welding helmet
14.	Projectiles	☐ **Yes**	☐ **No**	Dual eye protection

If any of the indicated hazards are present, eliminate the hazard or use the indicated PPE. Include any additional guidance in the available section below each item.

Hand Hazards

15.	Chemical exposure	☐ **Yes** ☐ **No**	Use chemical-resistant gloves specific to hazard; consult SDS, subject matter expert, and/or Safety Representative
16.	Sharp edges, splinters, sharp tools, machine parts, etc.	☐ **Yes** ☐ **No**	Leather or Kevlar gloves
17.	Impact or crush hazards	☐ **Yes** ☐ **No**	Impact resistant gloves
18.	Temperature extremes – heat	☐ **Yes** ☐ **No**	Leather gloves, welder's gloves, hot mill gloves
19.	Temperature extremes – cold	☐ **Yes** ☐ **No**	Insulated gloves
20.	Blood, fungus, biological agents	☐ **Yes** ☐ **No**	Nitrile gloves
21.	Exposure to live electrical currents	☐ **Yes** ☐ **No**	Electrical gloves; consult Safety representative
22.	Vibrating tool operation	☐ **Yes** ☐ **No**	Anti-Vibration gloves
23.	Material handling	☐ **Yes** ☐ **No**	Leather, cotton, synthetic gloves

Foot Hazards

24.	Heavy materials (greater than 50 pounds) handled by employees	☐ **Yes** ☐ **No**	Safety shoes or boots
25.	Potential to crush or cut whole foot	☐ **Yes** ☐ **No**	Safety shoes or boots with metatarsal guard
26.	Sharp edges or points (puncture risk)	☐ **Yes** ☐ **No**	Safety shoes or boots
27.	Exposure to electrical hazards	☐ **Yes** ☐ **No**	Safety shoes or boots with: Conductive - Protects the wearer in an environment where the accumulation of static electricity on the body is a hazard. Static dissipative - Reduces accumulation of excess static electricity by conducting body charge to ground while maintaining a sufficiently high level of resistance. Electrical hazard - Provides a secondary source of protection against accidental contact with live electrical circuits, electrically energized conductors, parts or apparatus, and is manufactured with non-conductive electrical shock resistant soles and heels.

If any of the indicated hazards are present, eliminate the hazard or use the indicated PPE. Include any additional guidance in the available section below each item.

28.	Slippery conditions	☐ **Yes**	☐ **No**	Rubber-soled boots or grips
29.	Chemical contamination	☐ **Yes**	☐ **No**	Rubber, PVC, or polyurethane boots or boot covers with puncture and protective toe if task required
30.	Wet conditions	☐ **Yes**	☐ **No**	Rubber boots or boot covers
31.	Construction/demolition	☐ **Yes**	☐ **No**	Safety boots with metatarsal guard if foot-crushing hazard exists

Fall Hazards

32.	Elevations above 4 feet (general industry) or 6 feet (construction) without guardrails	☐ **Yes**	☐ **No**	ANSI A-10.14 Type 1 full-body harness
33.	Suspended scaffolds, boatswain's chairs, float scaffolds, or suspended staging	☐ **Yes**	☐ **No**	ANSI A-10.14 Type 1 full-body harness
34.	Working in trees	☐ **Yes**	☐ **No**	ANSI A-10.14 Type 1 full-body harness
35.	Working in vehicle-mounted elevating work platforms (e.g., bucket trucks, aerial lifts)	☐ **Yes**	☐ **No**	ANSI A-10.14 Type 1 full-body harness

Water Hazards

36.	Working on or above water where a risk of drowning exist	☐ **Yes**	☐ **No**	U.S. Coast Guard approved personal floatation device; Type I, II, or III

Excessive Heat or Flame

37.	Full body chemical protective clothing in temperatures greater than 80 °F	☐ **Yes**	☐ **No**	Cooling vest
38.	Work around molten metal or flame	☐ **Yes**	☐ **No**	Nomex or heat reflective clothing
39.	Welding activities	☐ **Yes**	☐ **No**	Welding leathers for those areas that are exposed to flame, spark, or molten metal

Respiratory Hazards

40.	Airborne particulates, gases, vapors, or mists in excess of established exposure limits	☐ **Yes**	☐ **No**	Refer to *S3AM-123-PR1 Respiratory Protection* for respirator selection guidance

Excessive Noise

41.	Exposure to noise	☐ **Yes**	☐ **No**	Ear plugs, muffs or both

If any of the indicated hazards are present, eliminate the hazard or use the indicated PPE. Include any additional guidance in the available section below each item.

Body and Leg Protection

42.	Chemical exposure	☐ **Yes** ☐ **No**	Contact SH&E Representative and/or subject matter expert for assistance in proper selection
43.	Using chainsaw, cutting brush	☐ **Yes** ☐ **No**	Chainsaw chaps
44.	Exposure to snakes	☐ **Yes** ☐ **No**	Snake chaps
45.	Exposure to vehicle traffic or heavy equipment	☐ **Yes** ☐ **No**	High visibility apparel

I certify that the above inspection was performed to the best of my knowledge and ability, based on the hazards present on: _____

Name _____ Signature _____

This document should be included in the location specific SH&E Plan.

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ATTACHMENT D

Stretch and Flex Poster

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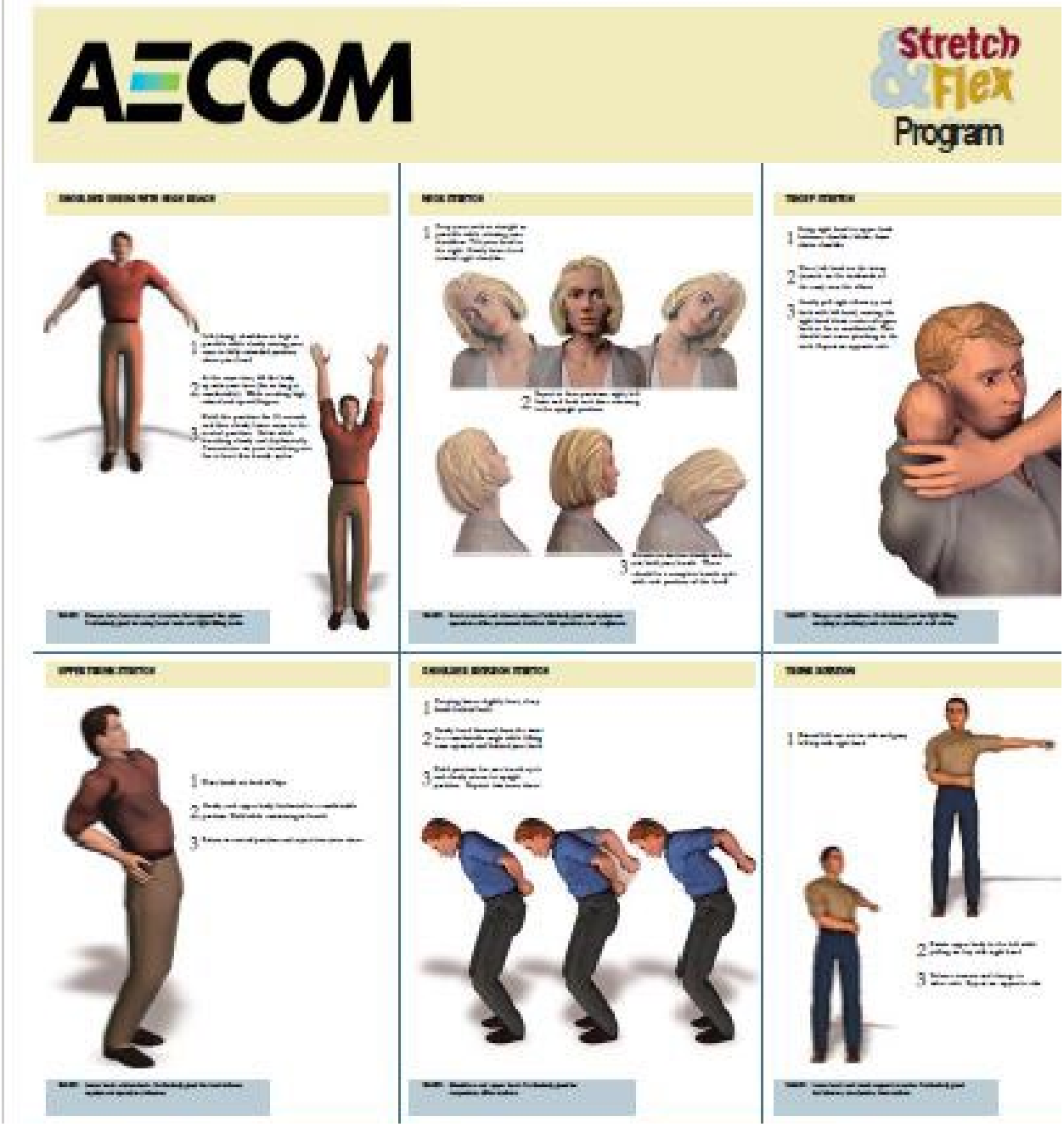

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ATTACHMENT E

Site Orientation

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E-1: SITE ORIENTATION INSTRUCTIONS AND CHECKLIST

AECOM will conduct a site safety briefing for a person's initial visit to the site. The briefing will be conducted:

- Prior to the start of work;
- For any new AECOM or subconsultant personnel; and
- At each mobilization, or whenever there is a change in task or significant change in task location.

All personnel working on the project who have received the site briefing (including the HASP review) will sign the Personal Acknowledgement located at the end of the HASP. Visitors may receive a shortened version to address the hazards specific to their visit.

The following items, at minimum, will be discussed during the site safety briefing:

- Contents of this HASP;
- The Emergency Response Plan;
- Contractor SH&E Management expectations;
- Injury management, including notification and hospital and occupational clinic locations;
- The AECOM 4-Sight program;
- Stop Work authority;
- The THAs (**Attachment B**) for the tasks that will be performed on a given project;
- Types of hazards at the site and means for minimizing exposure to them;
- Instructions for new operations to be conducted, and safe work practices;
- PPE that must be used;
- Lone worker check-in procedures;
- Emergency evacuation routes, muster points, and tornado/storm shelters; and
- Location and use of emergency equipment.

These meetings must be documented and maintained in the project files.

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ATTACHMENT F

Safety Data Sheets

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SAFETY DATA SHEET

SDS ID NO.: 0156MAR019
Revision Date: 05/14/2015

1. IDENTIFICATION

Product Name: Marathon Petroleum Benzene

Synonym: Benzene; Cyclohexatriene
Chemical Family: Petroleum Hydrocarbon

Recommended Use: Solvent. Chemical intermediate.
Use Restrictions: All others.

Supplier Name and Address:

MARATHON PETROLEUM COMPANY LP
539 South Main Street
Findlay, OH 45840

SDS information: 1-419-421-3070

Emergency Telephone: 1-877-627-5463

2. HAZARD IDENTIFICATION

Classification

OSHA Regulatory Status
This chemical is considered hazardous according to the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids	Category 2
Skin corrosion/irritation	Category 2
Serious eye damage/eye irritation	Category 2A
Germ cell mutagenicity	Category 1B
Carcinogenicity	Category 1A
Specific target organ toxicity (repeated exposure)	Category 1
Aspiration toxicity	Category 1
Acute aquatic toxicity	Category 2

Hazards Not Otherwise Classified (HNOC)
Static accumulating flammable liquid

Label elements

EMERGENCY OVERVIEW

Danger

HIGHLY FLAMMABLE LIQUID AND VAPOR
May accumulate electrostatic charge and ignite or explode

May be fatal if swallowed and enters airways
Causes skin irritation
Causes serious eye irritation
May cause genetic defects
May cause cancer
Causes damage to organs (blood, blood-forming organs, immune system) through prolonged or repeated exposure
Toxic to aquatic life



Appearance Clear Liquid **Physical State** Liquid **Odor** Sweet , Distinct

Precautionary Statements - Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Keep away from heat/sparks/open flames/hot surfaces. — No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools
Take precautionary measures against static discharge
Do not breathe dust/fume/gas/mist/vapors/spray
Do not eat, drink or smoke when using this product
Wash hands and any possibly exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection
Avoid release to the environment

Precautionary Statements - Response
IF exposed or concerned: Get medical attention
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
If eye irritation persists: Get medical attention
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
If skin irritation occurs: Get medical attention
Wash contaminated clothing before reuse
IF SWALLOWED: Immediately call a POISON CENTER or doctor
Do NOT induce vomiting
In case of fire: Use water spray, fog or regular foam for extinction

Precautionary Statements - Storage
Store in a well-ventilated place. Keep cool
Store locked up

Precautionary Statements - Disposal
Dispose of contents/container at an approved waste disposal plant

3. COMPOSITION/INFORMATION ON INGREDIENTS

Benzene is a six carbon aromatic petroleum hydrocarbon.

Composition Information:

Name	CAS Number	Weight %
Benzene	71-43-2	99-100

4. FIRST AID MEASURES

First Aid Measures

General advice

In case of accident or if you feel unwell, seek medical advice immediately (show directions for use or safety data sheet if possible).

Inhalation:

Remove to fresh air. If not breathing, institute rescue breathing. If breathing is difficult, ensure airway is clear, give oxygen and continue to monitor. If heart has stopped, immediately begin cardiopulmonary resuscitation (CPR). Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

Skin Contact:

Immediately wash exposed skin with plenty of soap and water while removing contaminated clothing and shoes. May be absorbed through the skin in harmful amounts. Get medical attention if irritation persists.

Place contaminated clothing in closed container until cleaned or discarded. If clothing is to be laundered, inform the person performing the operation of contaminant's hazardous properties. Destroy contaminated, non-chemical resistant footwear.

Eye Contact:

Flush immediately with large amounts of water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Gently remove contacts while flushing. Get medical attention if irritation persists.

Ingestion:

Do not induce vomiting because of danger of aspirating liquid into lungs, causing serious damage and chemical pneumonitis. If spontaneous vomiting occurs, keep head below hips, or if patient is lying down, turn body and head to side to prevent aspiration and monitor for breathing difficulty. Never give anything by mouth to an unconscious person. Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

Most important signs and symptoms, both short-term and delayed with overexposure

Adverse Effects:

Overexposure to vapors may cause eye, skin and respiratory irritation. Headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue. Prolonged and repeated contact may cause defatting and drying of the skin and may lead to irritation and/or dermatitis. Prolonged or repeated exposure may cause adverse effects on blood, blood-forming organs, and immune system.

Indication of any immediate medical attention and special treatment needed

NOTES TO PHYSICIAN:

INHALATION: This material (or a component) sensitizes the myocardium to the effects of sympathomimetic amines. Epinephrine and other sympathomimetic drugs may initiate cardiac arrhythmias in individuals exposed to this material. Administration of sympathomimetic drugs should be avoided.

INGESTION: This material represents a significant aspiration and chemical pneumonitis hazard. Induction of emesis is not recommended.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media

For small fires, Class B fire extinguishing media such as CO2, dry chemical, foam (AFFF/ATC) or water spray can be used. For large fires, water spray, fog or foam (AFFF/ATC) can be used. Firefighting should be attempted only by those who are adequately trained and equipped with proper protective equipment.

Unsuitable extinguishing media

Do not use straight water streams to avoid spreading fire.

Specific hazards arising from the chemical
This product has been determined to be a highly flammable liquid per the OSHA Hazard Communication Standard and should be handled accordingly. Vapors may travel along the ground or be moved by ventilation and ignited by many sources such as pilot lights, sparks, electric motors, static discharge, or other ignition sources at locations distant from material handling. Flashback can occur along vapor trail. For additional fire related information, see NFPA 30 or the North American Emergency Response Guide 130.

Hazardous combustion products
Smoke, carbon monoxide, and other products of incomplete combustion.

Explosion data
Sensitivity to Mechanical Impact No.
Sensitivity to Static Discharge Yes.

Special protective equipment and precautions for firefighters
Firefighters should wear full protective clothing and positive-pressure self-contained breathing apparatus (SCBA) with a full face-piece, as appropriate. Avoid using straight water streams. Water may be ineffective in extinguishing low flash point fires, but can be used to cool exposed surfaces. Avoid excessive water spray application. Water spray and foam (AFFF/ATC) must be applied carefully to avoid frothing and from as far a distance as possible. Keep run-off water out of sewers and water sources.

NFPA:	Health 2	Flammability 3	Instability 0	Special Hazards -

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions:	Keep public away. Isolate and evacuate area. Shut off source if safe to do so. Eliminate all ignition sources.
Protective Equipment:	Use personal protection measures as recommended in Section 8.
Emergency Procedures:	Advise authorities and National Response Center (800-424-8802) if the product has entered a water course or sewer. Notify local health and pollution control agencies, if appropriate.
Environmental precautions:	Avoid release to the environment. Avoid subsoil penetration.
Methods and materials for containment:	Contain liquid with sand or soil.
Methods and materials for cleaning up:	Use suitable absorbent materials such as vermiculite, sand, or clay to clean up residual liquids. Recover and return free product to proper containers. When recovering free liquids ensure all equipment is grounded and bonded. Use only non-sparking tools.

7. HANDLING AND STORAGE

Safe Handling Precautions: NEVER SIPHON THIS PRODUCT BY MOUTH. Static accumulating flammable liquid. Use appropriate grounding and bonding practices. Bonding and grounding may be insufficient to eliminate the hazard from static electricity. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. Use only non-sparking tools. Do not cut, drill, grind or weld on empty containers since explosive residues may remain. Avoid contact with skin, eyes and clothing. Avoid breathing vapors or mists. Use only with adequate ventilation. Use personal protection measures as recommended in Section 8. Exercise good personal hygiene including removal of soiled clothing and prompt washing with soap and water. Comply with all applicable EPA, OSHA, NFPA and consistent state and local requirements.

Hydrocarbons are basically non-conductors of electricity and can become electrostatically charged during mixing, filtering, pumping at high flow rates or loading and transfer operations. If this charge reaches a sufficiently high level, sparks can form that may ignite the vapors of flammable liquids. Sudden release of hot organic chemical vapors or mists from process equipment operating under elevated temperature and pressure, or sudden ingress of air into vacuum equipment may result in ignition of vapors or mists without the presence of obvious ignition sources. Nozzle spouts must be kept in contact with the containers or tank during the entire filling operation.

Storage Conditions: Store in properly closed containers that are appropriately labeled and in a cool, well-ventilated area.

Incompatible materials Strong oxidizing agents.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Name	ACGIH TLV	OSHA PELS:	OSHA - Vacated PELs	NIOSH IDLH
Benzene 71-43-2	0.5 ppm TWA 2.5 ppm STEL Skin - potential significant contribution to overall exposure by the cutaneous route	TWA: 10 ppm (applies to industry segments exempt from the benzene standard at 29 CFR 1910.1028) TWA: 1 ppm STEL: 5 ppm (see 29 CFR 1910.1028)	25 ppm Ceiling 1 ppm TWA 5 ppm STEL	500 ppm

Notes: The manufacturer has voluntarily elected to provide exposure limits contained in OSHA's 1989 air contaminants standard in its SDSs, even though certain of those exposure limits were vacated in 1992.

Engineering measures: Local or general exhaust required in an enclosed area or when there is inadequate ventilation. Use mechanical ventilation equipment that is explosion-proof.

Personal protective equipment

Eye protection: Use goggles or face-shield if the potential for splashing exists.

Skin and body protection: For non-exposure jobs or where exposure is expected to be less than 15 minutes, neoprene gloves can be used to prevent skin contact. For all exposure jobs expected to be greater than 15 minutes, viton gloves should be used to prevent skin contact. Glove suitability is based on workplace conditions and usage. Contact the glove manufacturer for specific advice on glove selection and breakthrough times. Depending upon the conditions of use and specific work situations, additional protective equipment and/or clothing may be required to control exposures.

Respiratory protection: Approved organic vapor chemical cartridge or supplied air respirators should be worn for exposures to any components exceeding the established exposure limits. Observe respirator assigned protection factors (APFs) criteria cited in federal OSHA 29 CFR 1910.134. Self-contained breathing apparatus should be used for fire fighting.

Hygiene measures: Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes and clothing.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical State	Liquid
Appearance	Clear Liquid
Color	Colorless
Odor	Sweet , Distinct
Odor Threshold	12 ppmv

Property	**Values (Method)**
Melting Point / Freezing Point	5.5 °C / 42 °F
Initial Boiling Point / Boiling Range	80 °C / 176 °F
Flash Point	-11 °C / 12 °F
Evaporation Rate	5.1 (Butyl acetate = 1)
Flammability (solid, gas)	Not applicable.
Flammability Limit in Air (%)	
Upper Flammability Limit:	7.1
Lower Flammability Limit:	1.4
Vapor Pressure	3.21 psia @ 100°F
Vapor Density	2.7 (Air = 1)
Specific Gravity / Relative Density	0.883
Water Solubility	No available data.
Solubility in other solvents	No available data.
Partition Coefficient	No available data.
Decomposition temperature:	No available data.
pH:	Not Applicable
Autoignition Temperature	562 °C / 1044 °F
Kinematic Viscosity	0.593 cSt @ 100°F
Dynamic Viscosity	No available data.
Explosive Properties	No available data.
Softening Point	No available data.
VOC Content (%)	No available data.
Density	No available data.
Bulk Density	Not applicable.

10. STABILITY AND REACTIVITY

Reactivity The product is non-reactive under normal conditions.

Chemical stability The material is stable at 70°F, 760 mmHg pressure.

Possibility of hazardous reactions None under normal processing.

Hazardous polymerization Will not occur.

Conditions to avoid Sources of heat or ignition.

Incompatible materials Strong oxidizing agents.

Hazardous decomposition products None known under normal conditions of use.

11. TOXICOLOGICAL INFORMATION

Potential short-term adverse effects from overexposures

Inhalation Overexposure may cause respiratory tract irritation and central nervous system depression. Breathing high concentrations of this material, for example, in a confined space or by intentional abuse, can cause irregular heartbeats which can cause death.

Eye contact Irritating to eyes.

Skin contact Irritating to skin. May be absorbed through the skin in harmful amounts. Effects may become more serious with repeated or prolonged contact.

Ingestion May be fatal if swallowed or vomited and enters airways. May cause irritation of the mouth, throat and gastrointestinal tract. May cause central nervous system depression or effects.

Acute Toxicological data

Name	Oral LD50	Dermal LD50	Inhalation LC50
Benzene 71-43-2	> 2000 mg/kg (Rat)	> 5000 mg/kg (Rabbit)	> 20 mg/l (Rat) 4 h

Delayed and immediate effects as well as chronic effects from short and long-term exposure

BENZENE: Studies of workers exposed to benzene show clear evidence that overexposure can cause cancer and other diseases of the blood forming organs including Acute Myelogenous Leukemia (AML), and Aplastic Anemia (AA), an often fatal disease. Some studies suggest overexposure to benzene may also be associated with Myelodysplastic Syndrome (MDS). Findings from a case control study of workers exposed to benzene was reported during the 2009 Benzene Symposium in Munich included an increase in Acute Myeloid Leukemias and Non-Hodgkins Lymphoid Neoplasms (NHLN) of the subtype follicular lymphoma (FL) in some occupational categories. Some studies of workers exposed to benzene have shown an association with increased rates of chromosome aberrations in circulating lymphocytes. One study of women workers exposed to benzene suggested a weak association with irregular menstruation. However, other studies of workers exposed to benzene have not demonstrated clear evidence of an effect on fertility or reproductive outcome in humans. Benzene can cross the placenta and affect the developing fetus. Cases of AA have been reported in the offspring of persons severely overexposed to benzene. Studies in laboratory animals indicate that prolonged, repeated exposure to high levels of benzene vapor can cause bone marrow suppression and cancer in multiple organ systems. Studies in laboratory animals show evidence of adverse effects on male reproductive organs following high levels of exposure but no significant effects on reproduction have been observed. Embryotoxicity has been reported in studies of laboratory animals but effects were limited to reduced fetal weight and minor skeletal variations. Benzene has been classified as a proven human carcinogen by OSHA and a Group 1 (Carcinogenic to Humans) material by IARC. The current proposed IARC classification for benzene is summarized as follows: Sufficient evidence for Acute Myeloid Leukemia; limited evidence for Acute Lymphatic Leukemia, Chronic Lymphatic Leukemia, Non-Hodgkin Lymphoma, and Multiple Myeloma.

Adverse effects related to the physical, chemical and toxicological characteristics

Signs & Symptoms Overexposure to vapors may cause eye, skin and respiratory irritation. Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting. Repeated or prolonged skin contact may cause drying, reddening, itching and cracking.

Sensitization Not expected to be a skin or respiratory sensitizer.

Mutagenic effects May cause genetic defects.

Carcinogenicity Cancer designations are listed in the table below.

Name	ACGIH (Class)	IARC (Class)	NTP	OSHA
Benzene 71-43-2	Confirmed human carcinogen (A1)	Carcinogenic to humans (1)	Known to be human carcinogen	Known carcinogen

Reproductive toxicity None known.

Specific Target Organ Toxicity (STOT) - single exposure Not classified.

Specific Target Organ Toxicity (STOT) - repeated exposure Blood. Blood-forming organs. Immune system.

Aspiration hazard May be fatal if swallowed or vomited and enters airways.

12. ECOLOGICAL INFORMATION

Ecotoxicity This product should be considered toxic to aquatic organisms.

Name	Algae/aquatic plants	Fish	Toxicity to Microorganisms	Crustacea
Benzene 71-43-2	72-hr EC50 = 29 mg/l Algae	96-hr LC50 = 5.3 mg/l Rainbow trout (flow-through)	-	48-hr EC50 = 8.76-15.6 mg/l Daphnia magna (Static)

Persistence and degradability Readily biodegradable in the environment.

Bioaccummulation Not expected to bioaccumulate in aquatic organisms.

Mobility in soil May partition into air, soil and water.

Other adverse effects No information available.

13. DISPOSAL CONSIDERATIONS

Description of Waste Residues
This material may be a flammable liquid waste.

Safe Handling of Wastes
Handle in accordance with applicable local, state, and federal regulations. Use personal protection measures as required. Use appropriate grounding and bonding practices. Use only non-sparking tools. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. No smoking.

Disposal of Wastes / Methods of Disposal
The user is responsible for determining if any discarded material is a hazardous waste (40 CFR 262.11). Dispose of in accordance with federal, state and local regulations.

Methods of Contaminated Packaging Disposal
Empty containers should be completely drained and then discarded or recycled, if possible. Do not cut, drill, grind or weld on empty containers since explosive residues may be present. Dispose of in accordance with federal, state and local regulations.

14. TRANSPORT INFORMATION

DOT (49 CFR 172.101):

UN Proper shipping name:	Benzene
UN/Identification No:	UN 1114
Transport Hazard Class(es):	3
Packing group:	II
DOT reportable quantity (lbs):	10 pounds.

TDG (Canada):

UN Proper shipping name:	Benzene
UN/Identification No:	UN 1114
Transport Hazard Class(es):	3
Packing group:	II
Regulated Substances:	10 pounds.

15. REGULATORY INFORMATION

US Federal Regulatory Information:

US TSCA Chemical Inventory Section 8(b): This product and/or its components are listed on the TSCA Chemical Inventory.

EPA Superfund Amendment & Reauthorization Act (SARA):

SARA Section 302: This product does not contain any component(s) included on EPA's Extremely Hazardous Substance (EHS) List.

Name	CERCLA/SARA - Section 302 Extremely Hazardous Substances and TPQs
Benzene	NA

SARA Section 304: This product may contain component(s) identified either as an EHS or a CERCLA Hazardous substance which in case of a spill or release may be subject to SARA reporting requirements:

Name	CERCLA/SARA - Hazardous Substances and their Reportable Quantities
Benzene	10 lb final RQ 4.54 kg final RQ

SARA: The following EPA hazard categories apply to this product:

Acute Health Hazard
Chronic Health Hazard
Fire Hazard

SARA Section 313: This product may contain component(s), which if in exceedance of the de minimus threshold, may be subject to the reporting requirements of SARA Title III Section 313 Toxic Release Reporting (Form R).

Name	CERCLA/SARA 313 Emission reporting:
Benzene	0.1 % de minimis concentration

State and Community Right-To-Know Regulations:
The following component(s) of this material are identified on the regulatory lists below:

Benzene

Louisiana Right-To-Know:	Not Listed.
California Proposition 65:	Carcinogen, initial date 2/27/87 Developmental toxicity, initial date 12/26/97 Male reproductive toxicity, initial date 12/26/97
New Jersey Right-To-Know:	SN 0197
Pennsylvania Right-To-Know:	Environmental hazard; Special hazardous substance
Massachusetts Right-To Know:	Carcinogen; Extraordinarily hazardous
Florida Substance List:	Not Listed.
Rhode Island Right-To-Know:	Toxic (skin); Flammable (skin); Carcinogen (skin)
Michigan Critical Materials Register List:	100 lb Annual usage threshold
Massachusetts Extraordinarily Hazardous Substances:	Carcinogen; Extraordinarily hazardous
California - Regulated Carcinogens:	Not Listed.
Pennsylvania RTK - Special Hazardous Substances:	Present
New Jersey - Special Hazardous Substances:	Carcinogen; Flammable - third degree; Mutagen
New Jersey - Environmental Hazardous Substances List:	SN 0197 TPQ: 500 lb
Illinois - Toxic Air Contaminants	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	10 lb RQ (air); 1 lb RQ (land/water)

Canada DSL/NDSL Inventory: This product and/or its components are listed either on the Domestic Substances List (DSL) or are exempt.

Canadian Regulatory Information: "This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the (M)SDS contains all the information required by the Controlled Products Regulations."

Name	Canada - WHMIS: Classifications of Substances:	Canada - WHMIS: Ingredient Disclosure:
Benzene	B2,D2A,D2B	0.1%



NOTE: Not Applicable.

16. OTHER INFORMATION

Prepared By Toxicology and Product Safety
Revision Date: 05/14/2015

Revision Note:
Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information is intended as guidance for safe handling, use, processing, storage, transportation, accidental release, clean-up and disposal and is not considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

SAFETY DATA SHEET

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier **N,N-Diethyl-m-toluamide (DEET)**

Synonyms: N,N-Diethyl-m-toluamide, DETA

Chemical Abstracts Registry No: 134-62-3

1.2. Relevant identified uses of the substance or mixture and uses advised against

For Manufacturing of End-User Insect Repellent Products and Testing Purposes.

1.3. Details of the supplier of the safety data sheet

Vertellus LLC
201 North Illinois Street, Suite 1800
Indianapolis, Indiana 46204 USA
1-336-292-1781

e-mail Address: sds@vertellus.com

1.4. Emergency telephone number

Vertellus: 1-336-292-1781
CHEMTREC (USA): +1-800-424-9300 (collect calls accepted)
CHEMTREC (International): +1-703-527-3887 (collect calls accepted)
NRCC (China): +86 25 85477110

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture (According to Regulation (EC) No 1272/2008, 29 CFR 1910.1200 and the Globally Harmonized System)

Skin Irritation Category 2
Serious Eye Irritation Category 2
Environmental Chronic Category 3
Acute Toxicity Oral Category 4

2.2. Label elements

Hazard Symbols (Pictogram):



Signal Word: Warning

Hazard Precautions:
H315 - Causes skin irritation.
H302 - Harmful if swallowed.
H319 - Causes serious eye irritation.
H412 - Harmful to aquatic life with long lasting effects.

Prevention Precautionary Statements:
P270 - Do not eat, drink or smoke when using this product.
P273 - Avoid release to the environment.
P280 - Wear protective gloves/protective clothing/eye protection/face protection.

First Aid Precautionary Statements: P302+P352 - IF ON SKIN: Wash with plenty of soap and water.

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P305+P351+P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P337+P313 - If eye irritation persists: Get medical advice/attention.
P362 - Take off contaminated clothing and wash before reuse.

Storage Precautionary Statements: Not required.

2.3. Other hazards

Other Hazards: Not applicable.

SECTION 3: Composition/information on ingredients

3.1. Substances or 3.2. Mixtures

Ingredient	CAS Number	Concentration (weight %)	EC Number	CLP Inventory/ Annex VI	EU CLP Classification (1272/2008)
N,N-Diethyl-m-toluamide (DEET)	134-62-3	~ 100	205-149-7	616-018-00-2	Aquatic Chronic 3; H412 Acute Tox. 4; H302 Eye Irrit. 2; H319 Skin Irrit. 2; H315

NOTE: See Section 8 for exposure limit data for these ingredients. See Section 15 for trade secret information (where applicable).

SECTION 4: First aid measures

4.1. Description of first aid measures

Skin Contact: Wash thoroughly after skin contact.

Eye Contact: Immediately flush eyes with plenty of water. Get medical attention, if irritation persists.

Inhalation: Remove from exposure. If not breathing, give artificial respiration and call a physician. Seek medical advice if symptoms persist.

Ingestion: If swallowed, contact physician or poison control center immediately.

4.2 Most important symptoms and effects, both acute and delayed

Acute: May be harmful if ingested in sufficient quantities.
Contact with skin may cause slight irritation.
Moderately irritating to eyes.
High gas, vapor, or mist concentrations may be harmful if inhaled.

Delayed Effects: None known.

4.3. Indication of any immediate medical attention and special treatment needed

Note to Physician: No specific indications. Treatment should be based on the judgment of the physician in response to the reactions of the patient.

SECTION 5: Firefighting measures

5.1. Extinguishing media

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Appropriate Extinguishing Media: Foam, Dry chemical, Carbon dioxide, Water spray

5.2. Special hazards arising from the substance or mixture

Hazardous Products of Combustion: Combustion will produce carbon monoxide, carbon dioxide and oxides of nitrogen.

Potential for Dust Explosion: Not applicable.

Special Flammability Hazards: Not applicable.

5.3. Advice for firefighters

Basic Fire Fighting Guidance: Wear self-contained breathing apparatus and protective clothing. Normal firefighting procedures may be used.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Evacuation Procedures: Isolate the hazard area and deny entry to unnecessary and unprotected personnel.

Special Instructions: See Section 8 for personal protective equipment recommendations. Remove all contaminated clothing to prevent further absorption. Decontaminate affected personnel using the first aid procedures in Section 4. Leather shoes that have been saturated must be discarded.

6.2. Environmental precautions

Prevent releases to soils, drains, sewers and waterways.

6.3. Methods and material for containment and cleaning up

Remove all ignition sources. Ventilate the area of spill or leak. Wear protective equipment during clean-up. Contain spilled liquid with sand or vermiculite and place in chemical waste container. Prevent runoff from entering drains, sewers, and streams. After collection of material, flush area with water. Dispose of contents & container in accordance with local, regional, national or international regulations.

6.4. Reference to other sections

Refer to section 8 for information on selecting personal protective equipment. Refer to section 13 for information on spilled product, absorbent and clean up material disposal instructions.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for Unique Hazards: Not applicable.

Practices to Minimize Risk: Wear appropriate protective equipment when performing maintenance on contaminated equipment. Wash hands thoroughly before eating or smoking after handling this material. Do not eat, drink or smoke in work areas. Prevent contact with incompatible materials. Avoid spills and keep away from drains. Handle in a manner to prevent generation of aerosols, vapors or dust clouds.

Special Handling Equipment: Not applicable.

7.2. Conditions for safe storage, including any incompatibilities

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Storage Precautions & Recommendations:	This product should be stored at ambient temperature in a dry, well-ventilated location. Keep container closed when not in use.
Dangerous Incompatibility Reactions:	Incompatible with oxidizing materials.
Incompatibilities with Materials of Construction:	None known

7.3. Specific end use(s)

If a chemical safety assessment has been completed an exposure scenario is attached as an annex to this Safety Data Sheet. Refer to this annex for the specific exposure scenario control parameters for uses identified in subsection 1.2.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Occupational Exposure Limit	Not applicable.
Air Monitoring Method:	Not applicable.

8.2. Exposure controls

Also see the annex to this SDS (if applicable) for specific exposure scenario controls.

Other Engineering Controls:	All operations should be conducted in well-ventilated conditions. Local exhaust ventilation should be provided.
Personal Protective Equipment:	Impervious gloves, boots, and clothing, chemical goggles or face shield where necessary, and a NIOSH approved chemical cartridge respirator or supplied air breathing apparatus with organic vapour/acid gas cartridges with particle filters.
Respirator Caution:	Observe OSHA regulations for respirator use (29 CFR 1910.134). Air-purifying respirators must not be used in oxygen-deficient atmospheres.
Thermal Hazards:	Not applicable.
Environmental Exposure Controls:	The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Select controls based on a risk assessment of local circumstances. If user operations generate dust, fumes, gas, vapor or mist, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance, State & Odor (ambient temperature):	Clear, oily liquid with mild, characteristic odor		
Vapor Pressure:	< 1 mm Hg @ 32.4°C	**Evaporation Rate:**	< 1 (Butyl Acetate = 1)
Specific Gravity or Density:	0.996 @ 20°C	**Vapor Density (air = 1):**	6.7
Boiling Point:	292 °C @ 760 mm Hg	**Freezing / Melting Point:**	-43 °C (pour point) -45 °F
Solubility in Water:	9.04 mg/mL @ 25°C	**Octanol / Water Coefficient:**	11,200 mg/L @ 25°C

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pH:	No data available.	**Odor Threshold:**	No data available.
Viscosity:	21.86 mPa @ 20°C	**Autoignition Temperature:**	> 200°C
Flash Point and Method:	311°F (155°C) Tag Closed Cup	**Flammable Limits:**	No data available.
Flammability (solid, gas):	Not applicable.	**Decomposition Temperature:**	No data available.
Explosive Properties:	Not explosive.	**Oxidizing Properties:**	Not an oxidizer.

9.2. Other information

Not applicable.

SECTION 10: Stability and reactivity

10.1. Reactivity	Not classified as dangerously reactive.
10.2. Chemical stability	Stable
10.3. Possibility of hazardous reactions	Will not occur.
10.4. Conditions to avoid	Uncontrolled exposure to high temperatures.
10.5. Incompatible materials	Incompatible with oxidizing materials.
10.6. Hazardous decomposition products	Combustion will produce carbon monoxide, carbon dioxide and oxides of nitrogen.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute Oral LD_{50}:	1892 mg/kg (rat) 2040 mg/ kg (rat) 2600 mg/kg (rat)	[KEY] Moore 2000a Moore, GE (1999) Moore, GE (1999).
Acute Dermal LD_{50}:	> 5000 mg/kg (rat) > 2000 (rabbit)	[KEY] Moore 2001a Moore, GE (1999)
Acute Inhalation LC_{50}:	2 mg/L/4-hours (rat)	[KEY] Moore 2000b
Skin Irritation:	Slightly irritating to skin.	
Eye Irritation:	Moderately irritating to eyes.	
Skin Sensitization:	Not a sensitizer	
Mutagenicity:	In vitro gene mutation in bacteria: Negative. In vitro cytogenicity in mammalian cells: Negative. In vitro gene mutation in mammalian cells: Negative in two separate studies. (DEET CAR 2010)	
Reproductive / Developmental Toxicity:	There were no effects on reproduction in a 2-generation study in rats. (DEET CAR 2010) No teratogenic effects observed in the studies up to maternally toxic doses, embryotoxicity was only expressed as decreased fetal body weights (rats). (DEET CAR 2010)	
Carcinogenicity:	2-year rat and 18-month mouse studies: no treatment related tumors observed at highest dose tested. (DEET CAR 2010)	

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Target Organs:	No data available.
Aspiration Hazard:	Not likely to be an aspiration hazard.
Primary Route(s) of Exposure:	Skin contact and absorption, eye contact, and inhalation. Ingestion is not likely to be a primary route of exposure.
Most important symptoms and effects, both acute and delayed	May be harmful if ingested in sufficient quantities. Contact with skin may cause slight irritation. Moderately irritating to eyes. High gas, vapor, or mist concentrations may be harmful if inhaled. Delayed Effects: None known.
Additive or Synergistic effects:	None known.

SECTION 12: Ecological information

12.1. Toxicity

EC50 (48h) Daphnia = 75 ppm	[KEY] Forbis 1989
LC50 (96h) Oncorhynchus mykiss (rainbow trout) = 97 mg/L	[KEY] Palmer 2002
LC50 Colinus virginianus (Northern bobwhite quail) = 1375 mg/kg	[KEY} Grimes 1989
NOEC (72-hr) Pseudokirchneriella subcapitata (algae) = 7.6 mg/L	[KEY] Desjardins 2002

12.2. Persistence and degradability Readily biodegradable.

12.3. Bioaccumulative potential Bioconcentration is not expected to occur.

12.4. Mobility in soil This material is expected to have high mobility in soil. It absorbs weakly to most soil types.

12.5. Results of PBT and vPvB assessment This substance is not a PBT or vPvB.

12.6. Other adverse effects BCF = 22; Koc = 43.3 (Schaefer 2002; Lezotte 2002)

SECTION 13: Disposal considerations

13.1. Waste treatment methods

US EPA Waste Number:	Non-Hazardous
Waste Classification: (per US regulations)	The waste may be classified as "special" or hazardous per State regulations.
Waste Disposal:	NOTE: Generator is responsible for proper waste characterization. State hazardous waste regulations may differ substantially from federal regulations. Dispose of this material responsibly, and in accordance with standard practice for disposal of potentially hazardous materials as required by applicable international, national, regional, state or local laws, and environmental protection duty of care principles. Do NOT dump into any sewers, on the ground, or into any body of water. For disposal within the EC, the appropriate classification code according to the European Community List of Wastes should be used. Note that disposal regulations may also apply to empty containers and equipment rinsates.

SECTION 14: Transport information

The following information applies to all shipping modes (DOT/IATA/ICAO/IMDG/ADR/RID/ADN), unless otherwise indicated:

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14.1. UN number	Not applicable	**14.2. UN proper shipping name**	Insect repellent other than agricultural DEET
14.3. Transport hazard class(es)	Non-hazardous	**14.4. Packing group**	Not applicable
14.5. Environmental hazards	Not applicable		
14.6. Special precautions for user	Not applicable.		
NA Emergency Guidebook Numbers:	Not applicable	**IMDG EMS:**	Not applicable;
14.7. Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code			Not applicable.

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

Chemical Inventory Lists:	**Status:**		
USA TSCA:	Listed	**EINECS:**	205-149-7
Canada(DSL/NDSL):	DSL	**Japan:**	(3)-1321
Korea:	KE-10492	**Australia:**	Listed
China:	Listed	**Philippines:**	Listed
Taiwan:	Listed	**New Zealand:**	Listed

German Water Hazard Classification: ID Number 4679, hazard class 2 - hazard to waters *(N,N-Diethyl-m-toluamid)*

SARA 313: Not applicable.

Reportable Quantities: Not applicable.

State Regulations: This product is regulated under various pesticide laws (e.g., US FIFRA, EU Biocides Regulation) at international, federal and state levels. Contact DEETRegulatory@Vertellus.com with any questions.

HMIS IV:



NFPA:



15.2. Chemical safety assessment

Not applicable.

SECTION 16: Other information

Key Data Sources:

- **[DEET CAR 2010]** Directive 98/8/EC concerning the placing biocidal products on the market, Inclusion of active substances in Annex I or IA to Directive 98/8/EC, Assessment Report, N,N- diethyl-meta-toluamide (DEET) Product-type 19 (Repellents and attractants), 11 March 2010.
- **[Desjardins 2002]** Desjardins, D, Kendall, T, and Krueger, H (2002) DEET: A 96-Hour Toxicity Test with the Freshwater Alga (*Selenastrum capricornutum*). Wildlife International, Ltd., Project No. 538A-102 (unpublished).
- **[Forbis 1985]** Forbis, AD and Burgess, D (1985) Acute Toxicity of N,N-Diethyl-Meta-Toluamide (DEET) to *Daphnia magna*. Analytical Bio-Chemistry Laboratories, Inc., Report No. 33909 (unpublished).

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SAFETY DATA SHEET

- **[Grimes 1989]** Grimes, J and Jaber, M (1989) An Evaluation of DEET in an Acute Oral Toxicity Study with the Bobwhite. Wildlife International Ltd., Project No. 262-101 (unpublished).
- **[Lezotte 2002]** Lezotte, FJ and Nixon, WB (2002) DEET: An Evaluation of Hydrolysis as a Function of pH. Wildlife International, Ltd., Project No. 538C-103 (unpublished).
- **[Moore 2000a]** Moore, GE (2000) Acute Oral Toxicity with DEET Insect Repellent. Product Safety Labs, Project No. 8392 (unpublished).
- **[Moore 2000b]** Moore, GE (2000) Acute Inhalation Toxicity Test with DEET Insect Repellent. Product Safety Labs, Project No. 8394 (unpublished).
- **[Moore 2000c]** Moore, GE (2000) Primary Skin Irritation Test with DEET Insect Repellent. Product Safety Labs, Project No. 8396 (unpublished).
- **[Moore 2001a]** Moore, GE (2001) Acute Dermal Toxicity Study - Limit Test with N, N-Diethyl-m-toluamide. Product Safety Labs, Project No. 10883 (unpublished).
- **[Moore 2001b]** Moore, GE (2001) Primary Eye Irritation Study in Rabbits with N,N-Diethyl-m-toluamide. Product Safety Labs, Project No. 10885 (unpublished).
- **[Moore 2001c]** Moore, GE (2001) Dermal Sensitization Study in Guinea Pigs (Buehler Method) with N,N-Diethyl-m-toluamide Product Safety Labs, Project No. 10887 (unpublished).
- **[Palmer 2002]** Palmer, SJ, Kendall, TZ and Krueger, HO (2002) A 96-Hour Static Acute Toxicity Test with the Rainbow Trout (*Oncorhynchus mykiss*). Wildlife International, Ltd., Project No. 538A-101 (unpublished) [Ref. No. 100049].
- **[Schaefer 2002]** Schaefer, EC and Siddiqui, AI (2002) Ready Biodegradability by the Carbon Dioxide Evolution Test Method. Wildlife International, Ltd., Project No. 538E-102 (unpublished).

Classification Method: On basis of test data

Legend of Abbreviations:

ACGIH = American Conference on Governmental Industrial Hygienists.
CAS = Chemical Abstracts Service.
CFR = Code of Federal Regulations.
DSL/NDSL = Domestic Substances List/Non-Domestic Substances List.
EC = European Community.
EINECS = European Inventory of Existing Commercial Chemical Substances.
ELINCS = European List of Notified Chemical Substances.
EU = European Union.
GHS = Globally Harmonized System.
LC = Lethal Concentration.
LD = Lethal Dose.
NFPA = National Fire Protection Association.
NIOSH = National Institute of Occupational Safety and Health.
NTP = National Toxicology Program.
OSHA = Occupational Safety and Health Administration
PEL = Permissible Exposure Limit.
RQ = Reportable Quantity.
SARA = Superfund Amendments and Reauthorization Act of 1986.
TLV = Threshold Limit Value.
WHMIS = Workplace Hazardous Materials Information System.

Important Note: Please note that the information contained herein is furnished without warranty of any kind. Users should consider these data only as a supplement to other information gathered by them and must make independent determinations of suitability and completeness of information from all sources to assure proper use and disposal of these materials and the safety and health of employees and customers. Recipients are advised to confirm in advance of need that the information is current, applicable, and suitable to their circumstances. The information contained herein may change without prior notice. THIS SAFETY DATA SHEET SUPERSEDES ALL PREVIOUS EDITIONS.

Revision Date:	13 Feb 2017	**Original Date of Issue:**	No data available.
Issued by:	Regulatory Management Department	**Email:**	SDS@Vertellus.com
Revision Details:	Revised format		

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Safety Data Sheet
Diesel Fuel

SECTION 1 IDENTIFICATION

Product Name: Diesel Fuel
Synonyms: No. 2 Diesel Fuel, Ultra Low Sulfur Diesel, Oil Distillate, Cycle Oil, Fuel Oil Diesels Cycle Oil, Furnace Oil, Dyed Fuel

SDS #: F2

Product Use: Diesel Fuel
Restrictions on Use: Use only as directed

Manufacturer:
Sinclair Oil Company
P.O. Box 30825
Salt Lake City, Utah 84130

Telephone: **General Information:** (801) 524-2777 **Fax:** (801) 524-2740
Contact person: Jeremiah Webster

Emergency Telephone: 800-424-9300 (CHEMTREC) or (703) 527-3887

SDS Date of Preparation: January 23, 2015

SECTION 2: HAZARDS IDENTIFICATION

Classification:

Physical	Health
Flammable Liquid Category 3	Acute Toxicity Category 4 (Oral) Aspiration Toxicity Category 1 Skin Irritation Category 2 Specific Target Organ Toxicity Repeat Exposure Category 1 Carcinogen Category 2

Label Elements:
Danger!



Hazard Phrases:
Flammable liquid and vapor.
Harmful if inhaled.
May be fatal if swallowed and enters airways.
Causes skin irritation.
Suspected of causing cancer.
Causes damage to thymus, liver and bone marrow through prolonged or repeated exposure.

Precautionary Phrases:
Prevention
Obtain special instructions before use.
Do not handle until all safety precautions have been read and understood.
Keep away from heat, sparks, open flames, and hot surfaces. No smoking.
Keep container tightly closed.
Ground and bond container and receiving equipment
Use explosion-proof electrical, ventilating and lighting equipment.
Use only non-sparking tools.
Take precautionary measures against static discharge.
Do not breathe mist, vapors or spray.
Wash thoroughly after handling.
Use only outdoors or in a well-ventilated area.
Wear protective gloves, eye protection.

Response
IF SWALLOWED: Immediately call a POISON CENTER or doctor.
Do NOT induce vomiting.
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water.
If skin irritation occurs: Get medical attention.
Take off contaminated clothing and wash it before reuse.
IF INHALED: Remove person to fresh air and keep comfortable for breathing.
Call a POISON CENTER or doctor.
IF exposed or concerned: Get medical attention.
In case of fire: Use water fog, foam, carbon dioxide, or dry chemical to extinguish.

Storage and Disposal
Store in a well-ventilated place. Keep cool. Keep container tightly closed.
Store locked up.
Dispose of contents and container in accordance with local and national regulations.

SECTION 3 COMPOSITION / INFORMATION ON INGREDIENTS

Chemical name	CAS No.	Concentration
Diesel Fuel	68476-34-6	97-100%
Naphthalene	91-20-3	0-3%

SECTION 4 EMERGENCY and FIRST AID PROCEDURES

Eye Contact: Immediately flush eyes with water for several minutes. Get medical attention if irritation persists.

Skin Contact: Remove contaminated clothing and flush skin with water for several minutes. Wash thoroughly with soap and water. Get medical attention if irritation develops or persists. Launder clothing before reuse. Discard contaminated shoes.

Inhalation: Remove to fresh air. If breathing is difficult have qualified personnel administer oxygen. If breathing has stopped, administer artificial respiration. Get medical attention**.**

Ingestion: Do not induce vomiting. Rinse mouth with water. Never give anything by mouth to an unconsciousness person. If vomiting occurs spontaneously, keep head below hips to prevent aspiration into the lungs. Get immediate medical attention.

Most important symptoms/effects, acute and delayed: May cause eye irritation. Causes skin irritation with redness and drying. Inhalation may cause respiratory irritation and central nervous system effects. Harmful or fatal if swallowed. Aspiration during swallowing or vomiting may cause lung damage. May cause cancer based on animal data.

Indication of immediate medical attention and special treatment, if necessary: Immediate medical attention is required for ingestion.

SECTION 5 FIRE and EXPLOSION HAZARD DATA

Suitable extinguishing media: Use water fog, foam, carbon dioxide, or dry chemical. Do not use a steady stream of water. Product may float on the surface of water and create a floating fire hazard.
Specific hazards arising from the chemical: This product is highly flammable and forms explosive mixtures with air. Vapors are heavier than air and will travel along surfaces to remote ignition sources and flash back. Closed containers may explode if exposed to extreme heat. Combustion may produce carbon oxides and other products of incomplete combustion.
Special protective equipment and precautions for fire-fighters: Firefighters should wear full emergency equipment and a NIOSH approved positive pressure self-contained breathing apparatus. Cool fire exposed container with water. Do not allow run-off from firefighting to enter drains or water courses.

SECTION 6 ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment, and emergency procedures: Wear appropriate protective equipment. Eliminate ignitions sources and ventilate the area with explosion proof equipment. Wash thoroughly after handling.
Environmental hazards: Avoid release into the environment. Report spill as required by local and federal regulations.
Methods and materials for containment and cleaning up: Contain with an inert absorbent and place into a closable container for disposal. Use non-sparking tools and equipment. If spill has not ignited, use water spray to disperse the vapors and protect personnel attempting to stop leak. Prevent entry in storm sewers and waterways. Runoff can cause a fire or explosion hazard in sewers.

SECTION 7 HANDLING and STORAGE

Precautions for safe handling: Avoid contact with eyes, skin and clothing. Avoid breathing vapors. Wash thoroughly after handling. Use only with adequate ventilation. Wash thoroughly with soap and water after handling. Keep containers closed when not in use. Keep product away from heat, sparks, flames and all other sources of ignition. Do not permit smoking in use or storage areas. Use with non-sparking tools and explosion proof equipment. Electrically bond and ground containers for transfer

Do not cut, drill, grind or weld on or near containers, even empty containers. Empty containers retain product residues can be hazardous. Follow all SDS precautions when handling empty containers.

Conditions for safe storage, including any incompatibilities: S Store in accordance with regulations for the storage of flammable liquids. Store in a dry, well ventilated area away from heat, direct sunlight and all sources of ignition. Store away from oxidizers and other incompatible materials. Protect containers from physical damage.

SECTION 8 EXPOSURE CONTROLS and PERSONAL PROTECTION

Exposure Guidelines:

INGREDIENTS	EXPOSURE LIMITS
Diesel Fuel	100 mg/m^3 TWA ACGIH TLV (inhalable fraction and vapor)
Naphthalene	10 ppm TWA OSHA PEL
	10 ppm, skin TWA ACGIH TLV

Appropriate engineering controls: Use with local exhaust ventilation to maintain exposures below the occupational exposure limits. Use explosion proof equipment where required

Respiratory protection: If exposures are exceeded, use a NIOSH approved organic vapor respirator appropriate for the form and concentration of the contaminants should be used. Selection of respiratory protection depends on the contaminant type, form and concentration. Select in accordance with OSHA 1910.134 and good Industrial Hygiene practice.
Skin protection: Impervious gloves such as nitrile rubber recommended to prevent skin contact.
Eye protection: Wear chemical safety goggles to avoid eye contact.
Other: Impervious coveralls, apron and boots is required to prevent skin contact and contamination of personal clothing. A safety shower and eye wash should be available in the immediate work area.

SECTION 9 PHYSICAL and CHEMICAL PROPERTIES

Appearance (physical state, color, etc.): Colored or clear liquid
Odor: Aromatic hydrocarbon odor.

Odor threshold: Not available	**pH:** Not applicable
Melting point/Pourpoint: Not available	**Boiling Point:** 320-700° F (160-371-1°C)
Flash point: 126-152°F (51.6-66.6°C)	**Evaporation rate:** Not available
Flammability (solid, gas): Not applicable	
Flammable limits: LEL: 0.6%	**UEL:** 7.5%
Vapor pressure: <1 mmHg @ 60°F	**Vapor density:** ~3
Relative density: 0.82-0.88	**Solubility:** Insoluble in water
Partition coefficient: n-ctanol/water: Not available	**Auto-ignition temperature:** >490-545°F (>254.4-285°C)
Decomposition temperature: Not available	**Viscosity:** Not applicable

SECTION 10 STABILITY and REACTIVITY

Reactivity: This product is not expected to be reactive.
Chemical stability: The product is stable.
Possibility of hazardous reactions: None known.
Conditions to avoid: Keep away from heat and all sources of ignition.
Incompatible materials: Avoid oxidizing agents, acids, alkalies and halogens.
Hazardous decomposition products: Thermal decomposition may yield carbon oxides and other products of incomplete combustion.

SECTION 11 TOXICOLOGICAL INFORMATION

Health Hazards:

Inhalation: Vapors may cause respiratory irritation and central nervous system effect including headache, dizziness, headaches, giddiness, euphoria, vertigo, blurred vision, nausea, numbness, drowsiness, anesthesia, and coma.

Skin Contact: Skin contact may cause irritation, redness and defatting of the skin.

Eye Contact: Eye contact may cause mild irritation with redness, tearing and pain.

Ingestion: Swallowing may cause gastrointestinal irritation, nausea, vomiting, diarrhea, vertigo, drowsiness, mental confusion, staggering gait, slurred speech, convulsions, unconsciousness and death due to circulatory failure. Aspiration during swallowing or vomiting may cause lung damage.

Chronic Effects of Overexposure: Prolonged occupational overexposure may cause dermatitis. Reports have associated repeated and prolonged overexposure to petroleum distillates with adverse liver, kidney and bone marrow effects and with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the product may be harmful or fatal.

Mutagenicity: Diesel fuel was negative in the AMES test and in an in vitro mouse lymphoma assay.

Reproductive Toxicity: In a developmental study with diesel fuel, rats were administered 100 and 400 ppm for 6 hours a day from day 6-15 of gestation. No adverse effects were seen on reproduction or developmental paramental or in soft tissues or skeletons. NOEAL: 400 ppm

Carcinogenicity: Naphthalene is listed by IARC as “Possibly Carcinogenic to Humans”, Group 2B, as “Reasonably Anticipated to be a Human Carcinogen” and as a “Confirmed Animal Carcinogen with Unknown Relevance to Humans”, A3 by ACGIH.

Acute Toxicity Values: Acute Toxicity Estimate: Oral 14492 mg/kg
Diesel Fuel: Oral rat LD50 17900 mg/kg, Inhalation rat LC50 4.1 mg/L/4 hr, Dermal rabbit LD50 >4300 mg/kg
Naphthalene: Oral rat LD50 533 mg/kg, Inhalation rat LC0 0.4 mg/L (highest attainable concentration), Dermal rat LC50 >2500 mg/kg

SECTION 12: ECOLOGICAL INFORMATION

Ecotoxicity:
Diesel Fuel: 96 hr LL50 Oncorhynchus mykiss 65 mg/kg, 48 hr EL50 > 1000, 72 hr EL50 Pseudokirchnerella subcapitata 10 mg/L
Naphthalene: 96 hr LC50 Pimephales promelas 6.08 mg/L, 48 hr EC50 daphnia magna 2.16 mg/L

Persistence and degradability: Diesel fuel is inherently biodegradable.
Bioaccumulative potential: The bioaccumulation potentials of the major components of diesel fuel range from low to high. Some higher molecular weight components may be taken up by fish and domestic animals and bioconcentrated if they persist in environment.
Mobility in soil: No data available.
Other adverse effects: None known.

SECTION 13: DISPOSAL INFORMATION

Waste Disposal Method: Dispose in accordance with all local, state and federal regulations.

SECTION 14: TRANSPORTATION INFORMATION

	UN Number	Proper shipping name	Hazard Class	Packing Group	Environmental Hazard
DOT	NA1993	Diesel Fuel	3	PG III	No
TDG	UN1202	Diesel Fuel	3	PG III	No
IMDG	UN1202	Diesel Fuel	3	PG III	No
IATA	UN1202	Diesel Fuel	3	PG III	No

Transport in bulk (according to Annex II of MARPOL 73/78 and the IBC Code): Not applicable.

Special precautions: None known.

SECTION 15: REGULATORY INFORMATION

Safety, health, and environmental regulations specific for the product in question.

CERCLA Hazardous Substances (Section 103)/RQ: This product has a Reportable Quantity (RQ) of 3,333 lbs. (based on the RQ for Naphthalene of 100 lbs). Releases above the RQ must be reported to the National Response Center. Many states have more stringent release reporting requirements. Report spills required under federal, state and local regulations.

EPA SARA 311 Hazard Classification: Acute Health, Chronic Health, Fire Hazard

SARA 313: This product contains the following chemicals subject to Annual Release Reporting Requirements Under SARA Title III, Section 313 (40 CFR 372):

Naphthalene 91-20-3 0-3%

CALIFORNIA PROPOSITION 65: This product contains the following chemicals known to the State of California to cause cancer or reproductive toxicity.

Naphthalene 91-20-3 0-3% Cancer

WHMIS CLASSIFICATION: Class B, Division 3 (Combustible Liquid), Class D, Division 2A (Very Toxic Material Causing Other Toxic Effects)

This product has been classified in accordance with the hazard criteria in the CPR and the SDS contains all the information required by the CPR.

Australia AICS: All of the components are listed on the Australian Inventory of Chemical Substances.

Canada DSL: All of the components are listed on the Canadian Domestic Substances List.

China: All the components are listed on Inventory of Existing Chemical Substances in China.

European EINECS: All of the ingredients are listed on the EINECS inventory.

Korea: All the components are listed on the Korean Existing Chemical List.

New Zealand: All the components are listed on the New Zealand Inventory of Chemicals.

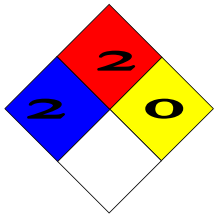
Philippines: All the components are listed on the Philippine Inventory of Chemical and Chemical Substances inventory.

US EPA Toxic Substances Control Act: All of the components of this product are listed on the TSCA inventory.

SECTION 16: OTHER INFORMATION

SDS Revision History: Converted to GHS format – all Sections revised
Date of current revision: January 23, 2015
Date of previous revision: January 2007

National Fire Protection Association (U.S.A)



Health: 2*
Flammability : 2
Instability: 0
Specific Hazard:

Disclaimer: This product material safety data sheet provides health and safety information. The product should be used in applications consistent with this product literature. For any other uses, exposures should be evaluated so that appropriate handling practices and training programs can be established to ensure safe workplace operations.

This material safety data sheet is provided in good faith and meets the requirements of the hazardous communication provisions of SARA TITLE III and 29 CFR 1910.1200(g) of the OSHA regulations. The above information is based on review of available information Sinclair believes is reliable and is supplied for informational purposes only. Sinclair does not guarantee its completeness or accuracy. Since conditions of use are outside the control of Sinclair, Sinclair disclaims all warranties, express or implied, and any liability for damage or injury which results from the use of the above data. Nothing herein is intended to permit infringement of valid patents and licenses.

SAFETY DATA SHEET

Version 6.1
Revision Date 01/15/2020
Print Date 04/04/2020

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name : Ethylbenzene

Product Number : 03079
Brand : Sigma-Aldrich
Index-No. : 601-023-00-4
CAS-No. : 100-41-4

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich Inc.
3050 Spruce Street
ST. LOUIS MO 63103
UNITED STATES

Telephone : +1 314 771-5765
Fax : +1 800 325-5052

1.4 Emergency telephone number

Emergency Phone # : +1-703-527-3887

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

Flammable liquids (Category 2), H225
Acute toxicity, Inhalation (Category 4), H332
Carcinogenicity (Category 2), H351
Specific target organ toxicity - repeated exposure (Category 2), H373
Aspiration hazard (Category 1), H304
Short-term (acute) aquatic hazard (Category 2), H401

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word Danger

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Hazard statement(s)

H225	Highly flammable liquid and vapour.
H304	May be fatal if swallowed and enters airways.
H332	Harmful if inhaled.
H351	Suspected of causing cancer.
H373	May cause damage to organs through prolonged or repeated exposure.
H401	Toxic to aquatic life.

Precautionary statement(s)

P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P210	Keep away from heat/sparks/open flames/hot surfaces. No smoking.
P233	Keep container tightly closed.
P240	Ground/bond container and receiving equipment.
P241	Use explosion-proof electrical/ ventilating/ lighting equipment.
P242	Use only non-sparking tools.
P243	Take precautionary measures against static discharge.
P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P310	IF SWALLOWED: Immediately call a POISON CENTER/doctor.
P303 + P361 + P353	IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
P304 + P340 + P312	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER/doctor if you feel unwell.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P331	Do NOT induce vomiting.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
P403 + P235	Store in a well-ventilated place. Keep cool.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

SECTION 3: Composition/information on ingredients

3.1 Substances

Formula	:	C_8H_{10}
Molecular weight	:	106.17 g/mol
CAS-No.	:	100-41-4
EC-No.	:	202-849-4
Index-No.	:	601-023-00-4

Component	Classification	Concentration
Ethylbenzene		
	Flam. Liq. 2; Acute Tox. 4;	<= 100 %

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	Carc. 2; STOT RE 2; Asp. Tox. 1; Aquatic Acute 2; H225, H332, H351, H373, H304, H401	

For the full text of the H-Statements mentioned in this Section, see Section 16.

SECTION 4: First aid measures

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
Carbon oxides

5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information
Use water spray to cool unopened containers.

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SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.
For personal protection see section 8.

6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up

Contain spillage, soak up with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and transfer to a container for disposal according to local / national regulations (see section 13).

6.4 Reference to other sections

For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.
Use explosion-proof equipment.Keep away from sources of ignition - No smoking.Take measures to prevent the build up of electrostatic charge.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

hygroscopic
Storage class (TRGS 510): 3: Flammable liquids

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Ethylbenzene	100-41-4	TWA	100 ppm 435 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
	Remarks	The value in mg/m3 is approximate.		

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		PEL	5 ppm 22 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		STEL	30 ppm 130 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Ethylbenzene	100-41-4	Sum of mandelic acid and phenyl glyoxylic acid	0.15g/g creatinine	Urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift (As soon as possible after exposure ceases)			

8.2 Exposure controls

Appropriate engineering controls
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection
Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: Fluorinated rubber
Minimum layer thickness: 0.7 mm
Break through time: 480 min
Material tested:Vitoject® (KCL 890 / Aldrich Z677698, Size M)

Splash contact
Material: Fluorinated rubber
Minimum layer thickness: 0.7 mm
Break through time: 480 min
Material tested:Vitoject® (KCL 890 / Aldrich Z677698, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our

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customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection
Complete suit protecting against chemicals, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: liquid Colour: colourless
b)	Odour	No data available
c)	Odour Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	Melting point/range: -95 °C (-139 °F) - lit.
f)	Initial boiling point and boiling range	136 °C 277 °F - lit.
g)	Flash point	15.0 °C (59.0 °F) - closed cup
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	Upper explosion limit: 6.7 %(V) Lower explosion limit: 1 %(V)
k)	Vapour pressure	13.3 hPa at 20.0 °C (68.0 °F)
l)	Vapour density	No data available
m)	Relative density	0.867 g/mL at 25 °C (77 °F)
n)	Water solubility	0.2 g/l at 25 °C (77 °F) - slightly soluble
o)	Partition coefficient: n-octanol/water	log Pow: 3.6 at 20 °C (68 °F)
p)	Auto-ignition temperature	432.0 °C (809.6 °F)
q)	Decomposition	No data available

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	temperature	
r)	Viscosity	0.773 mm2/s at 20 °C (68 °F) -
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety information

Surface tension	71.2 mN/m at 23 °C (73 °F)

SECTION 10: Stability and reactivity

10.1 Reactivity
No data available

10.2 Chemical stability
Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions
Vapours may form explosive mixture with air.

10.4 Conditions to avoid
Heat, flames and sparks.

10.5 Incompatible materials
Strong oxidizing agents

10.6 Hazardous decomposition products
Hazardous decomposition products formed under fire conditions. - Carbon oxides
Other decomposition products - No data available
In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - Rat - male and female - 3,500 mg/kg
Inhalation: No data available
LD50 Dermal - Rabbit - 15,433 mg/kg
No data available

Skin corrosion/irritation
Skin - Rabbit
Result: Moderate skin irritation - 24 h

Serious eye damage/eye irritation
Eyes - Rabbit
Result: Mild eye irritation

Respiratory or skin sensitisation
No data available

Germ cell mutagenicity
Hamster

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ovary
Result: negative

Mouse - male and female
Result: negative

Carcinogenicity

IARC: 2B - Group 2B: Possibly carcinogenic to humans (Ethylbenzene)

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is on OSHA's list of regulated carcinogens.

Reproductive toxicity
No data available

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
May be fatal if swallowed and enters airways.

Additional Information

Repeated dose toxicity - Rat - male and female - No observed adverse effect level - 75 mg/kg
RTECS: DA0700000

Central nervous system depression, Nausea, Headache, Vomiting, Ataxia., Tremors

Stomach - Irregularities - Based on Human Evidence
Stomach - Irregularities - Based on Human Evidence

SECTION 12: Ecological information

12.1 Toxicity

Toxicity to fish	LC50 - Oncorhynchus mykiss (rainbow trout) - 4.2 mg/l - 96 h
Toxicity to daphnia and other aquatic invertebrates	static test EC50 - Daphnia magna (Water flea) - 1.8 - 2.4 mg/l - 48 h
Toxicity to algae	static test EC50 - Skeletonema costatum (marine diatom) - 4.9 mg/l - 72 h

12.2 Persistence and degradability

Biodegradability: aerobic - Exposure time 28 d
Result: 70 - 80 % - Readily biodegradable.

12.3 Bioaccumulative potential

Due to the distribution coefficient n-octanol/water, accumulation in organisms is not expected.

12.4 Mobility in soil

No data available

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12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.
Harmful to aquatic life with long lasting effects.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product
Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging
Dispose of as unused product.

SECTION 14: Transport information

DOT (US)
UN number: 1175 Class: 3 Packing group: II
Proper shipping name: Ethylbenzene
Reportable Quantity (RQ): 1000 lbs
Poison Inhalation Hazard: No

IMDG
UN number: 1175 Class: 3 Packing group: II EMS-No: F-E, S-D
Proper shipping name: ETHYLBENZENE

IATA
UN number: 1175 Class: 3 Packing group: II
Proper shipping name: Ethylbenzene

SECTION 15: Regulatory information

SARA 302 Components
No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Ethylbenzene	100-41-4	2007-07-01

SARA 311/312 Hazards
Fire Hazard, Chronic Health Hazard

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Massachusetts Right To Know Components
No components are subject to the Massachusetts Right to Know Act.

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Ethylbenzene	100-41-4	2007-07-01

SECTION 16: Other information

Further information

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

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Version: 6.1 Revision Date: 01/15/2020 Print Date: 04/04/2020

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SAFETY DATA SHEET

SDS ID NO.: 0130MAR019
Revision Date 03/19/2018

1. IDENTIFICATION

Product Name: Marathon Petroleum Gasoline with Ethanol - All Grades

Synonym: Gasoline; Gasoline with Ethanol; Regular Unleaded Gasoline With Ethanol; Regular Unleaded Gasoline With Alcohol; Mid Grade Unleaded Gasoline With Ethanol; Mid Grade Unleaded Gasoline with Alcohol; Premium Unleaded Gasoline With Ethanol; Premium Unleaded Gasoline With Alcohol; 0128MAR019; 0129MAR019
Product Code: 0130MAR019
Chemical Family: Complex Hydrocarbon Substance

Recommended Use: Fuel.
Restrictions on Use: All others.

Manufacturer, Importer, or Responsible Party Name and Address:
MARATHON PETROLEUM COMPANY LP
539 South Main Street
Findlay, OH 45840

SDS information (M-F, 8-5 PM EST): 1-419-421-3070

Emergency Telephone (24/7): CHEMTREC: 1-800-424-9300 CCN#: 13740

2. HAZARD IDENTIFICATION

Classification

OSHA Regulatory Status
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids	Category 1
Skin corrosion/irritation	Category 2
Serious eye damage/eye irritation	Category 2A
Germ cell mutagenicity	Category 1B
Carcinogenicity	Category 1A
Reproductive toxicity	Category 2
Specific target organ toxicity (single exposure)	Category 3
Specific target organ toxicity (repeated exposure)	Category 1
Aspiration toxicity	Category 1
Acute aquatic toxicity	Category 2
Chronic aquatic toxicity	Category 2

Hazards Not Otherwise Classified (HNOC)
Static accumulating flammable liquid

Label elements

EMERGENCY OVERVIEW

Danger

EXTREMELY FLAMMABLE LIQUID AND VAPOR
May accumulate electrostatic charge and ignite or explode
May be fatal if swallowed and enters airways
Causes skin irritation
Causes serious eye irritation
May cause respiratory irritation
May cause drowsiness or dizziness
May cause genetic defects
May cause cancer
Suspected of damaging fertility or the unborn child
Causes damage to organs (blood, blood-forming organs, immune system) through prolonged or repeated exposure
Toxic to aquatic life with long lasting effects



Appearance Clear yellow liquid **Physical State** Liquid **Odor** Hydrocarbon

Precautionary Statements - Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools.
Take precautionary measures against static discharge
Do not eat, drink or smoke when using this product
Do not breathe mist/vapors/spray
Use only outdoors or in a well-ventilated area
Wear protective gloves/protective clothing/eye protection/face protection
Wash hands and any possibly exposed skin thoroughly after handling
Avoid release to the environment

Precautionary Statements - Response
IF exposed, concerned or you feel unwell: Get medical attention
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
If eye irritation persists: Get medical attention
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
If skin irritation occurs: Get medical attention
Wash contaminated clothing before reuse
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Call a POISON CENTER or doctor if you feel unwell
IF SWALLOWED: Immediately call a POISON CENTER or doctor
Do NOT induce vomiting
In case of fire: Use water spray, fog or regular foam for extinction
Collect spillage

Precautionary Statements - Storage
Store in a well-ventilated place. Keep container tightly closed
Keep cool
Store locked up

Precautionary Statements - Disposal
Dispose of contents/container at an approved waste disposal plant

3. COMPOSITION/INFORMATION ON INGREDIENTS

Gasoline is a complex combination of hydrocarbons consisting of paraffins, cycloparaffins, aromatic and olefinic hydrocarbons having molecular chains ranging in length from four to ten carbons. May contain small amounts of dye and other additives (>0.02%) which are not considered hazardous at the concentrations used.

Composition Information:

Name	CAS Number	% Concentration
Gasoline	86290-81-5	100
Heptane (mixed isomers)	142-82-5	2.5-26
Butane (mixed isomers)	106-97-8	0.5-19
Pentane (mixed isomers)	78-78-4	6.5-19
Hexane Isomers (other than n-Hexane)	107-83-5	2-12
Ethyl Alcohol	64-17-5	5.7-10.6
Toluene	108-88-3	3-9.5
Xylene (mixed isomers)	1330-20-7	3.5-9.5
Benzene	71-43-2	0.1-4.9
n-Hexane	110-54-3	0.1-4.5
Cumene	98-82-8	0-4
1,2,4 Trimethylbenzene	95-63-6	1-4
Ethylbenzene	100-41-4	0.5-2.5
Cyclohexane	110-82-7	0-1.5
Octane	111-65-9	0-1.5
1,2,3-Trimethylbenzene	526-73-8	0-1
Naphthalene	91-20-3	0.1-0.5

Benzene concentration is percent by volume. All other concentrations are percent by weight unless material is a gas. Gas concentrations are in percent by volume.

4. FIRST AID MEASURES

First Aid Measures

General Advice: In case of accident or if you feel unwell, seek medical advice immediately (show directions for use or safety data sheet if possible).

Inhalation: Remove to fresh air. If not breathing, institute rescue breathing. If breathing is difficult, ensure airway is clear, give oxygen and continue to monitor. If heart has stopped, immediately begin cardiopulmonary resuscitation (CPR). Keep affected person warm and at rest. If symptoms occur get medical attention.

Skin Contact: Immediately wash exposed skin with plenty of soap and water while removing contaminated clothing and shoes. May be absorbed through the skin in harmful amounts. Get medical attention if irritation persists. Any injection injury from high pressure equipment should be evaluated immediately by a physician as potentially serious (See NOTES TO PHYSICIAN).

Place contaminated clothing in closed container until cleaned or discarded. If clothing is to be laundered, inform the person performing the operation of contaminant's hazardous properties. Destroy contaminated, non-chemical resistant footwear.

Eye Contact: Flush immediately with large amounts of water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Gently remove contacts while flushing. Get medical attention if irritation persists.

Ingestion: Do not induce vomiting because of danger of aspirating liquid into lungs, causing serious

damage and chemical pneumonitis. If spontaneous vomiting occurs, keep head below hips, or if patient is lying down, turn body and head to side to prevent aspiration and monitor for breathing difficulty. Never give anything by mouth to an unconscious person. Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

Most important signs and symptoms, both short-term and delayed with overexposure

Adverse Effects: Irritating to eyes, respiratory system and skin. Symptoms may include redness, itching, and inflammation. May cause nausea, vomiting, diarrhea, and signs of nervous system depression: headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue. Aspiration hazard. May cause coughing, chest pains, shortness of breath, pulmonary edema and/or chemical pneumonitis. Prolonged or repeated exposure may cause adverse effects on blood, blood-forming organs, and immune system. Repeated or prolonged skin contact may cause drying, reddening, itching and cracking.

Indication of any immediate medical attention and special treatment needed

Notes To Physician: INHALATION: This material (or a component) sensitizes the myocardium to the effects of sympathomimetic amines. Epinephrine and other sympathomimetic drugs may initiate cardiac arrhythmias in individuals exposed to this material. Administration of sympathomimetic drugs should be avoided.

SKIN: Leaks or accidents involving high-pressure equipment may inject a stream of material through the skin and initially produce an injury that may not appear serious. Only a small puncture wound may appear on the skin surface but, without proper treatment and depending on the nature, original pressure, volume, and location of the injected material, can compromise blood supply to an affected body part. Prompt surgical debridement of the wound may be necessary to prevent irreversible loss of function and/or the affected body part. High pressure injection injuries may be SERIOUS SURGICAL EMERGENCIES.

INGESTION: This material represents a significant aspiration and chemical pneumonitis hazard. Induction of emesis is not recommended.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media
For small fires, Class B fire extinguishing media such as CO2, dry chemical, foam (AFFF/ATC) or water spray can be used. For large fires, water spray, fog or foam (AFFF/ATC) can be used. Firefighting should be attempted only by those who are adequately trained and equipped with proper protective equipment.

Unsuitable extinguishing media
Do not use straight water streams to avoid spreading fire.

Specific hazards arising from the chemical
This product has been determined to be an extremely flammable liquid per the OSHA Hazard Communication Standard and should be handled accordingly. May accumulate electrostatic charge and ignite or explode. Vapors may travel along the ground or be moved by ventilation and ignited by many sources such as pilot lights, sparks, electric motors, static discharge, or other ignition sources at locations distant from material handling. Flashback can occur along vapor trail. For additional fire related information, see NFPA 30 or the Emergency Response Guidebook 128.

Hazardous combustion products
Smoke, carbon monoxide, and other products of incomplete combustion.

Explosion data
Sensitivity to Mechanical Impact No.
Sensitivity to Static Discharge Yes.

Special protective equipment and precautions for firefighters
Firefighters should wear full protective clothing and positive-pressure self-contained breathing apparatus (SCBA) with a full face-piece, as appropriate. Avoid using straight water streams. Water may be ineffective in extinguishing low flash point fires, but

can be used to cool exposed surfaces. Avoid excessive water spray application. Water spray and foam (AFFF/ATC) must be applied carefully to avoid frothing and from as far a distance as possible. Keep run-off water out of sewers and water sources.

Additional firefighting tactics
FIRES INVOLVING TANKS OR CAR/TRAILER LOADS: Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Cool containers with flooding quantities of water until well after the fire is out. Do not direct water at source of leak or safety devices; icing may occur. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles: if this is impossible, withdraw from area and let fire burn.

EVACUATION: Consider initial downwind evacuation for at least 1000 feet. If tank, rail car or tank truck is involved in a fire, ISOLATE for 5280 feet (1 mile) in all directions; also, consider initial evacuation of 5280 feet (1 mile) in all directions.

NFPA	Health 1	Flammability 3	Instability 0	Special Hazard -

6. ACCIDENTAL RELEASE MEASURES

Personal precautions: Keep public away. Isolate and evacuate area. Shut off source if safe to do so. Eliminate all ignition sources.

Protective equipment: Use personal protection measures as recommended in Section 8.

Emergency procedures: Advise authorities and National Response Center (800-424-8802) if the product has entered a water course or sewer. Notify local health and pollution control agencies, if appropriate.

Environmental precautions: Avoid release to the environment. Avoid subsoil penetration. Ethanol in gasoline phase seperates in contact with water. Monitor downstream for dissolved ethanol or other appropriate indicators.

Methods and materials for containment: Contain liquid with sand or soil. Prevent spilled material from entering storm drains, sewers, and open waterways.

Methods and materials for cleaning up: Use suitable absorbent materials such as vermiculite, sand, or clay to clean up residual liquids. Recover and return free product to proper containers. When recovering free liquids ensure all equipment is grounded and bonded. Use only non-sparking tools.

7. HANDLING AND STORAGE

Safe Handling Precautions: NEVER SIPHON THIS PRODUCT BY MOUTH. Use appropriate grounding and bonding practices. Static accumulating flammable liquid. Bonding and grounding may be insufficient to eliminate the hazard from static electricity. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. Vapors may travel along the ground or be moved by ventilation. Flashback may occur along vapor trails. No smoking. Use only non-sparking tools. Avoid contact with skin, eyes and clothing. Avoid breathing fumes, gas, or vapors. Use only with adequate ventilation. Avoid repeated and prolonged skin contact. Use personal protection measures as recommended in Section 8. Exercise good personal hygiene including removal of soiled clothing and prompt washing with soap and water. Do not cut, drill, grind or weld on empty containers since explosive residues may remain. Refer to applicable EPA, OSHA, NFPA and consistent state and local requirements.

Hydrocarbons are basically non-conductors of electricity and can become electrostatically charged during mixing, filtering, pumping at high flow rates or loading and transfer operations. If this charge reaches a sufficiently high level, sparks can form that may ignite the vapors of flammable liquids. Sudden release of hot organic chemical vapors or mists from process equipment operating under elevated temperature and pressure, or sudden ingress of air into vacuum equipment may result in ignition of vapors or mists without the presence of obvious ignition sources. Nozzle spouts must be kept in contact with the containers or tank during the entire filling operation.

Portable containers should never be filled while in or on a motor vehicle or marine craft. Containers should be placed on the ground. Static electric discharge can ignite fuel vapors when filling non-grounded containers or vehicles on trailers. The nozzle spout must be kept in contact with the container before and during the entire filling operation. Use only approved containers.

A buildup of static electricity can occur upon re-entry into a vehicle during fueling especially in cold or dry climate conditions. The charge is generated by the action of dissimilar fabrics (i.e., clothing and upholstery) rubbing across each other as a person enters/exits the vehicle. A flash fire can result from this discharge if sufficient flammable vapors are present. Therefore, do not get back in your vehicle while refueling.

Cellular phones and other electronic devices may have the potential to emit electrical charges (sparks). Sparks in potentially explosive atmospheres (including fueling areas such as gas stations) could cause an explosion if sufficient flammable vapors are present. Therefore, turn off cellular phones and other electronic devices when working in potentially explosive atmospheres or keep devices inside your vehicle during refueling.

High-pressure injection of any material through the skin is a serious medical emergency even though the small entrance wound at the injection site may not initially appear serious. These injection injuries can occur from high-pressure equipment such as paint spray or grease or guns, fuel injectors, or pinhole leaks in hoses or hydraulic lines and should all be considered serious. High pressure injection injuries may be SERIOUS SURGICAL EMERGENCIES (See First Aid Section 4).

Storage Conditions: Store in properly closed containers that are appropriately labeled and in a cool, well-ventilated area. Do not store near an open flame, heat or other sources of ignition.

Incompatible Materials Strong oxidizing agents.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Name	ACGIH TLV	OSHA PELS:	OSHA - Vacated PELs	NIOSH IDLH
Gasoline 86290-81-5	300 ppm TWA 500 ppm STEL	-	300 ppm TWA 900 mg/m³ TWA 500 ppm STEL 1500 mg/m³ STEL	-
Heptane (mixed isomers) 142-82-5	400 ppm TWA 500 ppm STEL	TWA: 500 ppm TWA: 2000 mg/m³	400 ppm TWA 1600 mg/m³ TWA 500 ppm STEL 2000 mg/m³ STEL	750 ppm
Butane (mixed isomers) 106-97-8	1000 ppm STEL	-	800 ppm TWA 1900 mg/m³ TWA	-
Pentane (mixed isomers) 78-78-4	1000 ppm TWA	-	-	-
Hexane Isomers (other than n-Hexane) 107-83-5	500 ppm TWA 1000 ppm STEL	-	500 ppm TWA 1800 mg/m³ TWA 1000 ppm STEL 3600 mg/m³ STEL	-
Ethyl Alcohol 64-17-5	1000 ppm STEL	TWA: 1000 ppm TWA: 1900 mg/m³	1000 ppm TWA 1900 mg/m³ TWA	3300 ppm
Toluene 108-88-3	20 ppm TWA	TWA: 200 ppm Ceiling: 300 ppm	100 ppm TWA 375 mg/m³ TWA 150 ppm STEL 560 mg/m³ STEL	500 ppm
Xylene (mixed isomers) 1330-20-7	100 ppm TWA 150 ppm STEL	TWA: 100 ppm TWA: 435 mg/m³	100 ppm TWA 435 mg/m³ TWA 150 ppm STEL 655 mg/m³ STEL	900 ppm
Benzene	0.5 ppm TWA	TWA: 10 ppm (applies to	25 ppm Ceiling	500 ppm

71-43-2	2.5 ppm STEL Skin - potential significant contribution to overall exposure by the cutaneous route	industry segments exempt from the benzene standard) TWA: 1 ppm STEL: 5 ppm (see 29 CFR 1910.1028)	1 ppm TWA 5 ppm STEL	
n-Hexane 110-54-3	50 ppm TWA Skin - potential significant contribution to overall exposure by the cutaneous route	TWA: 500 ppm TWA: 1800 mg/m³	50 ppm TWA 180 mg/m³ TWA	1100 ppm
Cumene 98-82-8	50 ppm TWA	TWA: 50 ppm TWA: 245 mg/m³ Skin	50 ppm TWA 245 mg/m³ TWA Limit applies to skin	900 ppm
1,2,4 Trimethylbenzene 95-63-6	25 ppm TWA	-	25 ppm TWA 125 mg/m³ TWA	-
Ethylbenzene 100-41-4	20 ppm TWA	TWA: 100 ppm TWA: 435 mg/m³	100 ppm TWA 435 mg/m³ TWA 125 ppm STEL 545 mg/m³ STEL	800 ppm
Cyclohexane 110-82-7	100 ppm TWA	TWA: 300 ppm TWA: 1050 mg/m³	300 ppm TWA 1050 mg/m³ TWA	1300 ppm
Octane 111-65-9	300 ppm TWA	TWA: 500 ppm TWA: 2350 mg/m³	300 ppm TWA 1450 mg/m³ TWA 375 ppm STEL 1800 mg/m³ STEL	1000 ppm
1,2,3-Trimethylbenzene 526-73-8	25 ppm TWA	-	25 ppm TWA 125 mg/m³ TWA	-
Naphthalene 91-20-3	10 ppm TWA Skin - potential significant contribution to overall exposure by the cutaneous route	TWA: 10 ppm TWA: 50 mg/m³	10 ppm TWA 50 mg/m³ TWA 15 ppm STEL 75 mg/m³ STEL	250 ppm

Notes: The manufacturer has voluntarily elected to provide exposure limits contained in OSHA's 1989 air contaminants standard in its SDSs, even though certain of those exposure limits were vacated in 1992.

Engineering measures: Local or general exhaust required in an enclosed area or when there is inadequate ventilation. Use mechanical ventilation equipment that is explosion-proof.

Personal protective equipment

Eye protection: Use goggles or face-shield if the potential for splashing exists.

Skin and body protection: Use nitrile rubber, Viton® or PVA gloves for repeated or prolonged skin exposure. Glove suitability is based on workplace conditions and usage. Contact the glove manufacturer for specific advice on glove selection and breakthrough times.

Respiratory protection: Use a NIOSH approved organic vapor chemical cartridge or supplied air respirators when there is the potential for airborne exposures to exceed permissible exposure limits or if excessive vapors are generated. Observe respirator assigned protection factors (APFs) criteria cited in federal OSHA 29 CFR 1910.134. Self-contained breathing apparatus should be used for fire fighting.

Hygiene measures: Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes and clothing.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical State Liquid
Appearance Clear yellow liquid

Color	Yellow
Odor	Hydrocarbon
Odor Threshold	No data available.

Property	**Values (Method)**
Melting Point / Freezing Point	No data available.
Initial Boiling Point / Boiling Range	24-210 °C / 75-410 °F (ASTM D86)
Flash Point	-43 °C / -45 °F
Evaporation Rate	No data available.
Flammability (solid, gas)	Not applicable.
Flammability Limit in Air (%):	
Upper Flammability Limit:	7.6
Lower Flammability Limit:	1.4
Explosion limits:	No data available.
Vapor Pressure	6.5-15 psi (ASTM D4814)
Vapor Density	3-4
Specific Gravity / Relative Density	0.70-0.76
Water Solubility	No data available.
Solubility in other solvents	No data available.
Partition Coefficient	No data available.
Decomposition temperature	No data available.
pH:	Not applicable
Autoignition Temperature	280 °C / 536 °F
Kinematic Viscosity	No data available.
Dynamic Viscosity	No data available.
Explosive Properties	No data available.
VOC Content (%)	100%
Density	No data available.
Bulk Density	Not applicable.

10. STABILITY AND REACTIVITY

Reactivity	The product is non-reactive under normal conditions.
Chemical stability	The material is stable at 70°F (21°C), 760 mmHg pressure.
Possibility of hazardous reactions	None under normal processing.
Hazardous polymerization	Will not occur.
Conditions to avoid	Excessive heat, sources of ignition, open flame.
Incompatible Materials	Strong oxidizing agents.
Hazardous decomposition products	None known under normal conditions of use.

11. TOXICOLOGICAL INFORMATION

Potential short-term adverse effects from overexposures

Inhalation	May cause irritation of respiratory tract. May cause drowsiness or dizziness. Breathing high concentrations of this material in a confined space or by intentional abuse can cause irregular heartbeats which can cause death.
Eye contact	Eye irritation may result from contact with the liquid or exposure to vapor.
Skin contact	Causes skin irritation. Effects may become more serious with repeated or prolonged contact. May be absorbed through the skin in harmful amounts.
Ingestion	May be fatal if swallowed or vomited and enters airways. May cause irritation of the mouth,

throat and gastrointestinal tract.

Acute toxicological data

Name	Oral LD50	Dermal LD50	Inhalation LC50
Gasoline 86290-81-5	14000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 5.2 mg/L (Rat) 4 h
Heptane (mixed isomers) 142-82-5	-	3000 mg/kg (Rabbit)	103 g/m³ (Rat) 4 h
Butane (mixed isomers) 106-97-8	-	-	658 mg/L (Rat) 4 h
Pentane (mixed isomers) 78-78-4	-	-	450 mg/L (Mouse) 2 h
Hexane Isomers (other than n-Hexane) 107-83-5	> 5000 mg/kg (Rat)	-	-
Ethyl Alcohol 64-17-5	> 5000 mg/kg (Rat)	-	124.7 mg/L (Rat) 4 h
Toluene 108-88-3	> 2000 mg/kg (Rat)	8390 mg/kg (Rabbit)	12.5 mg/L (Rat) 4 h
Xylene (mixed isomers) 1330-20-7	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 5.04 mg/L (Rat) 4 h
Benzene 71-43-2	> 2000 mg/kg (Rat)	> 5000 mg/kg (Rabbit)	> 20 mg/l (Rat) 4 h
n-Hexane 110-54-3	15000 mg/kg (Rat)	3000 mg/kg (Rabbit)	48000 ppm (Rat) 4 h
Cumene 98-82-8	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 20 mg/L (Rat) 6 h
1,2,4 Trimethylbenzene 95-63-6	3280 mg/kg (Rat)	> 3160 mg/kg (Rabbit)	18,000 mg/m³ (Rat) 4 h
Ethylbenzene 100-41-4	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	17.2 mg/L (Rat) 4 h
Cyclohexane 110-82-7	> 5000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	13.9 mg/L (Rat) 4 h
Octane 111-65-9	-	-	118 g/m³ (Rat) 4 h
1,2,3-Trimethylbenzene 526-73-8	-	-	-
Naphthalene 91-20-3	490 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 340 mg/m³ (Rat) 1 h

Delayed and immediate effects as well as chronic effects from short and long-term exposure

NAPHTHAS: In a large epidemiological study on over 15,000 employees at several petroleum refineries and amongst residents located near these refineries, no increased risk of kidney cancer was observed in association with gasoline exposures (a similar material). In a similar study, no increased risk of kidney cancer was observed among petroleum refinery workers, but there was a slight trend in the incidence of kidney cancers among service station employees, especially after a 30-year latency period. Altered mental state, drowsiness, peripheral motor neuropathy, irreversible brain damage (so-called Petrol Sniffer's Encephalopathy), delirium, seizures, and sudden death have been reported from repeated overexposure to some hydrocarbon solvents, naphthas, and gasoline.

ISOPARAFFINS: Studies in laboratory animals have shown that long-term exposure to similar materials (isoparaffins) can cause kidney damage and kidney cancer in male laboratory rats. However, in-depth research indicates that these findings are unique to the male rat, and that these effects are not relevant to humans.

C9 AROMATIC HYDROCARBONS: A developmental inhalation study was conducted in laboratory mice. Increased implantation losses, reduced fetal weights, delayed ossification and an increased incidence of cleft palate were observed at the highest exposure level (1,500 ppm). This exposure level was extremely toxic to pregnant female mice (44% mortality). Reduced fetal body weights were also observed at 500 ppm. A multi-generation reproduction inhalation study was conducted in laboratory rats.

Reductions in pup weights, pup weight gain, litter size, and pup survival were observed at 1,500 ppm, an exposure level at which significant maternal toxicity was observed. Reduced pup weight gain was also observed at 500 ppm.

BUTANES: Studies in laboratory animals indicate exposure to extremely high levels of butanes (1-10 or higher vol.% in air) may cause cardiac arrhythmias (irregular heartbeats) which may be serious or fatal.

PENTANES: Studies of pentane isomers in laboratory animals indicate exposure to extremely high levels (roughly 10 vol.%) may induce cardiac arrhythmias (irregular heartbeats) which may be serious or fatal.

ETHANOL: Repeated ingestion of ethanol can result in alcohol abuse, causing behavioral changes, memory loss, impaired judgement, decreased appetite, irregular heartbeats, and decreased fertility. Prolonged and repeated ingestion of ethanol has also been associated with cancers of the mouth, pharynx, esophagus and liver. Ethanol ingestion by pregnant women can cause miscarriage, low birth weight, premature birth and fetal alcohol syndrome. In males, acute and chronic alcohol ingestion may affect gonadal hormone levels. It may also affect the liver, kidney, brain, blood and cardiovascular system.

TOLUENE: Case studies of persons abusing toluene suggest isolated incidences of adverse effects on the fetus including birth defects. Abuse of toluene at high concentrations (e.g., glue sniffing and solvent abuse) has been associated with adverse effects on the liver, kidney and nervous system, and can cause CNS depression, cardiac arrhythmias, and death. Studies of workers indicate longterm exposure may be related to impaired color vision and hearing. Some studies of workers suggest longterm exposure may be related to neurobehavioral and cognitive changes. Some of these effects have been observed in laboratory animals following repeated exposure to high levels of toluene. Several studies of workers suggest longterm exposure may be related to small increases in spontaneous abortions and changes in some gonadotropic hormones. However, the weight of evidence does not indicate toluene is a reproductive hazard to humans. Studies in laboratory animals indicate some changes in reproductive organs following high levels of exposure, but no significant effects on mating performance or reproduction were observed. Case studies of persons abusing toluene suggest isolated incidences of adverse effects on the fetus including birth defects. Findings in laboratory animals have been largely negative. Positive findings include small increases in minor skeletal and visceral malformations and developmental delays following very high levels of maternal exposure. Studies of workers indicate long-term exposure may be related to effects on the liver, kidney and blood, but these appear to be limited to changes in serum enzymes and decreased leukocyte counts. Adverse effects on the liver, kidney, thymus and nervous system were observed in animal studies following very high levels of exposure. The relevance of these findings to humans is not clear at this time.

XYLENES, ALL ISOMERS: Overexposure to xylene may cause upper respiratory tract irritation, headache, cyanosis, blood serum changes, nervous system damage and narcosis. Effects may be increased by the use of alcoholic beverages. Evidence of liver and kidney impairment were reported in workers recovering from a gross overexposure. Effects from Prolonged or Repeated Exposure: Impaired neurological function was reported in workers exposed to solvents including xylene. Studies in laboratory animals have shown evidence of impaired hearing following high levels of exposure. Studies in laboratory animals suggest some changes in reproductive organs following high levels of exposure but no significant effects on reproduction were observed. Studies in laboratory animals indicate skeletal and visceral malformations, developmental delays, and increased fetal resorptions following extremely high levels of maternal exposure with evidence of maternal toxicity. The relevance of these observations to humans is not clear at this time. Adverse effects on the liver, kidney, bone marrow (changes in blood cell parameters) were observed in laboratory animals following high levels of exposure. The relevance of these observations to humans is not clear at this time.

BENZENE: Studies of workers exposed to benzene show clear evidence that overexposure can cause cancer and other diseases of the blood forming organs including Acute

Myelogenous Leukemia (AML), and Aplastic Anemia (AA), an often fatal disease. Some studies suggest overexposure to benzene may also be associated with Myelodysplastic Syndrome (MDS). Findings from a case control study of workers exposed to benzene was reported during the 2009 Benzene Symposium in Munich included an increase in Acute Myeloid Leukemias and Non-Hodgkins Lymphoid Neoplasms (NHLN) of the subtype follicular lymphoma (FL) in some occupational categories. Some studies of workers exposed to benzene have shown an association with increased rates of chromosome aberrations in circulating lymphocytes. One study of women workers exposed to benzene suggested a weak association with irregular menstruation. However, other studies of workers exposed to benzene have not demonstrated clear evidence of an effect on fertility or reproductive outcome in humans. Benzene can cross the placenta and affect the developing fetus. Cases of AA have been reported in the offspring of persons severely overexposed to benzene. Studies in laboratory animals indicate that prolonged, repeated exposure to high levels of benzene vapor can cause bone marrow suppression and cancer in multiple organ systems. Studies in laboratory animals show evidence of adverse effects on male reproductive organs following high levels of exposure but no significant effects on reproduction have been observed. Embryotoxicity has been reported in studies of laboratory animals but effects were limited to reduced fetal weight and minor skeletal variations. Benzene has been classified as a proven human carcinogen by OSHA and a Group 1 (Carcinogenic to Humans) material by IARC. The current proposed IARC classification for benzene is summarized as follows: Sufficient evidence for Acute Myeloid Leukemia; limited evidence for Acute Lymphatic Leukemia, Chronic Lymphatic Leukemia, Non-Hodgkin Lymphoma, and Multiple Myeloma.

N-HEXANE: Long-term or repeated exposure to n-hexane can cause peripheral nerve damage. Initial symptoms are numbness of the fingers and toes. Also, motor weakness can occur in the digits, but may also involve muscles of the arms, thighs and forearms. The onset of these symptoms may be delayed for several months to a year after the beginning of exposure. Testicular atrophy and partial to full loss of the germ cell line were observed in sub-chronic high-dose inhalation studies of laboratory rodents. These effects appeared irreversible. Rodent reproduction studies have shown evidence of reduced fetal weight but no frank malformations.

CUMENE: Overexposure to cumene may cause upper respiratory tract irritation and CNS depression. Studies in laboratory animals indicate evidence of respiratory tract hyperplasia, and adverse effects on the liver, kidney and adrenal glands following high level exposure. The relevance of these findings to humans is not clear at this time. Findings from lifetime laboratory rodent inhalation studies were as follows: In F344/N rats: an increased incidence of renal carcinomas and adenomas, respiratory epithelial adenomas, and interstitial cell adenomas of the testes. In B6C3F1 mice: an increased incidence of carcinomas and adenomas of the bronchi and lung, liver neoplasms, hemangiosarcomas of the spleen, and adenomas of the thyroid.

1,2,4-TRIMETHYLBENZENE: The following information pertains to a mixture of C9 aromatic hydrocarbons, over 40% of which was composed of 1,2,4-trimethylbenzene. A developmental inhalation study was conducted in laboratory mice. Increased implantation losses, reduced fetal weights, delayed ossification and an increased incidence of cleft palate were observed at the highest exposure level (1,500 ppm). This exposure level was extremely toxic to pregnant female mice (44% mortality). Reduced fetal body weights were also observed at 500 ppm. A multi-generation reproduction inhalation study was conducted in laboratory rats. Reductions in pup weights, pup weight gain, litter size, and pup survival were observed at 1,500 ppm, an exposure level at which significant maternal toxicity was observed. Reduced pup weight gain was also observed at 500 ppm. Embryotoxicity has been reported in studies of laboratory animals. Adverse effects included increased implantation losses, reduced fetal weights, delayed ossification and an increased incidence of cleft palate.<n><n>

ETHYLBENZENE: Findings from a 2-year inhalation study in rodents conducted by NTP were as follows: Effects were observed only at the highest exposure level (750 ppm). At this level the incidence of renal tumors was elevated in male rats (tubular carcinomas) and female rats (tubular adenomas). The incidence of tumors was also elevated in male mice

(alveolar and bronchiolar carcinomas) and female mice (hepatocellular carcinomas). IARC has classified ethyl benzene as "possibly carcinogenic to humans" (Group 2B). Studies in laboratory animals indicate some evidence of post-implantation deaths following high levels of maternal exposure. The relevance of these findings to humans is not clear at this time. Studies in laboratory animals indicate limited evidence of renal malformations, resorptions, and developmental delays following high levels of maternal exposure with evidence of maternal toxicity. The relevance of these findings to humans is not clear at this time. Studies in laboratory animals have demonstrated evidence of ototoxicity (hearing loss) following exposure levels as low as 300 ppm for 5 days. Studies in laboratory animals indicate some evidence of adverse effects on the liver, kidney, thyroid, and pituitary gland.

NAPHTHALENE: Severe jaundice, neurotoxicity (kernicterus) and fatalities have been reported in young children and infants as a result of hemolytic anemia from overexposure to naphthalene. Persons with glucose 6-phosphate dehydrogenase (G6PD) deficiency are more prone to the hemolytic effects of naphthalene. Adverse effects on the kidney have been reported in persons overexposed to naphthalene but these effects are believed to be a consequence of hemolytic anemia, and not a direct effect. Hemolytic anemia has been observed in laboratory animals exposed to naphthalene. Laboratory rodents exposed to naphthalene vapor for 2 years (lifetime studies) developed non-neoplastic and neoplastic tumors and inflammatory lesions of the nasal and respiratory tract. Cataracts and other adverse effects on the eye have been observed in laboratory animals exposed to high levels of naphthalene. Findings from a large number of bacterial and mammalian cell mutation assays have been negative. A few studies have shown chromosomal effects (elevated levels of Sister Chromatid Exchange or chromosomal aberrations) in vitro. Naphthalene has been classified as Possibly Carcinogenic to Humans (2B) by IARC, based on findings from studies in laboratory animals.

CARBON MONOXIDE: is a chemical asphyxiant with no warning properties (such as odor). At 400-500 ppm for 1 hour headache and dyspnea may occur. If activity is increased, symptoms of overexposure may include nausea, irritability, increased respiration, tinnitus, sweating, chest pain, confusion, impaired judgement, dizziness, weakness, drowsiness, ataxia, irregular heart beat, cyanosis and pallor. Levels in excess of 1000 ppm can result in collapse, loss of conciousness, respiratory failure and death. Extremely high concentrations (12,800 ppm) can cause immediate unconsciousness and death in 1-3 minutes. Repeated anoxia can lead to central nervous system damage and peripheral neuropathy, with loss of sensation in the fingers, amnesia, and mental deterioration and possible congestive heart failure. Damage may also occur to the fetus, lung, liver, kidney, spleen, cardiovascular system and other organs.

WHOLLY-VAPORIZED UNLEADED GASOLINE: Lifetime exposure to wholly vaporized unleaded gasoline produced an increased incidence of liver tumors in female mice exposed to the highest exposure concentration (2056 ppm) and α-2 urinary globulin-mediated kidney tumors in male rats. No exposure-related tumors were observed in male mice or female rats. The male-specific rat kidney tumors are not considered relevant to human health. Mice receiving lifetime repeated skin application of various petroleum naphthas exhibited an irritation-dependent increased incidence of skin tumors. Additional studies suggest that these tumors occur through a mechanism that may not be relevant to human health. Epidemiological data from over 18,000 petroleum marketing and distribution workers showed no increased risk of leukemia, multiple myeloma, or kidney cancer resulting from gasoline exposure. Unleaded gasoline has been identified as possibly carcinogenic to humans (2B) by the International Agency for Research on Cancer (IARC).

COMBUSTION ENGINE EXHAUST: Chronic inhalation studies of gasoline engine exhaust in mice, rats and hamsters did not produce any carcinogenic effects. Condensates/extracts of gasoline engine exhaust produced an increase in tumors compared to controls when testing by skin painting, subcutaneous injection, intratracheal instillation or implantation into the lungs. Gasoline exhaust has been classified as possibly carcinogenic to humans (2B) by the International Agency for Research on Cancer (IARC).

Adverse effects related to the physical, chemical and toxicological characteristics

Signs and Symptoms Irritating to eyes, respiratory system and skin. Symptoms may include redness, itching, and inflammation. May cause nausea, vomiting, diarrhea, and signs of nervous system depression: headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue. Aspiration hazard. May cause coughing, chest pains, shortness of breath, pulmonary edema and/or chemical pneumonitis. Prolonged or repeated exposure may cause damage to organs. Repeated or prolonged skin contact may cause drying, reddening, itching and cracking.

Sensitization Not expected to be a skin or respiratory sensitizer.

Mutagenic effects May cause genetic defects.

Carcinogenicity May cause cancer.

Cancer designations are listed in the table below

Name	ACGIH (Class)	IARC (Class)	NTP	OSHA
Gasoline 86290-81-5	Confirmed animal carcinogen (A3)	Possible human carcinogen (2B)	Not Listed	Not Listed
Heptane (mixed isomers) 142-82-5	Not Listed	Not Listed	Not Listed	Not Listed
Butane (mixed isomers) 106-97-8	Not Listed	Not Listed	Not Listed	Not Listed
Pentane (mixed isomers) 78-78-4	Not Listed	Not Listed	Not Listed	Not Listed
Hexane Isomers (other than n-Hexane) 107-83-5	Not Listed	Not Listed	Not Listed	Not Listed
Ethyl Alcohol 64-17-5	Confirmed animal carcinogen (A3)	Alcoholic Beverages Carcinogenic to humans (1)	Alcoholic Beverage Consumption Known to be human carcinogen	Not Listed
Toluene 108-88-3	Not Classifiable (A4)	Not Classifiable (3)	Not Listed	Not Listed
Xylene (mixed isomers) 1330-20-7	Not classifiable (A4)	Not classifiable (3)	Not Listed	Not Listed
Benzene 71-43-2	Confirmed human carcinogen (A1)	Carcinogenic to humans (1)	Known to be human carcinogen	Known carcinogen
n-Hexane 110-54-3	Not Listed	Not Listed	Not Listed	Not Listed
Cumene 98-82-8	Not listed	Possible human carcinogen (2B)	Reasonably anticipated to be a human carcinogen	Not listed
1,2,4 Trimethylbenzene 95-63-6	Not Listed	Not Listed	Not Listed	Not Listed
Ethylbenzene 100-41-4	Confirmed animal carcinogen (A3)	Possible human carcinogen (2B)	Not Listed	Not Listed
Cyclohexane 110-82-7	Not Listed	Not Listed	Not Listed	Not Listed
Octane 111-65-9	Not Listed	Not Listed	Not Listed	Not Listed
1,2,3-Trimethylbenzene 526-73-8	Not Listed	Not Listed	Not Listed	Not Listed
Naphthalene 91-20-3	Confirmed animal carcinogen (A3)	Possible human carcinogen (2B)	Reasonably anticipated to be a human carcinogen	Not Listed

Reproductive toxicity Suspected of damaging fertility or the unborn child.

Specific Target Organ Toxicity (STOT) - single exposure Respiratory system. Central nervous system.

Specific Target Organ Toxicity (STOT) - repeated exposure Blood. Blood-forming organs. Immune system.

Aspiration hazard May be fatal if swallowed or vomited and enters airways.

12. ECOLOGICAL INFORMATION

Ecotoxicity This product should be considered toxic to aquatic organisms, with the potential to cause long lasting adverse effects in the aquatic environment.

Name	Algae/aquatic plants	Fish	Toxicity to Microorganisms	Crustacea
Gasoline 86290-81-5	72-hr EC50 = 56 mg/l Algae	96-hr LC50 = 11 mg/l Rainbow trout (static)	-	48-hr LC50 = 7.6 mg/l Daphnia magna
Heptane (mixed isomers) 142-82-5	-	96-hr LC50 = 375 mg/L Tilapia	-	-
Butane (mixed isomers) 106-97-8	-	-	-	-
Pentane (mixed isomers) 78-78-4	-	96-hr LC50 = 3.1 mg/L Rainbow trout	-	48-hr EC50 = >1 - <10 mg/L Daphnia magna
Hexane Isomers (other than n-Hexane) 107-83-5	-	-	-	-
Ethyl Alcohol 64-17-5	-	96-hr LC50 >1,000 mg/l Rainbow Trout (static) 96-hr LC50 >100 mg/l Fathead minnow (static)	-	48-hr LC50 >1,000 mg/l Daphnia magna
Toluene 108-88-3	72-hr EC50 = 12.5 mg/l Algae	96-hr LC50 <= 10 mg/l Rainbow trout	-	48-hr EC50 = 5.46-9.83 mg/l Daphnia magna 48-hr EC50 = 11.5 mg/l Daphnia magna (Static)
Xylene (mixed isomers) 1330-20-7	72-hr EC50 = 11 mg/l Algae	96-hr LC50 = 8 mg/l Rainbow trout	-	48-hr LC50 = 3.82 mg/l Daphnia magna
Benzene 71-43-2	72-hr EC50 = 29 mg/l Algae	96-hr LC50 = 5.3 mg/l Rainbow trout (flow-through)	-	48-hr EC50 = 8.76-15.6 mg/l Daphnia magna (Static)
n-Hexane 110-54-3	-	96-hr LC50 = 2.5 mg/l Fathead minnow	-	-
Cumene 98-82-8	72-hr EC50 = 2.6 mg/l Algae	96-hr LC50 = 6.04-6.61 mg/l Fathead minnow (Flow-through) 96-hr LC50 = 2.7 mg/l Rainbow trout (semi-static)	-	48-hr EC50 = 7.9-14.1 mg/l Daphnia magna (static)
1,2,4 Trimethylbenzene 95-63-6	-	96-hr LC50 = 7.19-8.28 mg/l Fathead minnow (flow-through)	-	48-hr EC50 = 6.14 mg/L Daphnia magna
Ethylbenzene 100-41-4	72-hr EC50 = 1.7-7.6 mg/l Algae	96-hr LC50 = 4 mg/L Rainbow trout	-	48-hr EC50 = 1-4 mg/L Daphnia magna
Cyclohexane 110-82-7	72-hr EC50 = 500 mg/l Algae	96-hr LC50 = 3.96-5.18 mg/l Fathead minnow	-	48-hr EC50 = 1.7-3.5 mg/L Bay shrimp
Octane 111-65-9	-	-	-	48-hr LC50 = 0.38 mg/l Daphnia magna
1,2,3-Trimethylbenzene 526-73-8	-	96-hr LC50 = 7.72 mg/l Fathead Minnow (flow-through)	-	-
Naphthalene 91-20-3	-	96-hr LC50 = 0.91-2.82 mg/l Rainbow trout (static) 96-hr LC50 = 1.99 mg/l Fathead minnow (static)	-	48-hr LC50 = 1.6 mg/l Daphnia magna

Persistence and degradability Expected to be inherently biodegradable. The presence of ethanol in this product may impede the biodegradation of benzene, toluene, ethylbenzene and xylene in groundwater, resulting in elongated plumes of these constituents.

Bioaccumulation Has the potential to bioaccumulate.

Mobility in soil May partition into air, soil and water.

Other adverse effects No information available.

13. DISPOSAL CONSIDERATIONS

Description of Waste Residues
This material may be a flammable liquid waste.

Safe Handling of Wastes
Handle in accordance with applicable local, state, and federal regulations. Use personal protection measures as required. Use appropriate grounding and bonding practices. Use only non-sparking tools. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. No smoking.

Disposal of Wastes / Methods of Disposal
The user is responsible for determining if any discarded material is a hazardous waste (40 CFR 262.11). Dispose of in accordance with federal, state and local regulations.

Methods of Contaminated Packaging Disposal
Empty containers should be completely drained and then discarded or recycled, if possible. Do not cut, drill, grind or weld on empty containers since explosive residues may be present. Dispose of in accordance with federal, state and local regulations.

14. TRANSPORT INFORMATION

DOT (49 CFR 172.101):

UN Proper Shipping Name:	Gasoline
UN/Identification No:	UN 1203
Class:	3
Packing Group:	II

TDG (Canada):

UN Proper Shipping Name:	Gasoline
UN/Identification No:	UN 1203
Transport Hazard Class(es):	3
Packing Group:	II

15. REGULATORY INFORMATION

US Federal Regulatory Information:

US TSCA Chemical Inventory Section 8(b): This product and/or its components are listed on the TSCA Chemical Inventory.

EPA Superfund Amendment & Reauthorization Act (SARA):

SARA Section 302: This product does not contain any component(s) included on EPA's Extremely Hazardous Substance (EHS) List.

Name	CERCLA/SARA - Section 302 Extremely Hazardous Substances and TPQs
Gasoline	NA
Heptane (mixed isomers)	NA
Butane (mixed isomers)	NA
Pentane (mixed isomers)	NA
Hexane Isomers (other than n-Hexane)	NA
Ethyl Alcohol	NA
Toluene	NA
Xylene (mixed isomers)	NA
Benzene	NA
n-Hexane	NA
Cumene	NA

1,2,4 Trimethylbenzene	NA
Ethylbenzene	NA
Cyclohexane	NA
Octane	NA
1,2,3-Trimethylbenzene	NA
Naphthalene	NA

SARA Section 304: This product may contain component(s) identified either as an EHS or a CERCLA Hazardous substance which in case of a spill or release may be subject to SARA reporting requirements:

Name	Hazardous Substances RQs
Gasoline	NA
Heptane (mixed isomers)	NA
Butane (mixed isomers)	NA
Pentane (mixed isomers)	NA
Hexane Isomers (other than n-Hexane)	NA
Ethyl Alcohol	NA
Toluene	1000 lb final RQ 454 kg final RQ
Xylene (mixed isomers)	100
Benzene	10
n-Hexane	5000
Cumene	5000
1,2,4 Trimethylbenzene	NA
Ethylbenzene	1000
Cyclohexane	1000
Octane	NA
1,2,3-Trimethylbenzene	NA
Naphthalene	100 lb final RQ 45.4 kg final RQ

SARA Section 311/312: The following EPA hazard categories apply to this product:

Acute Health Hazard
Chronic Health Hazard
Fire Hazard

SARA Section 313: This product may contain component(s), which if in exceedance of the de minimus threshold, may be subject to the reporting requirements of SARA Title III Section 313 Toxic Release Reporting (Form R).

Name	CERCLA/SARA 313 Emission reporting:
Gasoline	None
Heptane (mixed isomers)	None
Butane (mixed isomers)	None
Pentane (mixed isomers)	None
Hexane Isomers (other than n-Hexane)	None
Ethyl Alcohol	None
Toluene	1.0 % de minimis concentration
Xylene (mixed isomers)	1.0 % de minimis concentration
Benzene	0.1 % de minimis concentration
n-Hexane	1.0 % de minimis concentration
Cumene	1.0 % de minimis concentration
1,2,4 Trimethylbenzene	1.0 % de minimis concentration
Ethylbenzene	0.1 % de minimis concentration
Cyclohexane	1.0 % de minimis concentration
Octane	None
1,2,3-Trimethylbenzene	None
Naphthalene	0.1 % de minimis concentration

State and Community Right-To-Know Regulations:
The following component(s) of this material are identified on the regulatory lists below:

Gasoline

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 0957
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Not Listed
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Carcinogen; Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	SN 0957 TPQ: 10000 lb (Under N.J.A.C. 7:1G, environmental hazardous substances in mixtures such as gasoline or new and used petroleum oil may be reported under these categories)
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Heptane (mixed isomers)

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1339
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Butane (mixed isomers)

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 0273
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - fourth degree
New Jersey - Environmental Hazardous Substances List:	SN 0273 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 -	Not Listed

List of Hazardous Substances:	
Pentane (mixed isomers)	
Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1064
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Not Listed
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - fourth degree
New Jersey - Environmental Hazardous Substances List:	SN 1064 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed
Hexane Isomers (other than n-Hexane)	
Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1285
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Not Listed
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed
Ethyl Alcohol	
Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Carcinogen, initial date 4/29/11 (in alcoholic beverages) Carcinogen, initial date 7/1/88 (when associated with alcohol abuse) Developmental toxicity, initial date 10/1/87 (in alcoholic beverages)
New Jersey Right-To-Know:	SN 0844
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Teratogen
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Carcinogen; Flammable - third degree; Mutagen; Teratogen
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 -	Not Listed

List of Hazardous Substances:

Toluene

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Developmental toxicity, initial date 1/1/91 Female reproductive toxicity, initial date 8/7/09
New Jersey Right-To-Know:	SN 1866
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic (skin); Flammable (skin)
Michigan Critical Materials Register List:	100 lb Annual usage threshold
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree; Teratogen
New Jersey - Environmental Hazardous Substances List:	SN 1866 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1000 lb RQ (air); 1 lb RQ (land/water)

Xylene (mixed isomers)

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 2014
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic (skin); Flammable (skin)
Michigan Critical Materials Register List:	100 lb Annual usage threshold all isomers
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	SN 2014 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1000 lb RQ (air); 1 lb RQ (land/water)

Benzene

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Carcinogen, initial date 2/27/87 Developmental toxicity, initial date 12/26/97 Male reproductive toxicity, initial date 12/26/97
New Jersey Right-To-Know:	SN 0197
Pennsylvania Right-To-Know:	Environmental hazard; Special hazardous substance
Massachusetts Right-To Know:	Carcinogen; Extraordinarily hazardous
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic (skin); Flammable (skin); Carcinogen (skin)
Michigan Critical Materials Register List:	100 lb Annual usage threshold
Massachusetts Extraordinarily Hazardous Substances:	Carcinogen; Extraordinarily hazardous
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Present
New Jersey - Special Hazardous Substances:	Carcinogen; Flammable - third degree; Mutagen
New Jersey - Environmental Hazardous Substances List:	SN 0197 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	10 lb RQ (air); 1 lb RQ (land/water)

n-Hexane

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1340
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	SN 1340 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1 lb RQ (air); 1 lb RQ (land/water)

Cumene

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Carcinogen, initial date 4/6/10
New Jersey Right-To-Know:	SN 0542
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic (skin); Flammable (skin)
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	SN 0542 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	5000 lb RQ (air); 1 lb RQ (land/water)

1,2,4 Trimethylbenzene

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1929
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Not Listed
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Ethylbenzene

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Carcinogen, initial date 6/11/04
New Jersey Right-To-Know:	SN 0851

Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Carcinogen; flammable - Third degree
New Jersey - Environmental Hazardous Substances List:	SN 0851 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1000 lb RQ (air); 1 lb RQ (land/water)

Cyclohexane

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 0565
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	SN 0565 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1000 lb RQ (air); 1 lb RQ (land/water)

Octane

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1434
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

1,2,3-Trimethylbenzene

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1929
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic

Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Not Listed
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Naphthalene

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Carcinogen, initial date 4/19/02
New Jersey Right-To-Know:	SN 1322 SN 3758
Pennsylvania Right-To-Know:	Environmental hazard Present (particulate)
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Carcinogen
New Jersey - Environmental Hazardous Substances List:	SN 1322 TPQ: 500 lb (Reportable at the de minimis quantity of >0.1%)
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	100 lb RQ (air); 1 lb RQ (land/water)

Canada DSL/NDSL Inventory: This product and/or its components are listed either on the Domestic Substances List (DSL) or are exempt.

Canadian Regulatory Information: This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the SDS contains all of the information required by those regulations.

Name	Canada - WHMIS: Classifications of Substances:	Canada - WHMIS: Ingredient Disclosure:
Gasoline	B2,D2A,D2B	0.1%
Heptane (mixed isomers)	B2,D2B	1%
Butane (mixed isomers)	A,B1	1%
Pentane (mixed isomers)	B2	1%
Hexane Isomers (other than n-Hexane)	B2	1%
Ethyl Alcohol	B2,D2B	0.1%
Toluene	B2,D2A,D2B	0.1%
Xylene (mixed isomers)	B2,D2A,D2B	m-, o-isomers 1.0%; p-isomer 0.1%
Benzene	B2,D2A,D2B	0.1%
n-Hexane	B2,D2A,D2B	1%
Cumene	B2,D2A	0.1%
1,2,4 Trimethylbenzene	B3,D2B	1%
Ethylbenzene	B2,D2A,D2B	0.1%
Cyclohexane	B2,D2B	1%
Octane	B2,D2B	1%
1,2,3-Trimethylbenzene	B3	1%
Naphthalene	B4,D2A	0.1%



Note: Not applicable.

16. OTHER INFORMATION

Prepared By Toxicology and Product Safety

Revision Notes

Revision Date 03/19/2018
Previous Publish Date 11/06/2017
Revised Sections The following sections (§) have been updated:
2. HAZARD IDENTIFICATION
3. COMPOSITION/INFORMATION ON INGREDIENTS
4. FIRST AID MEASURES
11. TOXICOLOGICAL INFORMATION

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information is intended as guidance for safe handling, use, processing, storage, transportation, accidental release, clean-up and disposal and is not considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

SAFETY DATA SHEET

SDS ID NO.: 0127MAR019
Revision Date: 06/01/2016

1. IDENTIFICATION

Product Name: Marathon Petroleum Gasoline - All Grades

Synonym: Gasoline; Regular Unleaded Gasoline; Conventional Regular Unleaded Gasoline; Mid Grade Unleaded Gasoline; Conventional Mid Grade Unleaded Gasoline; Premium Unleaded Gasoline; Conventional Premium Unleaded Gasoline; Sub-Octane Gasoline; Regular RBOB; Super RBOB; Premium RBOB; RBOB; Reformulated Blend Stock For Oxygenated Blending; 84 Octane Gasoline; CBOB; Premium CBOB; Conventional Blend Stock for Oxygenate Blending; Recreational Gasoline; Recreational Gasoline; Recreational Unleaded Gasoline; 89 Recreational Gasoline; Brand 89 Recreational Gasoline; 7.0 Max RVP 89 Recreational Gasoline; BR 7.0 Max RVP 89 Recreational Gasoline; 90 Recreational Gasoline; 90 Marina Gasoline; Brand 91 Recreational Gasoline; 91 Recreational Gasoline; 91 Marina Gasoline; 90 Octane Midgrade Gasoline with No Ethanol; 0125MAR019; 0126MAR019; 0134MAR019; 0313MAR019; 0314MAR019

Chemical Family: Complex Hydrocarbon Substance

Recommended Use: Fuel.
Restrictions on Use: All others.

Manufacturer, Importer, or Responsible Party Name and Address:

MARATHON PETROLEUM COMPANY LP
539 South Main Street
Findlay, OH 45840

SDS information: 1-419-421-3070

Emergency Telephone: 1-877-627-5463

2. HAZARD IDENTIFICATION

Classification

OSHA Regulatory Status
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids	Category 1
Skin corrosion/irritation	Category 2
Germ cell mutagenicity	Category 1B
Carcinogenicity	Category 1B
Reproductive toxicity	Category 2
Specific target organ toxicity (single exposure)	Category 3
Aspiration toxicity	Category 1
Acute aquatic toxicity	Category 2
Chronic aquatic toxicity	Category 2

Hazards Not Otherwise Classified (HNOC)

Static accumulating flammable liquid

Label elements

EMERGENCY OVERVIEW

Danger

EXTREMELY FLAMMABLE LIQUID AND VAPOR
May accumulate electrostatic charge and ignite or explode
May be fatal if swallowed and enters airways
Causes skin irritation
May cause respiratory irritation
May cause drowsiness or dizziness
May cause genetic defects
May cause cancer
Suspected of damaging fertility or the unborn child
Toxic to aquatic life with long lasting effects



Appearance Clear yellow liquid **Physical State** Liquid **Odor** Hydrocarbon

Precautionary Statements - Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools.
Take precautionary measures against static discharge
Avoid breathing mist/vapors/spray
Use only outdoors or in a well-ventilated area
Wear protective gloves/protective clothing/eye protection/face protection
Wash hands and any possibly exposed skin thoroughly after handling
Avoid release to the environment

Precautionary Statements - Response
IF exposed or concerned: Get medical attention
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
If skin irritation occurs: Get medical attention
Wash contaminated clothing before reuse
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Call a POISON CENTER or doctor if you feel unwell
IF SWALLOWED: Immediately call a POISON CENTER or doctor
Do NOT induce vomiting
In case of fire: Use water spray, fog or regular foam for extinction
Collect spillage

Precautionary Statements - Storage
Store in a well-ventilated place. Keep container tightly closed
Keep cool
Store locked up

Precautionary Statements - Disposal
Dispose of contents/container at an approved waste disposal plant

3. COMPOSITION/INFORMATION ON INGREDIENTS

Gasoline is a complex combination of hydrocarbons consisting of paraffins, cycloparaffins, aromatic and olefinic hydrocarbons having molecular chains ranging in length from four to ten carbons. May contain small amounts of dye and other additives (>0.02%) which are not considered hazardous at the concentrations used.

Composition Information:

Name	CAS Number	% Concentration
Gasoline	86290-81-5	100
Heptane (mixed isomers)	142-82-5	2.5-26
Pentane (mixed isomers)	78-78-4	6.5-19
Butane (mixed isomers)	106-97-8	0.5-14
Hexane Isomers (other than n-Hexane)	107-83-5	2-12
Toluene	108-88-3	3-9.5
Xylene (mixed isomers)	1330-20-7	3.5-9.5
n-Hexane	110-54-3	0.1-4.5
Cumene	98-82-8	0-4
1,2,4 Trimethylbenzene	95-63-6	1-4
Ethylbenzene	100-41-4	0.5-2.5
Benzene	71-43-2	0.1-1.5
Cyclohexane	110-82-7	0-1.5
Octane	111-65-9	0-1.5
1,2,3-trimethylbenzene	526-73-8	0-1
Naphthalene	91-20-3	0.1-0.5

All concentrations are percent by weight unless material is a gas. Gas concentrations are in percent by volume.

4. FIRST AID MEASURES

First Aid Measures

General Advice: In case of accident or if you feel unwell, seek medical advice immediately (show directions for use or safety data sheet if possible).

Inhalation: Remove to fresh air. If not breathing, institute rescue breathing. If breathing is difficult, ensure airway is clear, give oxygen and continue to monitor. If heart has stopped, immediately begin cardiopulmonary resuscitation (CPR). Keep affected person warm and at rest. If symptoms occur get medical attention.

Skin Contact: Immediately wash exposed skin with plenty of soap and water while removing contaminated clothing and shoes. May be absorbed through the skin in harmful amounts. Get medical attention if irritation persists. Any injection injury from high pressure equipment should be evaluated immediately by a physician as potentially serious (See NOTES TO PHYSICIAN).

Place contaminated clothing in closed container until cleaned or discarded. If clothing is to be laundered, inform the person performing the operation of contaminant's hazardous properties. Destroy contaminated, non-chemical resistant footwear.

Eye Contact: Flush immediately with large amounts of water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Gently remove contacts while flushing. Get medical attention if irritation persists.

Ingestion: Do not induce vomiting because of danger of aspirating liquid into lungs, causing serious damage and chemical pneumonitis. If spontaneous vomiting occurs, keep head below hips, or if patient is lying down, turn body and head to side to prevent aspiration and monitor for breathing difficulty. Never give anything by mouth to an unconscious person. Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

Most important signs and symptoms, both short-term and delayed with overexposure

Adverse Effects: Irritating to the skin and mucous membranes. Symptoms may include redness, itching, and inflammation. May cause nausea, vomiting, diarrhea, and signs of nervous system depression: headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue. Aspiration hazard. May cause coughing, chest pains, shortness of breath, pulmonary edema and/or chemical pneumonitis. Repeated or prolonged skin contact may cause drying, reddening, itching and cracking.

Indication of any immediate medical attention and special treatment needed

Notes To Physician: INHALATION: This material (or a component) sensitizes the myocardium to the effects of sympathomimetic amines. Epinephrine and other sympathomimetic drugs may initiate cardiac arrhythmias in individuals exposed to this material. Administration of sympathomimetic drugs should be avoided.

SKIN: Leaks or accidents involving high-pressure equipment may inject a stream of material through the skin and initially produce an injury that may not appear serious. Only a small puncture wound may appear on the skin surface but, without proper treatment and depending on the nature, original pressure, volume, and location of the injected material, can compromise blood supply to an affected body part. Prompt surgical debridement of the wound may be necessary to prevent irreversible loss of function and/or the affected body part. High pressure injection injuries may be SERIOUS SURGICAL EMERGENCIES.

INGESTION: This material represents a significant aspiration and chemical pneumonitis hazard. Induction of emesis is not recommended.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media
For small fires, Class B fire extinguishing media such as CO2, dry chemical, foam (AFFF/ATC) or water spray can be used. For large fires, water spray, fog or foam (AFFF/ATC) can be used. Firefighting should be attempted only by those who are adequately trained and equipped with proper protective equipment.

Unsuitable extinguishing media
Do not use straight water streams to avoid spreading fire.

Specific hazards arising from the chemical
This product has been determined to be an extremely flammable liquid per the OSHA Hazard Communication Standard and should be handled accordingly. May accumulate electrostatic charge and ignite or explode. Vapors may travel along the ground or be moved by ventilation and ignited by many sources such as pilot lights, sparks, electric motors, static discharge, or other ignition sources at locations distant from material handling. Flashback can occur along vapor trail. For additional fire related information, see NFPA 30 or the Emergency Response Guidebook 128.

Hazardous combustion products
Smoke, carbon monoxide, and other products of incomplete combustion.

Explosion data
Sensitivity to Mechanical Impact No.
Sensitivity to Static Discharge Yes.

Special protective equipment and precautions for firefighters
Firefighters should wear full protective clothing and positive-pressure self-contained breathing apparatus (SCBA) with a full face-piece, as appropriate. Avoid using straight water streams. Water may be ineffective in extinguishing low flash point fires, but can be used to cool exposed surfaces. Avoid excessive water spray application. Water spray and foam (AFFF/ATC) must be applied carefully to avoid frothing and from as far a distance as possible. Keep run-off water out of sewers and water sources.

Additional firefighting tactics
FIRES INVOLVING TANKS OR CAR/TRAILER LOADS: Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Cool containers with flooding quantities of water until well after the fire is out. Do not direct water at source of leak or safety devices; icing may occur. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles: if this is impossible, withdraw from area and let fire burn.

EVACUATION: Consider initial downwind evacuation for at least 1000 feet. If tank, rail car or tank truck is involved in a fire, ISOLATE for 5280 feet (1 mile) in all directions; also, consider initial evacuation of 5280 feet (1 mile) in all directions.

NFPA	Health 1	Flammability 3	Instability 0	Special Hazard -

6. ACCIDENTAL RELEASE MEASURES

Personal precautions:	Keep public away. Isolate and evacuate area. Shut off source if safe to do so. Eliminate all ignition sources.
Protective equipment:	Use personal protection measures as recommended in Section 8.
Emergency procedures:	Advise authorities and National Response Center (800-424-8802) if the product has entered a water course or sewer. Notify local health and pollution control agencies, if appropriate.
Environmental precautions:	Avoid release to the environment. Avoid subsoil penetration. Ethanol in gasoline phase seperates in contact with water. Monitor downstream for dissolved ethanol or other appropriate indicators.
Methods and materials for containment:	Contain liquid with sand or soil. Prevent spilled material from entering storm drains, sewers, and open waterways.
Methods and materials for cleaning up:	Use suitable absorbent materials such as vermiculite, sand, or clay to clean up residual liquids. Recover and return free product to proper containers. When recovering free liquids ensure all equipment is grounded and bonded. Use only non-sparking tools.

7. HANDLING AND STORAGE

Safe Handling Precautions:

NEVER SIPHON THIS PRODUCT BY MOUTH. Use appropriate grounding and bonding practices. Static accumulating flammable liquid. Bonding and grounding may be insufficient to eliminate the hazard from static electricity. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. Vapors may travel along the ground or be moved by ventilation. Flashback may occur along vapor trails. No smoking. Use only non-sparking tools. Avoid contact with skin, eyes and clothing. Avoid breathing fumes, gas, or vapors. Use only with adequate ventilation. Avoid repeated and prolonged skin contact. Use personal protection measures as recommended in Section 8. Exercise good personal hygiene including removal of soiled clothing and prompt washing with soap and water. Do not cut, drill, grind or weld on empty containers since explosive residues may remain. Refer to applicable EPA, OSHA, NFPA and consistent state and local requirements.

Hydrocarbons are basically non-conductors of electricity and can become electrostatically charged during mixing, filtering, pumping at high flow rates or loading and transfer operations. If this charge reaches a sufficiently high level, sparks can form that may ignite the vapors of flammable liquids. Sudden release of hot organic chemical vapors or mists from process equipment operating under elevated temperature and pressure, or sudden ingress of air into vacuum equipment may result in ignition of vapors or mists without the presence of obvious ignition sources. Nozzle spouts must be kept in contact with the containers or tank during the entire filling operation.

Portable containers should never be filled while in or on a motor vehicle or marine craft. Containers should be placed on the ground. Static electric discharge can ignite fuel vapors when filling non-grounded containers or vehicles on trailers. The nozzle spout must be kept in contact with the container before and during the entire filling operation. Use only approved containers.

A buildup of static electricity can occur upon re-entry into a vehicle during fueling especially in cold or dry climate conditions. The charge is generated by the action of dissimilar fabrics (i.e., clothing and upholstery) rubbing across each other as a person enters/exits the vehicle. A flash fire can result from this discharge if sufficient flammable vapors are present. Therefore, do not get back in your vehicle while refueling.

Cellular phones and other electronic devices may have the potential to emit electrical charges (sparks). Sparks in potentially explosive atmospheres (including fueling areas such as gas stations) could cause an explosion if sufficient flammable vapors are present. Therefore, turn off cellular phones and other electronic devices when working in potentially explosive atmospheres or keep devices inside your vehicle during refueling.

High-pressure injection of any material through the skin is a serious medical emergency even though the small entrance wound at the injection site may not initially appear serious. These injection injuries can occur from high-pressure equipment such as paint spray or grease or guns, fuel injectors, or pinhole leaks in hoses or hydraulic lines and should all be considered serious. High pressure injection injuries may be SERIOUS SURGICAL EMERGENCIES (See First Aid Section 4).

Storage Conditions:

Store in properly closed containers that are appropriately labeled and in a cool, well-ventilated area. Do not store near an open flame, heat or other sources of ignition.

Incompatible Materials

Strong oxidizing agents.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Name	ACGIH TLV	OSHA PELS:	OSHA - Vacated PELs	NIOSH IDLH
Gasoline 86290-81-5	300 ppm TWA 500 ppm STEL	-	300 ppm TWA 900 mg/m^3 TWA 500 ppm STEL 1500 mg/m^3 STEL	-

Heptane (mixed isomers) 142-82-5	400 ppm TWA 500 ppm STEL	TWA: 500 ppm TWA: 2000 mg/m^3	400 ppm TWA 1600 mg/m^3 TWA 500 ppm STEL 2000 mg/m^3 STEL	750 ppm
Pentane (mixed isomers) 78-78-4	1000 ppm TWA	-	-	-
Butane (mixed isomers) 106-97-8	1000 ppm STEL	-	800 ppm TWA 1900 mg/m^3 TWA	-
Hexane Isomers (other than n-Hexane) 107-83-5	500 ppm TWA 1000 ppm STEL	-	500 ppm TWA 1800 mg/m^3 TWA 1000 ppm STEL 3600 mg/m^3 STEL	-
Toluene 108-88-3	20 ppm TWA	TWA: 200 ppm Ceiling: 300 ppm	100 ppm TWA 375 mg/m^3 TWA 150 ppm STEL 560 mg/m^3 STEL	500 ppm
Xylene (mixed isomers) 1330-20-7	100 ppm TWA 150 ppm STEL	TWA: 100 ppm TWA: 435 mg/m^3	100 ppm TWA 435 mg/m^3 TWA 150 ppm STEL 655 mg/m^3 STEL	900 ppm
n-Hexane 110-54-3	50 ppm TWA Skin - potential significant contribution to overall exposure by the cutaneous route	TWA: 500 ppm TWA: 1800 mg/m^3	50 ppm TWA 180 mg/m^3 TWA	1100 ppm
Cumene 98-82-8	50 ppm TWA	TWA: 50 ppm TWA: 245 mg/m^3 Skin	50 ppm TWA 245 mg/m^3 TWA Limit applies to skin	900 ppm
1,2,4 Trimethylbenzene 95-63-6	25 ppm TWA	-	25 ppm TWA 125 mg/m^3 TWA	-
Ethylbenzene 100-41-4	20 ppm TWA	TWA: 100 ppm TWA: 435 mg/m^3	100 ppm TWA 435 mg/m^3 TWA 125 ppm STEL 545 mg/m^3 STEL	800 ppm
Benzene 71-43-2	0.5 ppm TWA 2.5 ppm STEL Skin - potential significant contribution to overall exposure by the cutaneous route	TWA: 10 ppm (applies to industry segments exempt from the benzene standard) TWA: 1 ppm STEL: 5 ppm (see 29 CFR 1910.1028)	25 ppm Ceiling 1 ppm TWA 5 ppm STEL	500 ppm
Cyclohexane 110-82-7	100 ppm TWA	TWA: 300 ppm TWA: 1050 mg/m^3	300 ppm TWA 1050 mg/m^3 TWA	1300 ppm
Octane 111-65-9	300 ppm TWA	TWA: 500 ppm TWA: 2350 mg/m^3	300 ppm TWA 1450 mg/m^3 TWA 375 ppm STEL 1800 mg/m^3 STEL	1000 ppm
1,2,3-trimethylbenzene 526-73-8	25 ppm TWA	-	25 ppm TWA 125 mg/m^3 TWA	-
Naphthalene 91-20-3	10 ppm TWA Skin - potential significant contribution to overall exposure by the cutaneous route	TWA: 10 ppm TWA: 50 mg/m^3	10 ppm TWA 50 mg/m^3 TWA 15 ppm STEL 75 mg/m^3 STEL	250 ppm

Notes: The manufacturer has voluntarily elected to provide exposure limits contained in OSHA's 1989 air contaminants standard in its SDSs, even though certain of those exposure limits were vacated in 1992.

Engineering measures: Local or general exhaust required in an enclosed area or when there is inadequate ventilation. Use mechanical ventilation equipment that is explosion-proof.

Personal protective equipment

Eye protection: Use goggles or face-shield if the potential for splashing exists.

Skin and body protection: Use nitrile rubber, Viton® or PVA gloves for repeated or prolonged skin exposure. Glove suitability is based on workplace conditions and usage. Contact the glove manufacturer for specific advice on glove selection and breakthrough times.

Respiratory protection: Use a NIOSH approved organic vapor chemical cartridge or supplied air respirators when there is the potential for airborne exposures to exceed permissible exposure limits or if excessive vapors are generated. Observe respirator assigned protection factors (APFs) criteria cited in federal OSHA 29 CFR 1910.134. Self-contained breathing apparatus should be used for fire fighting.

Hygiene measures: Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes and clothing.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical State	Liquid
Appearance	Clear yellow liquid
Color	Yellow
Odor	Hydrocarbon
Odor Threshold	No data available.

Property	**Values (Method)**
Melting Point / Freezing Point	No data available.
Initial Boiling Point / Boiling Range	24-210 °C / 75-410 °F (ASTM D86)
Flash Point	-43 °C / -45 °F
Evaporation Rate	No data available.
Flammability (solid, gas)	Not applicable.
Flammability Limit in Air (%):	
Upper Flammability Limit:	7.6
Lower Flammability Limit:	1.4
Explosion limits:	No data available.
Vapor Pressure	5.5-15 psi (ASTM D4814)
Vapor Density	3-4
Specific Gravity / Relative Density	0.70-0.76
Water Solubility	No data available.
Solubility in other solvents	No data available.
Partition Coefficient	2.13-4.5
Decomposition temperature	No data available.
pH:	Not applicable
Autoignition Temperature	280 °C / 536 °F
Kinematic Viscosity	No data available.
Dynamic Viscosity	No data available.
Explosive Properties	No data available.
VOC Content (%)	100%
Density	No data available.
Bulk Density	Not applicable.

10. STABILITY AND REACTIVITY

Reactivity The product is non-reactive under normal conditions.

Chemical stability The material is stable at 70°F, 760 mmHg pressure.

Possibility of hazardous reactions None under normal processing.

Hazardous polymerization Will not occur.

Conditions to avoid Excessive heat, sources of ignition, open flame.

Incompatible Materials Strong oxidizing agents.

Hazardous decomposition products None known under normal conditions of use.

11. TOXICOLOGICAL INFORMATION

Potential short-term adverse effects from overexposures

Inhalation May cause irritation of respiratory tract. May cause drowsiness or dizziness. Breathing high concentrations of this material in a confined space or by intentional abuse can cause irregular heartbeats which can cause death.

Eye contact Exposure to vapor or contact with liquid may cause mild eye irritation, including tearing, stinging, and redness.

Skin contact Causes skin irritation. Effects may become more serious with repeated or prolonged contact. May be absorbed through the skin in harmful amounts.

Ingestion May be fatal if swallowed or vomited and enters airways. May cause irritation of the mouth, throat and gastrointestinal tract.

Acute toxicological data

Name	Oral LD50	Dermal LD50	Inhalation LC50
Gasoline 86290-81-5	14000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 5.2 mg/L (Rat) 4 h
Heptane (mixed isomers) 142-82-5	-	3000 mg/kg (Rabbit)	103 g/m³ (Rat) 4 h
Pentane (mixed isomers) 78-78-4	-	-	450 mg/L (Mouse) 2 h
Butane (mixed isomers) 106-97-8	-	-	658 mg/L (Rat) 4 h
Hexane Isomers (other than n-Hexane) 107-83-5	> 5000 mg/kg (Rat)	-	-
Toluene 108-88-3	> 2000 mg/kg (Rat)	8390 mg/kg (Rabbit)	12.5 mg/L (Rat) 4 h
Xylene (mixed isomers) 1330-20-7	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 5.04 mg/L (Rat) 4 h
n-Hexane 110-54-3	15000 mg/kg (Rat)	3000 mg/kg (Rabbit)	48000 ppm (Rat) 4 h
Cumene 98-82-8	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 20 mg/L (Rat) 6 h
1,2,4 Trimethylbenzene 95-63-6	3280 mg/kg (Rat)	> 3160 mg/kg (Rabbit)	18,000 mg/m³ (Rat) 4 h
Ethylbenzene 100-41-4	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	17.2 mg/L (Rat) 4 h
Benzene 71-43-2	> 2000 mg/kg (Rat)	> 5000 mg/kg (Rabbit)	> 20 mg/l (Rat) 4 h
Cyclohexane 110-82-7	> 5000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	13.9 mg/L (Rat) 4 h
Octane 111-65-9	-	-	118 g/m³ (Rat) 4 h
1,2,3-trimethylbenzene 526-73-8	-	-	-
Naphthalene 91-20-3	490 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 340 mg/m³ (Rat) 1 h

Delayed and immediate effects as well as chronic effects from short and long-term exposure

NAPHTHAS: In a large epidemiological study on over 15,000 employees at several petroleum refineries and amongst residents located near these refineries, no increased risk of kidney cancer was observed in association with gasoline exposures (a similar material). In a similar study, no increased risk of kidney cancer was observed among petroleum refinery workers, but there was a slight trend in the incidence of kidney cancers among service station employees, especially after a 30-year latency period. Altered mental state, drowsiness, peripheral motor neuropathy, irreversible brain damage (so-called Petrol Sniffer's Encephalopathy), delirium, seizures, and sudden death have been reported from repeated overexposure to some hydrocarbon solvents, naphthas, and gasoline.

ISOPARAFFINS: Studies in laboratory animals have shown that long-term exposure to similar materials (isoparaffins) can cause kidney damage and kidney cancer in male laboratory rats. However, in-depth research indicates that these findings are unique to the male rat, and that these effects are not relevant to humans.

C9 AROMATIC HYDROCARBONS: A developmental inhalation study was conducted in laboratory mice. Increased implantation losses, reduced fetal weights, delayed ossification and an increased incidence of cleft palate were observed at the highest exposure level (1,500 ppm). This exposure level was extremely toxic to pregnant female mice (44% mortality). Reduced fetal body weights were also observed at 500 ppm. A multi-generation reproduction inhalation study was conducted in laboratory rats. Reductions in pup weights, pup weight gain, litter size, and pup survival were observed at 1,500 ppm, an exposure level at which significant maternal toxicity was observed. Reduced pup weight gain was also observed at 500 ppm.

PENTANES: Studies of pentane isomers in laboratory animals indicate exposure to extremely high levels (roughly 10 vol.%) may induce cardiac arrhythmias (irregular heartbeats) which may be serious or fatal.

BUTANES: Studies in laboratory animals indicate exposure to extremely high levels of butanes (1-10 or higher vol.% in air) may cause cardiac arrhythmias (irregular heartbeats) which may be serious or fatal.

TOLUENE: Case studies of persons abusing toluene suggest isolated incidences of adverse effects on the fetus including birth defects. Abuse of toluene at high concentrations (e.g., glue sniffing and solvent abuse) has been associated with adverse effects on the liver, kidney and nervous system, and can cause CNS depression, cardiac arrhythmias, and death. Studies of workers indicate longterm exposure may be related to impaired color vision and hearing. Some studies of workers suggest longterm exposure may be related to neurobehavioral and cognitive changes. Some of these effects have been observed in laboratory animals following repeated exposure to high levels of toluene. Several studies of workers suggest longterm exposure may be related to small increases in spontaneous abortions and changes in some gonadotropic hormones. However, the weight of evidence does not indicate toluene is a reproductive hazard to humans. Studies in laboratory animals indicate some changes in reproductive organs following high levels of exposure, but no significant effects on mating performance or reproduction were observed. Case studies of persons abusing toluene suggest isolated incidences of adverse effects on the fetus including birth defects. Findings in laboratory animals have been largely negative. Positive findings include small increases in minor skeletal and visceral malformations and developmental delays following very high levels of maternal exposure. Studies of workers indicate long-term exposure may be related to effects on the liver, kidney and blood, but these appear to be limited to changes in serum enzymes and decreased leukocyte counts. Adverse effects on the liver, kidney, thymus and nervous system were observed in animal studies following very high levels of exposure. The relevance of these findings to humans is not clear at this time.

XYLENES, ALL ISOMERS: Overexposure to xylene may cause upper respiratory tract irritation, headache, cyanosis, blood serum changes, nervous system damage and narcosis. Effects may be increased by the use of alcoholic beverages. Evidence of liver and kidney impairment were reported in workers recovering from a gross overexposure. Effects from Prolonged or Repeated Exposure: Impaired neurological function was reported

in workers exposed to solvents including xylene. Studies in laboratory animals have shown evidence of impaired hearing following high levels of exposure. Studies in laboratory animals suggest some changes in reproductive organs following high levels of exposure but no significant effects on reproduction were observed. Studies in laboratory animals indicate skeletal and visceral malformations, developmental delays, and increased fetal resorptions following extremely high levels of maternal exposure with evidence of maternal toxicity. The relevance of these observations to humans is not clear at this time. Adverse effects on the liver, kidney, bone marrow (changes in blood cell parameters) were observed in laboratory animals following high levels of exposure. The relevance of these observations to humans is not clear at this time.

1,2,4-TRIMETHYLBENZENE: The following information pertains to a mixture of C9 aromatic hydrocarbons, over 40% of which was composed of 1,2,4-trimethylbenzene. A developmental inhalation study was conducted in laboratory mice. Increased implantation losses, reduced fetal weights, delayed ossification and an increased incidence of cleft palate were observed at the highest exposure level (1,500 ppm). This exposure level was extremely toxic to pregnant female mice (44% mortality). Reduced fetal body weights were also observed at 500 ppm. A multi-generation reproduction inhalation study was conducted in laboratory rats. Reductions in pup weights, pup weight gain, litter size, and pup survival were observed at 1,500 ppm, an exposure level at which significant maternal toxicity was observed. Reduced pup weight gain was also observed at 500 ppm. Embryotoxicity has been reported in studies of laboratory animals. Adverse effects included increased implantation losses, reduced fetal weights, delayed ossification and an increased incidence of cleft palate.<n><n>

N-HEXANE: Long-term or repeated exposure to n-hexane can cause peripheral nerve damage. Initial symptoms are numbness of the fingers and toes. Also, motor weakness can occur in the digits, but may also involve muscles of the arms, thighs and forearms. The onset of these symptoms may be delayed for several months to a year after the beginning of exposure. Testicular atrophy and partial to full loss of the germ cell line were observed in sub-chronic high-dose inhalation studies of laboratory rodents. These effects appeared irreversible. Rodent reproduction studies have shown evidence of reduced fetal weight but no frank malformations.

CUMENE: Overexposure to cumene may cause upper respiratory tract irritation and CNS depression. Studies in laboratory animals indicate evidence of respiratory tract hyperplasia, and adverse effects on the liver, kidney and adrenal glands following high level exposure. The relevance of these findings to humans is not clear at this time. Findings from lifetime laboratory rodent inhalation studies were as follows: In F344/N rats: an increased incidence of renal carcinomas and adenomas, respiratory epithelial adenomas, and interstitial cell adenomas of the testes. In B6C3F1 mice: an increased incidence of carcinomas and adenomas of the bronchi and lung, liver neoplasms, hemangiosarcomas of the spleen, and adenomas of the thyroid.

ETHYLBENZENE: Findings from a 2-year inhalation study in rodents conducted by NTP were as follows: Effects were observed only at the highest exposure level (750 ppm). At this level the incidence of renal tumors was elevated in male rats (tubular carcinomas) and female rats (tubular adenomas). The incidence of tumors was also elevated in male mice (alveolar and bronchiolar carcinomas) and female mice (hepatocellular carcinomas). IARC has classified ethyl benzene as "possibly carcinogenic to humans" (Group 2B). Studies in laboratory animals indicate some evidence of post-implantation deaths following high levels of maternal exposure. The relevance of these findings to humans is not clear at this time. Studies in laboratory animals indicate limited evidence of renal malformations, resorptions, and developmental delays following high levels of maternal exposure with evidence of maternal toxicity. The relevance of these findings to humans is not clear at this time. Studies in laboratory animals have demonstrated evidence of ototoxicity (hearing loss) following exposure levels as low as 300 ppm for 5 days. Studies in laboratory animals indicate some evidence of adverse effects on the liver, kidney, thyroid, and pituitary gland.

BENZENE: Studies of workers exposed to benzene show clear evidence that overexposure can cause cancer and other diseases of the blood forming organs including Acute

Myelogenous Leukemia (AML), and Aplastic Anemia (AA), an often fatal disease. Some studies suggest overexposure to benzene may also be associated with Myelodysplastic Syndrome (MDS). Findings from a case control study of workers exposed to benzene was reported during the 2009 Benzene Symposium in Munich included an increase in Acute Myeloid Leukemias and Non-Hodgkins Lymphoid Neoplasms (NHLN) of the subtype follicular lymphoma (FL) in some occupational categories. Some studies of workers exposed to benzene have shown an association with increased rates of chromosome aberrations in circulating lymphocytes. One study of women workers exposed to benzene suggested a weak association with irregular menstruation. However, other studies of workers exposed to benzene have not demonstrated clear evidence of an effect on fertility or reproductive outcome in humans. Benzene can cross the placenta and affect the developing fetus. Cases of AA have been reported in the offspring of persons severely overexposed to benzene. Studies in laboratory animals indicate that prolonged, repeated exposure to high levels of benzene vapor can cause bone marrow suppression and cancer in multiple organ systems. Studies in laboratory animals show evidence of adverse effects on male reproductive organs following high levels of exposure but no significant effects on reproduction have been observed. Embryotoxicity has been reported in studies of laboratory animals but effects were limited to reduced fetal weight and minor skeletal variations. Benzene has been classified as a proven human carcinogen by OSHA and a Group 1 (Carcinogenic to Humans) material by IARC. The current proposed IARC classification for benzene is summarized as follows: Sufficient evidence for Acute Myeloid Leukemia; limited evidence for Acute Lymphatic Leukemia, Chronic Lymphatic Leukemia, Non-Hodgkin Lymphoma, and Multiple Myeloma.

NAPHTHALENE: Severe jaundice, neurotoxicity (kernicterus) and fatalities have been reported in young children and infants as a result of hemolytic anemia from overexposure to naphthalene. Persons with glucose 6-phosphate dehydrogenase (G6PD) deficiency are more prone to the hemolytic effects of naphthalene. Adverse effects on the kidney have been reported in persons overexposed to naphthalene but these effects are believed to be a consequence of hemolytic anemia, and not a direct effect. Hemolytic anemia has been observed in laboratory animals exposed to naphthalene. Laboratory rodents exposed to naphthalene vapor for 2 years (lifetime studies) developed non-neoplastic and neoplastic tumors and inflammatory lesions of the nasal and respiratory tract. Cataracts and other adverse effects on the eye have been observed in laboratory animals exposed to high levels of naphthalene. Findings from a large number of bacterial and mammalian cell mutation assays have been negative. A few studies have shown chromosomal effects (elevated levels of Sister Chromatid Exchange or chromosomal aberrations) in vitro. Naphthalene has been classified as Possibly Carcinogenic to Humans (2B) by IARC, based on findings from studies in laboratory animals.

CARBON MONOXIDE: is a chemical asphyxiant with no warning properties (such as odor). At 400-500 ppm for 1 hour headache and dyspnea may occur. If activity is increased, symptoms of overexposure may include nausea, irritability, increased respiration, tinnitus, sweating, chest pain, confusion, impaired judgement, dizziness, weakness, drowsiness, ataxia, irregular heart beat, cyanosis and pallor. Levels in excess of 1000 ppm can result in collapse, loss of conciousness, respiratory failure and death. Extremely high concentrations (12,800 ppm) can cause immediate unconsciousness and death in 1-3 minutes. Repeated anoxia can lead to central nervous system damage and peripheral neuropathy, with loss of sensation in the fingers, amnesia, and mental deterioration and possible congestive heart failure. Damage may also occur to the fetus, lung, liver, kidney, spleen, cardiovascular system and other organs.

WHOLLY-VAPORIZED UNLEADED GASOLINE: Lifetime exposure to wholly vaporized unleaded gasoline produced an increased incidence of liver tumors in female mice exposed to the highest exposure concentration (2056 ppm) and α-2 urinary globulin-mediated kidney tumors in male rats. No exposure-related tumors were observed in male mice or female rats. The male-specific rat kidney tumors are not considered relevant to human health. Mice receiving lifetime repeated skin application of various petroleum naphthas exhibited an irritation-dependent increased incidence of skin tumors. Additional studies suggest that these tumors occur through a mechanism that may not be relevant to human health. Epidemiological data from over 18,000 petroleum marketing and distribution workers

showed no increased risk of leukemia, multiple myeloma, or kidney cancer resulting from gasoline exposure. Unleaded gasoline has been identified as possibly carcinogenic to humans (2B) by the International Agency for Research on Cancer (IARC).

COMBUSTION ENGINE EXHAUST: Chronic inhalation studies of gasoline engine exhaust in mice, rats and hamsters did not produce any carcinogenic effects. Condensates/extracts of gasoline engine exhaust produced an increase in tumors compared to controls when testing by skin painting, subcutaneous injection, intratracheal instillation or implantation into the lungs. Gasoline exhaust has been classified as possibly carcinogenic to humans (2B) by the International Agency for Research on Cancer (IARC).

Adverse effects related to the physical, chemical and toxicological characteristics

Signs and Symptoms Irritating to the skin and mucous membranes. Symptoms may include redness, itching, and inflammation. May cause nausea, vomiting, diarrhea, and signs of nervous system depression: headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue. Aspiration hazard. May cause coughing, chest pains, shortness of breath, pulmonary edema and/or chemical pneumonitis. Repeated or prolonged skin contact may cause drying, reddening, itching and cracking.

Sensitization Not expected to be a skin or respiratory sensitizer.

Mutagenic effects May cause genetic defects.

Carcinogenicity May cause cancer.

Cancer designations are listed in the table below

Name	ACGIH (Class)	IARC (Class)	NTP	OSHA
Gasoline 86290-81-5	Confirmed animal carcinogen (A3)	Possible human carcinogen (2B)	Not Listed	Not Listed
Heptane (mixed isomers) 142-82-5	Not Listed	Not Listed	Not Listed	Not Listed
Pentane (mixed isomers) 78-78-4	Not Listed	Not Listed	Not Listed	Not Listed
Butane (mixed isomers) 106-97-8	Not Listed	Not Listed	Not Listed	Not Listed
Hexane Isomers (other than n-Hexane) 107-83-5	Not Listed	Not Listed	Not Listed	Not Listed
Toluene 108-88-3	Not Classifiable (A4)	Not Classifiable (3)	Not Listed	Not Listed
Xylene (mixed isomers) 1330-20-7	Not classifiable (A4)	Not classifiable (3)	Not Listed	Not Listed
n-Hexane 110-54-3	Not Listed	Not Listed	Not Listed	Not Listed
Cumene 98-82-8	Not listed	Possible human carcinogen (2B)	Reasonably anticipated to be a human carcinogen	Not listed
1,2,4 Trimethylbenzene 95-63-6	Not Listed	Not Listed	Not Listed	Not Listed
Ethylbenzene 100-41-4	Confirmed animal carcinogen (A3)	Possible human carcinogen (2B)	Not Listed	Not Listed
Benzene 71-43-2	Confirmed human carcinogen (A1)	Carcinogenic to humans (1)	Known to be human carcinogen	Known carcinogen
Cyclohexane 110-82-7	Not Listed	Not Listed	Not Listed	Not Listed
Octane 111-65-9	Not Listed	Not Listed	Not Listed	Not Listed
1,2,3-trimethylbenzene 526-73-8	Not Listed	Not Listed	Not Listed	Not Listed
Naphthalene 91-20-3	Confirmed animal carcinogen (A3)	Possible human carcinogen (2B)	Reasonably anticipated to be a human carcinogen	Not Listed

Reproductive toxicity Suspected of damaging fertility or the unborn child.

Specific Target Organ Toxicity (STOT) - single exposure Respiratory system. Central nervous system.

Specific Target Organ Toxicity (STOT) - repeated exposure Not classified.

Aspiration hazard May be fatal if swallowed or vomited and enters airways.

12. ECOLOGICAL INFORMATION

Ecotoxicity This product should be considered toxic to aquatic organisms, with the potential to cause long lasting adverse effects in the aquatic environment.

Name	Algae/aquatic plants	Fish	Toxicity to Microorganisms	Crustacea
Gasoline 86290-81-5	72-hr EC50 = 56 mg/l Algae	96-hr LC50 = 11 mg/l Rainbow trout (static)	-	48-hr LC50 = 7.6 mg/l Daphnia magna
Heptane (mixed isomers) 142-82-5	-	96-hr LC50 = 375 mg/L Tilapia	-	-
Pentane (mixed isomers) 78-78-4	-	96-hr LC50 = 3.1 mg/L Rainbow trout	-	48-hr EC50 = >1 - <10 mg/L Daphnia magna
Butane (mixed isomers) 106-97-8	-	-	-	-
Hexane Isomers (other than n-Hexane) 107-83-5	-	-	-	-
Toluene 108-88-3	72-hr EC50 = 12.5 mg/l Algae	96-hr LC50 <= 10 mg/l Rainbow trout	-	48-hr EC50 = 5.46-9.83 mg/l Daphnia magna 48-hr EC50 = 11.5 mg/l Daphnia magna (Static)
Xylene (mixed isomers) 1330-20-7	72-hr EC50 = 11 mg/l Algae	96-hr LC50 = 8 mg/l Rainbow trout	-	48-hr LC50 = 3.82 mg/l Daphnia magna
n-Hexane 110-54-3	-	96-hr LC50 = 2.5 mg/l Fathead minnow	-	-
Cumene 98-82-8	72-hr EC50 = 2.6 mg/l Algae	96-hr LC50 = 6.04-6.61 mg/l Fathead minnow (Flow-through) 96-hr LC50 = 2.7 mg/l Rainbow trout (semi-static)	-	48-hr EC50 = 7.9-14.1 mg/l Daphnia magna (static)
1,2,4 Trimethylbenzene 95-63-6	-	96-hr LC50 = 7.19-8.28 mg/l Fathead minnow (flow-through)	-	48-hr EC50 = 6.14 mg/L Daphnia magna
Ethylbenzene 100-41-4	72-hr EC50 = 1.7-7.6 mg/l Algae	96-hr LC50 = 4 mg/L Rainbow trout	-	48-hr EC50 = 1-4 mg/L Daphnia magna
Benzene 71-43-2	72-hr EC50 = 29 mg/l Algae	96-hr LC50 = 5.3 mg/l Rainbow trout (flow-through)	-	48-hr EC50 = 8.76-15.6 mg/l Daphnia magna (Static)
Cyclohexane 110-82-7	72-hr EC50 = 500 mg/l Algae	96-hr LC50 = 3.96-5.18 mg/l Fathead minnow	-	48-hr EC50 = 1.7-3.5 mg/L Bay shrimp
Octane 111-65-9	-	-	-	48-hr LC50 = 0.38 mg/l Daphnia magna
1,2,3-trimethylbenzene 526-73-8	-	96-hr LC50 = 7.72 mg/l Fathead Minnow (flow-through)	-	-
Naphthalene 91-20-3	-	96-hr LC50 = 0.91-2.82 mg/l Rainbow trout (static) 96-hr LC50 = 1.99 mg/l Fathead minnow (static)	-	48-hr LC50 = 1.6 mg/l Daphnia magna

Persistence and degradability Expected to be inherently biodegradable. The presence of ethanol in this product may impede the biodegradation of benzene, toluene, ethylbenzene and xylene in groundwater, resulting in elongated plumes of these constituents.

Bioaccumulation Has the potential to bioaccumulate.

Mobility in soil May partition into air, soil and water.

Other adverse effects No information available.

13. DISPOSAL CONSIDERATIONS

Description of Waste Residues
This material may be a flammable liquid waste.

Safe Handling of Wastes
Handle in accordance with applicable local, state, and federal regulations. Use personal protection measures as required. Use appropriate grounding and bonding practices. Use only non-sparking tools. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. No smoking.

Disposal of Wastes / Methods of Disposal
The user is responsible for determining if any discarded material is a hazardous waste (40 CFR 262.11). Dispose of in accordance with federal, state and local regulations.

Methods of Contaminated Packaging Disposal
Empty containers should be completely drained and then discarded or recycled, if possible. Do not cut, drill, grind or weld on empty containers since explosive residues may be present. Dispose of in accordance with federal, state and local regulations.

14. TRANSPORT INFORMATION

DOT (49 CFR 172.101):

UN Proper Shipping Name:	Gasoline
UN/Identification No:	UN 1203
Transport Hazard Class(es):	3
Packing Group:	II

TDG (Canada):

UN Proper Shipping Name:	Gasoline
UN/Identification No:	UN 1203
Transport Hazard Class(es):	3
Packing Group:	II

15. REGULATORY INFORMATION

US Federal Regulatory Information:

US TSCA Chemical Inventory Section 8(b): This product and/or its components are listed on the TSCA Chemical Inventory.

EPA Superfund Amendment & Reauthorization Act (SARA):

SARA Section 302: This product does not contain any component(s) included on EPA's Extremely Hazardous Substance (EHS) List.

Name	CERCLA/SARA - Section 302 Extremely Hazardous Substances and TPQs
Gasoline	NA
Heptane (mixed isomers)	NA
Pentane (mixed isomers)	NA
Butane (mixed isomers)	NA
Hexane Isomers (other than n-Hexane)	NA
Toluene	NA
Xylene (mixed isomers)	NA

n-Hexane	NA
Cumene	NA
1,2,4 Trimethylbenzene	NA
Ethylbenzene	NA
Benzene	NA
Cyclohexane	NA
Octane	NA
1,2,3-trimethylbenzene	NA
Naphthalene	NA

SARA Section 304: This product may contain component(s) identified either as an EHS or a CERCLA Hazardous substance which in case of a spill or release may be subject to SARA reporting requirements:

Name	Hazardous Substances RQs
Gasoline	NA
Heptane (mixed isomers)	NA
Pentane (mixed isomers)	NA
Butane (mixed isomers)	NA
Hexane Isomers (other than n-Hexane)	NA
Toluene	1000 lb final RQ 454 kg final RQ
Xylene (mixed isomers)	100 lb final RQ 45.4 kg final RQ
n-Hexane	5000 lb final RQ 2270 kg final RQ
Cumene	5000 lb final RQ 2270 kg final RQ
1,2,4 Trimethylbenzene	NA
Ethylbenzene	1000 lb final RQ 454 kg final RQ
Benzene	10 lb final RQ 4.54 kg final RQ
Cyclohexane	1000 lb final RQ 454 kg final RQ
Octane	NA
1,2,3-trimethylbenzene	NA
Naphthalene	100 lb final RQ 45.4 kg final RQ

SARA: The following EPA hazard categories apply to this product:

Acute Health Hazard
Chronic Health Hazard
Fire Hazard

SARA Section 313: This product may contain component(s), which if in exceedance of the de minimus threshold, may be subject to the reporting requirements of SARA Title III Section 313 Toxic Release Reporting (Form R).

Name	CERCLA/SARA 313 Emission reporting:
Gasoline	None
Heptane (mixed isomers)	None
Pentane (mixed isomers)	None
Butane (mixed isomers)	None
Hexane Isomers (other than n-Hexane)	None
Toluene	1.0 % de minimis concentration
Xylene (mixed isomers)	1.0 % de minimis concentration
n-Hexane	1.0 % de minimis concentration
Cumene	1.0 % de minimis concentration

1,2,4 Trimethylbenzene	1.0 % de minimis concentration
Ethylbenzene	0.1 % de minimis concentration
Benzene	0.1 % de minimis concentration
Cyclohexane	1.0 % de minimis concentration
Octane	None
1,2,3-trimethylbenzene	None
Naphthalene	0.1 % de minimis concentration

State and Community Right-To-Know Regulations:
The following component(s) of this material are identified on the regulatory lists below:

Gasoline

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 0957
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Not Listed
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Carcinogen; Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	SN 0957 TPQ: 10000 lb (Under N.J.A.C. 7:1G, environmental hazardous substances in mixtures such as gasoline or new and used petroleum oil may be reported under these categories)
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Heptane (mixed isomers)

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1339
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Pentane (mixed isomers)

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1064
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Not Listed
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed

California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - fourth degree
New Jersey - Environmental Hazardous Substances List:	SN 1064 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Butane (mixed isomers)

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 0273
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - fourth degree
New Jersey - Environmental Hazardous Substances List:	SN 0273 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Hexane Isomers (other than n-Hexane)

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1285
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Not Listed
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Toluene

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Developmental toxicity, initial date 1/1/91 Female reproductive toxicity, initial date 8/7/09
New Jersey Right-To-Know:	SN 1866
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic (skin); Flammable (skin)
Michigan Critical Materials Register List:	100 lb Annual usage threshold
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed

New Jersey - Special Hazardous Substances:	Flammable - third degree; Teratogen
New Jersey - Environmental Hazardous Substances List:	SN 1866 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1000 lb RQ (air); 1 lb RQ (land/water)

Xylene (mixed isomers)

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 2014
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic (skin); Flammable (skin)
Michigan Critical Materials Register List:	100 lb Annual usage threshold all isomers
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	SN 2014 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1000 lb RQ (air); 1 lb RQ (land/water)

n-Hexane

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1340
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	SN 1340 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1 lb RQ (air); 1 lb RQ (land/water)

Cumene

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Carcinogen, initial date 4/6/10
New Jersey Right-To-Know:	SN 0542
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic (skin); Flammable (skin)
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	SN 0542 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Present

New York - Reporting of Releases Part 597 - List of Hazardous Substances:	5000 lb RQ (air); 1 lb RQ (land/water)

1,2,4 Trimethylbenzene

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1929
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Not Listed
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Ethylbenzene

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Carcinogen, initial date 6/11/04
New Jersey Right-To-Know:	SN 0851
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Carcinogen; flammable - Third degree
New Jersey - Environmental Hazardous Substances List:	SN 0851 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1000 lb RQ (air); 1 lb RQ (land/water)

Benzene

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Carcinogen, initial date 2/27/87 Developmental toxicity, initial date 12/26/97 Male reproductive toxicity, initial date 12/26/97
New Jersey Right-To-Know:	SN 0197
Pennsylvania Right-To-Know:	Environmental hazard; Special hazardous substance
Massachusetts Right-To Know:	Carcinogen; Extraordinarily hazardous
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic (skin); Flammable (skin); Carcinogen (skin)
Michigan Critical Materials Register List:	100 lb Annual usage threshold
Massachusetts Extraordinarily Hazardous Substances:	Carcinogen; Extraordinarily hazardous
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Present
New Jersey - Special Hazardous Substances:	Carcinogen; Flammable - third degree; Mutagen
New Jersey - Environmental Hazardous Substances List:	SN 0197 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	10 lb RQ (air); 1 lb RQ (land/water)

Cyclohexane

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 0565
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	SN 0565 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1000 lb RQ (air); 1 lb RQ (land/water)

Octane

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1434
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

1,2,3-trimethylbenzene

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1929
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Not Listed
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Naphthalene

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Carcinogen, initial date 4/19/02
New Jersey Right-To-Know:	SN 1322 SN 3758

Pennsylvania Right-To-Know:	Environmental hazard Present (particulate)
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Carcinogen
New Jersey - Environmental Hazardous Substances List:	SN 1322 TPQ: 500 lb (Reportable at the de minimis quantity of >0.1%)
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	100 lb RQ (air); 1 lb RQ (land/water)

Canada DSL/NDSL Inventory: This product and/or its components are listed either on the Domestic Substances List (DSL) or are exempt.

Canadian Regulatory Information: This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the (M)SDS contains all the information required by the Controlled Products Regulations.

Name	Canada - WHMIS: Classifications of Substances:	Canada - WHMIS: Ingredient Disclosure:
Gasoline	B2,D2A,D2B	0.1%
Heptane (mixed isomers)	B2,D2B	1%
Pentane (mixed isomers)	B2	1%
Butane (mixed isomers)	A,B1	1%
Hexane Isomers (other than n-Hexane)	B2	1%
Toluene	B2,D2A,D2B	0.1%
Xylene (mixed isomers)	B2,D2A,D2B	m-, o-isomers 1.0%; p-isomer 0.1%
n-Hexane	B2,D2A,D2B	1%
Cumene	B2,D2A	0.1%
1,2,4 Trimethylbenzene	B3,D2B	1%
Ethylbenzene	B2,D2A,D2B	0.1%
Benzene	B2,D2A,D2B	0.1%
Cyclohexane	B2,D2B	1%
Octane	B2,D2B	1%
1,2,3-trimethylbenzene	B3	1%
Naphthalene	B4,D2A	0.1%



Note: Not applicable.

16. OTHER INFORMATION

Prepared By Toxicology and Product Safety

Revision Date: 06/01/2016

Revision Note:

Revised Sections

The following sections (§) have been updated:
1. IDENTIFICATION
2. HAZARD IDENTIFICATION
3. COMPOSITION/INFORMATION ON INGREDIENTS
4. FIRST AID MEASURES
6. ACCIDENTAL RELEASE MEASURES
7. HANDLING AND STORAGE
8. EXPOSURE CONTROLS/PERSONAL PROTECTION
9. PHYSICAL AND CHEMICAL PROPERTIES
11. TOXICOLOGICAL INFORMATION
12. ECOLOGICAL INFORMATION
15. REGULATORY INFORMATION

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information is intended as guidance for safe handling, use, processing, storage, transportation, accidental release, clean-up and disposal and is not considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Safety Data Sheet
Gasoline

SECTION 1 IDENTIFICATION

Product Name: Gasoline
Synonyms: Unleaded Gasoline, Regular Gasoline, Motor Fuel, 85 Octane Gasoline, 87 Octane Gasoline

SDS #: F1

Product Use: Motor Fuel
Restrictions on Use: Use only as directed

Manufacturer:
Sinclair Oil Company
P.O. Box 30825
Salt Lake City, Utah 84130

Telephone: **General Information:** (801) 524-2777 **Fax:** (801) 524-2740
Contact person: Jeremiah Webster

Emergency Telephone: 800-424-9300 (CHEMTREC) or (703) 527-3887

SDS Date of Preparation: January 23, 2015

SECTION 2: HAZARDS IDENTIFICATION

Classification:

Physical	Health
Flammable Liquid Category 2	Aspiration Toxicity Category 1 Skin Irritation Category 2 Specific Target Organ Toxicity Single Exposure Category 3 (Nervous System) Carcinogen Category 1A Germ Cell Mutagenicity Category 1B

Label Elements:
Danger!



Hazard Phrases:
Highly flammable liquid and vapor.
May be fatal if swallowed and enters airways.
Causes skin irritation.
May cause drowsiness or dizziness.
May cause cancer.
May cause genetic defects.

Precautionary Phrases:
Prevention

Obtain special instructions before use.
Do not handle until all safety precautions have been read and understood
Keep away from heat, sparks, open flames, and hot surfaces. No smoking.
Keep container tightly closed.
Ground and bond container and receiving equipment
Use explosion-proof electrical, ventilating and lighting equipment.
Use only non-sparking tools.
Take precautionary measures against static discharge.
Avoid breathing vapors.
Wash thoroughly after handling.
Use only outdoors or in a well-ventilated area.
Wear protective gloves, skin protection and eye protection.

Response
IF SWALLOWED: Immediately call a POISON CENTER or doctor.
Do NOT induce vomiting.
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water.
If skin irritation occurs: Get medical attention.
Take off contaminated clothing and wash it before reuse.
IF INHALED: Remove person to fresh air and keep comfortable for breathing.
Call a POISON CENTER or doctor if you feel unwell.
IF exposed or concerned: Get medical attention.
In case of fire: Use water fog, carbon dioxide, dry chemical and foam to extinguish.

Storage and Disposal
Store in a well-ventilated place. Keep cool. Keep container tightly closed.
Store locked up.
Dispose of contents and container in accordance with local and national regulations.

SECTION 3 COMPOSITION / INFORMATION ON INGREDIENTS

Chemical name	CAS No.	Concentration
Gasoline	8006-61-9	95-100%
Naphthalene	91-20-3	0-3%
Benzene	71-43-2	0-0.5%

SECTION 4 EMERGENCY and FIRST AID PROCEDURES

Eye Contact: Immediately flush eyes with water for several minutes. Get medical attention if irritation persists.

Skin Contact: Remove contaminated clothing and flush skin with water for several minutes. Wash thoroughly with soap and water. Get medical attention if irritation develops or persists. Launder clothing before reuse. Discard contaminated shoes.

Inhalation: Remove to fresh air. If breathing is difficult have qualified personnel administer oxygen. If breathing has stopped, administer artificial respiration. Get medical attention**.**

Ingestion: Do not induce vomiting. Rinse mouth with water. Never give anything by mouth to an unconsciousness person. If vomiting occurs spontaneously, keep head below hips to prevent aspiration into the lungs. Get immediate medical attention.

Most important symptoms/effects, acute and delayed: May cause eye irritation. Causes skin irritation with redness and drying. Inhalation may cause respiratory irritation and central nervous system effects. Harmful or fatal if swallowed. Aspiration during swallowing or vomiting may cause lung damage. May cause cancer. May cause genetic defects.

Indication of immediate medical attention and special treatment, if necessary: Immediate medical attention is required for ingestion.

SECTION 5 FIRE and EXPLOSION HAZARD DATA

Suitable extinguishing media: Use water fog, foam, carbon dioxide, or dry chemical. Do not use a steady stream of water. Product may float on the surface of water and create a floating fire hazard.
Specific hazards arising from the chemical: This product is highly flammable and forms explosive mixtures with air. Vapors are heavier than air and will travel along surfaces to remote ignition sources and flash back. Closed containers may explode if exposed to extreme heat. Combustion may produce carbon oxides and other products of incomplete combustion.
Special protective equipment and precautions for fire-fighters: Firefighters should wear full emergency equipment and a NIOSH approved positive pressure self-contained breathing apparatus. Cool fire exposed container with water. Do not allow run-off from firefighting to enter drains or water courses.

SECTION 6 ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment, and emergency procedures: Wear appropriate protective equipment. Eliminate ignitions sources and ventilate the area with explosion proof equipment. Wash thoroughly after handling.
Environmental hazards: Avoid release into the environment. Report spill as required by local and federal regulations.
Methods and materials for containment and cleaning up: Contain with an inert absorbent and place into a closable container for disposal. Use non-sparking tools and equipment. If spill has not ignited, use water spray to disperse the vapors and protect personnel attempting to stop leak. Prevent entry in storm sewers and waterways. Runoff can cause a fire or explosion hazard in sewers.

SECTION 7 HANDLING and STORAGE

Precautions for safe handling: Avoid contact with eyes, skin and clothing. Avoid breathing vapors. Wash thoroughly after handling. Use only with adequate ventilation. Wash thoroughly with soap and water after handling. Keep containers closed when not in use. Keep product away from heat, sparks, flames and all other sources of ignition. Do not permit smoking in use or storage areas. Use with non-sparking tools and explosion proof equipment. Electrically bond and ground containers for transfer

Do not cut, drill, grind or weld on or near containers, even empty containers. Empty containers retain product residues can be hazardous. Follow all SDS precautions when handling empty containers.

Improper filling of portable gasoline containers creates a fire hazard. Only dispense gasoline into an approved and properly labeled gasoline container. Always place portable containers on the ground while filling. Ensure pump nozzle is in contact with the container while filling. Do not use the nozzle’s lock open device. Do not fill portable containers that are inside a vehicle or trailer/truck bed.

Do not use as a cleaner or solvent. Use only as a motor fuel. Do not siphon by mouth.

Refer to OSHA 1910.1028 for requirements for handling and use of benzene.

Conditions for safe storage, including any incompatibilities: S Store in accordance with regulations for the storage of flammable liquids. Store in a dry, well ventilated area away from heat, direct sunlight and all sources of ignition. Store away from oxidizers and other incompatible materials. Protect containers from physical damage.

SECTION 8 EXPOSURE CONTROLS and PERSONAL PROTECTION

Exposure Guidelines:

INGREDIENTS	EXPOSURE LIMITS
Gasoline	300 ppm TWA , 500 ppm STEL ACGIH TLV
Naphthalene	10 ppm TWA OSHA PEL
	10 ppm, skin TWA ACGIH TLV
Benzene	1 ppm TWA, 5 ppm STEL OSHA PEL
	0.5 ppm TWA, 2.5 ppm STEL ACGIH TLV

29 CFR 1910.1028 is the OSHA regulation on Occupational Exposure to Benzene. Assure compliance with these regulations.

Appropriate engineering controls: Use with local exhaust ventilation to maintain exposures below the occupational exposure limits. Use explosion proof equipment where required

Respiratory protection: If exposures are exceeded, use a NIOSH approved organic vapor respirator appropriate for the form and concentration of the contaminants should be used. Selection of respiratory protection depends on the contaminant type, form and concentration. Select in accordance with OSHA 1910.134 and good Industrial Hygiene practice.
Skin protection: Impervious gloves such as viton recommended to prevent skin contact.
Eye protection: Wear chemical safety goggles to avoid eye contact.
Other: Impervious coveralls, apron and boots is required to prevent skin contact and contamination of personal clothing. A safety shower and eye wash should be available in the immediate work area.

SECTION 9 PHYSICAL and CHEMICAL PROPERTIES

Appearance (physical state, color, etc.): Colored or clear liquid
Odor: Aromatic hydrocarbon odor.

Odor threshold: 0.3 ppm (gasoline)	**pH:** Not applicable
Melting point/Pourpoint: -76°F (-60°C)	**Boiling Point:** 230° F (110°C)
Flash point: -45°F (-42.8°C)	**Evaporation rate:** Not available
Flammability (solid, gas): Not applicable	
Flammable limits: LEL: 1.4%	**UEL:** 7.6%
Vapor pressure: 7-15 psia	**Vapor density:** >1
Relative density: 0.65-0.75	**Solubility:** Insoluble in water
Partition coefficient: n-ctanol/water: Not available	**Auto-ignition temperature:** >530°F (>276.6°C)
Decomposition temperature: Not available	**Viscosity:** Not applicable

SECTION 10 STABILITY and REACTIVITY

Reactivity: This product is not expected to be reactive.
Chemical stability: The product is stable.
Possibility of hazardous reactions: None known.
Conditions to avoid: Keep away from heat and all sources of ignition.
Incompatible materials: Avoid oxidizing agents, acids, alkalies and halogens.

Hazardous decomposition products: Thermal decomposition may yield carbon oxides and other products of incomplete combustion.

SECTION 11 TOXICOLOGICAL INFORMATION

Health Hazards:

Inhalation: Vapors may cause respiratory irritation and central nervous system effect including headache, dizziness, headaches, giddiness, euphoria, vertigo, blurred vision, nausea, numbness, drowsiness, anesthesia, and coma. Gasoline vapors are heavier than air and may cause asphyxiation in enclosed or poorly ventilated area. Overexposure to benzene by inhalation may cause exhilaration, nervous excitation, and/or giddiness, followed by a period of depression, drowsiness, or fatigue, tightness of the chest, unconsciousness, tremors or death.

Skin Contact: Skin contact may cause irritation, redness and defatting of the skin.

Eye Contact: Eye contact may cause mild irritation with redness, tearing and pain.

Ingestion: Swallowing may cause gastrointestinal irritation, nausea, vomiting, diarrhea, vertigo, drowsiness, mental confusion, staggering gait, slurred speech, convulsions, unconsciousness and death due to circulatory failure. Aspiration during swallowing or vomiting may cause lung damage.

Chronic Effects of Overexposure: Prolonged occupational overexposure may cause dermatitis. Reports have associated repeated and prolonged overexposure to petroleum distillates with adverse liver, kidney and bone marrow effects and with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the product may be harmful or fatal. Repetitive direct skin application of kerosene over a two year period resulted in skin cancer in laboratory animals. Petroleum hydrocarbons of similar composition and boiling ranges have been known to product kidney damage and tumors in male rats following prolonged inhalation exposures. Benzene has been shown to cause damage to the blood forming system with anemia, leukopenia and thrombocytopenia by all routes of exposure.

Mutagenicity: Benzene did not induce in vitro mutation in bacteria using standard AMES test conditions. Mammalian cell gene mutation tests carried out in various human, mouse and Chinese hamster cells resulted in mixed results. Benzene is an in vivo mutagen in mammals, especially when chromosomal aberrations and micronuclei are induced. It has been reported that benzene exposure in humans induces genotoxic effects in lymphocytes in vivo.

Reproductive Toxicity: In a reproductive study, rats were administered 250 and 1000 mg/kg of petroleum distillates for at least 70 days prior to mating and during the 14 day mating cycle. The absence of adverse effects on in-life parameters (such as body weight, feed consumption, and clinical observations), a dosage level of 1000 mg/kg/day was considered to be the no-observed-adverse-effect level (NOAEL) for reproductive and systemic toxicity.

Carcinogenicity: Gasoline is listed by IARC as “Possibly Carcinogenic to Humans”, Group 2B and as a “Confirmed Animal Carcinogen with Unknown Relevance to Humans: A3 by ACGIH. Benzene is listed by IARC as “Carcinogenic to Humans” Group 1, by NTP as “Known to Be a Human Carcinogen” and as a “Confirmed Human Carcinogen”, A1 by ACGIH. Naphthalene is listed by IARC as “Possibly Carcinogenic to Humans”, Group 2B, as “Reasonably Anticipated to be a Human Carcinogen” and as a “Confirmed Animal Carcinogen with Unknown Relevance to Humans”, A3 by ACGIH.

Acute Toxicity Values: Acute Toxicity Estimate: Oral 14492 mg/kg
Gasoline: Oral rat LD50 >5000 mg/kg, Inhalation rat LC50 >5.61 mg/L/4 hr, Dermal rabbit LD50 >2000 mg/kg
Naphthalene: Oral rat LD50 533 mg/kg, Inhalation rat LC0 0.4 mg/L (highest attainable concentration), Dermal rat LC50 >2500 mg/kg
Benzene: Oral rat LD50 >2000 mg/kg, Inhalation rat LC50 41.69 mg/L/4 hr, Dermal rabbit LD50 > 8260 mg/kg

SECTION 12: ECOLOGICAL INFORMATION

Ecotoxicity:
Gasoline: 96 hr LL50 Pimephales promelas 8.2 mg/kg, 48 hr EL50 4.5 mg/L, 72 hr EL50 Pseudokirchnerella subcapitata 3.1 mg/L
Naphthalene: 96 hr LC50 Pimephales promelas 6.08 mg/L, 48 hr EC50 daphnia magna 2.16 mg/L
Benzene: 96 hr LC50 Oncorhynchus mykiss 5.3 mg/L, 48 hr EC50 daphnia magna 10 mg/L, 72 hr EC50 Pseudokirchnerella subcapitata 32 mg/L

Persistence and degradability: Gasoline is inherently biodegradable.
Bioaccumulative potential: The bioaccumulation potentials of the major components of gasoline range from low to high. Some higher molecular weight components may be taken up by fish and domestic animals and bioconcentrated if they persist in environment.
Mobility in soil: Gasoline is expected to possess low to moderate mobility in soil.
Other adverse effects: None known.

SECTION 13: DISPOSAL INFORMATION

Waste Disposal Method: Dispose in accordance with all local, state and federal regulations.

SECTION 14: TRANSPORTATION INFORMATION

	UN Number	Proper shipping name	Hazard Class	Packing Group	Environmental Hazard
DOT	UN1203	Gasoline	3	PG II	No
TDG	UN1203	Gasoline	3	PG II	No
IMDG	UN1203	Gasoline	3	PG II	No
IATA	UN1203	Gasoline	3	PG II	No

Transport in bulk (according to Annex II of MARPOL 73/78 and the IBC Code): Not applicable.

Special precautions: None known.

SECTION 15: REGULATORY INFORMATION

Safety, health, and environmental regulations specific for the product in question.

CERCLA Hazardous Substances (Section 103)/RQ: This product has a Reportable Quantity (RQ) of 3,333 lbs. (based on the RQ for Naphthalene of 100 lbs). Releases above the RQ must be reported to the National Response Center. Many states have more stringent release reporting requirements. Report spills required under federal, state and local regulations.

EPA SARA 311 Hazard Classification: Acute Health, Chronic Health, Fire Hazard

SARA 313: This product contains the following chemicals subject to Annual Release Reporting Requirements Under SARA Title III, Section 313 (40 CFR 372):

Benzene	71-43-2	0-0.5%
Naphthalene	91-20-3	0-3%

CALIFORNIA PROPOSITION 65: This product contains chemicals known to the State of California to cause cancer or reproductive toxicity.

WHMIS CLASSIFICATION: Class B, Division 2 (Flammable Liquid), Class D, Division 2A (Very Toxic Material Causing Other Toxic Effects)

This product has been classified in accordance with the hazard criteria in the CPR and the MSDS contains all the information required by the CPR.

Australia AICS: All of the components are listed on the Australian Inventory of Chemical Substances.

Canada DSL: All of the components are listed on the Canadian Domestic Substances List.

China: All the components are listed on Inventory of Existing Chemical Substances in China.

European EINECS: All of the ingredients are listed on the EINECS inventory.

Korea: All the components are listed on the Korean Existing Chemical List.

New Zealand: All the components are listed on the New Zealand Inventory of Chemicals.

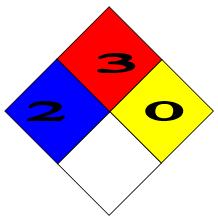
Philippines: All the components are listed on the Philippine Inventory of Chemical and Chemical Substances inventory.

US EPA Toxic Substances Control Act: All of the components of this product are listed on the TSCA inventory.

SECTION 16: OTHER INFORMATION

SDS Revision History: Converted to GHS format – all Sections revised
Date of current revision: January 9, 2015
Date of previous revision: December 2002

National Fire Protection Association (U.S.A)



Health: 2*
Flammability : 3
Instability: 0
Specific Hazard:

Disclaimer: This product material safety data sheet provides health and safety information. The product should be used in applications consistent with this product literature. For any other uses, exposures should be evaluated so that appropriate handling practices and training programs can be established to ensure safe workplace operations.

This material safety data sheet is provided in good faith and meets the requirements of the hazardous communication provisions of SARA TITLE III and 29 CFR 1910.1200(g) of the OSHA regulations. The above information is based on review of available information Sinclair believes is reliable and is supplied for informational purposes only. Sinclair does not guarantee its completeness or accuracy. Since conditions of use are outside the control of Sinclair, Sinclair disclaims all warranties, express or implied, and any liability for damage or injury which results from the use of the above data. Nothing herein is intended to permit infringement of valid patents and licenses.

SAFETY DATA SHEET

Creation Date 12-Nov-2010 **Revision Date** 19-May-2016 **Revision Number** 8

SECTION 1: IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1. Product identification

Product Description:	**Sulfuric acid, 94-98%**
Cat No. :	**A510-P500, A510-P1, A510-P212**
Synonyms	Hydrogen sulfate; Vitriol brown oil; Oil of vitriol
Molecular Formula	H2SO4
Reach Registration Number	-

1.2. Relevant identified uses of the substance or mixture and uses advised against

Recommended Use	Laboratory chemicals.
Sector of use	SU3 - Industrial uses: Uses of substances as such or in preparations at industrial sites
Product category	PC21 - Laboratory chemicals
Process categories	PROC15 - Use as a laboratory reagent
Environmental release category	ERC6a - Industrial use resulting in manufacture of another substance (use of intermediates)
Uses advised against	No Information available

1.3. Details of the supplier of the safety data sheet

Company	Fisher Scientific UK Bishop Meadow Road, Loughborough, Leicestershire LE11 5RG, United Kingdom
E-mail address	begel.sdsdesk@thermofisher.com

1.4. Emergency telephone number

Tel: 01509 231166
Chemtrec US: (800) 424-9300
Chemtrec EU: 001 (202) 483-7616

SECTION 2: HAZARDS IDENTIFICATION

2.1. Classification of the substance or mixture

CLP Classification - Regulation (EC) No 1272/2008

Physical hazards
Based on available data, the classification criteria are not met

Health hazards

Skin Corrosion/irritation	Category 1 A
Serious Eye Damage/Eye Irritation	Category 1

Environmental hazards
Based on available data, the classification criteria are not met

2.2. Label elements



Signal Word **Danger**

Hazard Statements

H314 - Causes severe skin burns and eye damage

Precautionary Statements

P280 - Wear protective gloves/ protective clothing/ eye protection/ face protection
P301 + P330 + P331 - IF SWALLOWED: Rinse mouth. Do NOT induce vomiting
P303 + P361 + P353 - IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower
P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing

2.3. Other hazards

No information available

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.2. Mixtures

Component	CAS-No	EC-No.	Weight %	CLP Classification - Regulation (EC) No 1272/2008
Water	7732-18-5	231-791-2	2 - 10	-
Sulfuric acid	7664-93-9	231-639-5	90 - 98	Skin Corr. 1A (H314) Eye Dam. 1 (H318)

Reach Registration Number	-	
Component	**Reach Registration Number**	
Sulfuric acid	01-2119458838-20	

Full text of Hazard Statements: see section 16

SECTION 4: FIRST AID MEASURES

4.1. Description of first aid measures

General Advice Show this safety data sheet to the doctor in attendance. Immediate medical attention is required.

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Immediate medical attention is required.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Remove and wash contaminated clothing before re-use. Call a physician immediately.

Ingestion Do not induce vomiting. Clean mouth with water. Never give anything by mouth to an unconscious person. Call a physician immediately.

Inhalation If not breathing, give artificial respiration. Remove from exposure, lie down. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Call a physician immediately.

Protection of First-aiders Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and prevent spread of contamination.

4.2. Most important symptoms and effects, both acute and delayed

Causes burns by all exposure routes. Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated: Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation

4.3. Indication of any immediate medical attention and special treatment needed

Notes to Physician Treat symptomatically.

SECTION 5: FIREFIGHTING MEASURES

5.1. Extinguishing media

Suitable Extinguishing Media
CO_2, dry chemical, dry sand, alcohol-resistant foam.

Extinguishing media which must not be used for safety reasons
No information available.

5.2. Special hazards arising from the substance or mixture

Thermal decomposition can lead to release of irritating gases and vapors. The product causes burns of eyes, skin and mucous membranes.

Hazardous Combustion Products
Sulfur oxides, Hydrogen.

5.3. Advice for firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Thermal decomposition can lead to release of irritating gases and vapors.

SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1. Personal precautions, protective equipment and emergency procedures

Ensure adequate ventilation. Use personal protective equipment. Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak.

6.2. Environmental precautions

Should not be released into the environment.

6.3. Methods and material for containment and cleaning up

Soak up with inert absorbent material. Keep in suitable, closed containers for disposal.

6.4. Reference to other sections

Refer to protective measures listed in Sections 8 and 13.

SECTION 7: HANDLING AND STORAGE

7.1. Precautions for safe handling

Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Use only under a chemical fume hood. Do not breathe vapors or spray mist. Do not ingest.

Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice. Keep away from food, drink and animal feeding stuffs. Do not eat, drink or smoke when using this product. Remove and wash contaminated clothing before re-use. Wash hands before breaks and at the end of workday.

7.2. Conditions for safe storage, including any incompatibilities

Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from water. Corrosives area.

7.3. Specific end use(s)

Use in laboratories

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1. Control parameters

Exposure limits
List source(s): **EU** - Commission Directive 2006/15/EC of 7 February 2006 establishing a second list of indicative occupational exposure limit values in implementation of Council Directive 98/24/EC and amending Directives 91/322/EEC and 2000/39/EC on the protection of the health and safety of workers from the risks related to chemical agents at work. **UK** - EH40/2005 Containing the workplace exposure limits (WELs) for use with the Control of Substances Hazardous to Health Regulations (COSHH) 2002 (as amended). Updated by September 2006 official press release and October 2007 Supplement. **IRE -** 2010 Code of Practice for the Safety, Health and Welfare at Work (Chemical Agents) Regulations 2001. Published by the Health and Safety Authority.

Component	European Union	The United Kingdom	France	Belgium	Spain
Sulfuric acid	TWA: 0.05 mg/m³ 8 hr	TWA: 0.05 mg/m³ 8 hr	TWA / VME: 0.05 mg/m³ (8 heures). STEL / VLCT: 3 mg/m³.	TWA: 0.2 mg/m³ 8 uren	TWA / VLA-ED: 0.05 mg/m³ (8 horas)

Component	Italy	Germany	Portugal	The Netherlands	Finland
Sulfuric acid	-	TWA: 0.1 mg/m³ (8 Stunden). AGW - exposure factor 1 TWA: 0.1 mg/m³ (8 Stunden). MAK Höhepunkt: 0.1 mg/m³	TWA: 0.05 mg/m³ 8 horas	TWA: 0.05 mg/m³ 8 uren	TWA: 0.05 mg/m³ 8 tunteina STEL: 0.1 mg/m³ 15 minuutteina

Component	Austria	Denmark	Switzerland	Poland	Norway
Sulfuric acid	MAK-KZW: 0.2 mg/m³ 15 Minuten MAK-TMW: 0.1 mg/m³ 8 Stunden	TWA: 0.05 mg/m³ 8 timer	STEL: 0.1 mg/m³ 15 Minuten TWA: 0.1 mg/m³ 8 Stunden	TWA: 0.05 mg/m³ 8 godzinach	TWA: 0.1 mg/m³ 8 timer STEL: 0.1 mg/m³ 15 minutter. inhalable fraction

Component	Bulgaria	Croatia	Ireland	Cyprus	Czech Republic
Sulfuric acid	TWA: 0.05 mg/m³	TWA-GVI: 0.05 mg/m³ 8 satima.	TWA: 0.05 ppm 8 hr. STEL: 0.15 ppm 15 min	TWA: 0.05 mg/m³	TWA: 1 mg/m³ 8 hodinách. SO3 TWA: 0.05 mg/m³ 8 hodinách. concentrated H2SO4 mist Ceiling: 2 mg/m³ SO3

Component	Estonia	Gibraltar	Greece	Hungary	Iceland
Sulfuric acid	TWA: 1 mg/m³ 8 tundides. fume	TWA: 0.05 mg/m³ 8 hr when selecting an appropriate exposure monitoring method, account should be taken of potential limitations and interferences that may arise in the presence of other	TWA: 0.05 mg/m³	TWA: 0.05 mg/m³ 8 órában. AK	TWA: 0.05 mg/m³ 8 klukkustundum. aerosols Ceiling: 0.1 mg/m³

		sulphur compounds thoracic fraction			

Component	Latvia	Lithuania	Luxembourg	Malta	Romania
Sulfuric acid	TWA: 0.05 mg/m³	TWA: 0.05 mg/m³ vapor IPRD STEL: 3 mg/m³	TWA: 0.05 mg/m³ 8 Stunden	TWA: 0.05 mg/m³	TWA: 0.05 mg/m³ 8 ore

Component	Russia	Slovak Republic	Slovenia	Sweden	Turkey
Sulfuric acid	Skin notation MAC: 1 mg/m³	TWA: 0.1 mg/m³	TWA: 0.05 mg/m³ 8 urah inhalable fraction, fog	STV: 0.2 mg/m³ 15 minuter LLV: 0.1 mg/m³ 8 timmar.	TWA: 0.05 mg/m³ 8 saat

Biological limit values
This product, as supplied, does not contain any hazardous materials with biological limits established by the region specific regulatory bodies.

Monitoring methods
BS EN 14042:2003 Title Identifier: Workplace atmospheres. Guide for the application and use of procedures for the assessment of exposure to chemical and biological agents.

Derived No Effect Level (DNEL) No information available

Route of exposure	Acute effects (local)	Acute effects (systemic)	Chronic effects (local)	Chronic effects (systemic)
Oral				
Dermal				
Inhalation				

Predicted No Effect Concentration (PNEC) No information available.

8.2. Exposure controls

Engineering Measures
Use only under a chemical fume hood. Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.
Wherever possible, engineering control measures such as the isolation or enclosure of the process, the introduction of process or equipment changes to minimise release or contact, and the use of properly designed ventilation systems, should be adopted to control hazardous materials at source

Personal protective equipment

Eye Protection Goggles (European standard - EN 166)
Hand Protection Protective gloves

Glove material	Breakthrough time	Glove thickness	EU standard	Glove comments
Butyl rubber	See manufacturers recommendations	-	EN 374	(minimum requirement)

Skin and body protection Long sleeved clothing

Inspect gloves before use.
Please observe the instructions regarding permeability and breakthrough time which are provided by the supplier of the gloves. (Refer to manufacturer/supplier for information)
Ensure gloves are suitable for the task: Chemical compatability, Dexterity, Operational conditions, User susceptibility, e.g. sensitisation effects, also take into consideration the specific local conditions under which the product is used, such as the danger of cuts, abrasion.
Remove gloves with care avoiding skin contamination.

Respiratory Protection When workers are facing concentrations above the exposure limit they must use appropriate certified respirators.
To protect the wearer, respiratory protective equipment must be the correct fit and be used

	and maintained properly
Large scale/emergency use	Use a NIOSH/MSHA or European Standard EN 136 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced **Recommended Filter type:** Particulates filter conforming to EN 143 Acid gases filter Type E Yellow conforming to EN14387
Small scale/Laboratory use	Use a NIOSH/MSHA or European Standard EN 149:2001 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced. **Recommended half mask:-** Valve filtering: EN405; or; Half mask: EN140; plus filter, EN 141 When RPE is used a face piece Fit Test should be conducted
Environmental exposure controls	No information available.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1. Information on basic physical and chemical properties

Appearance	Clear, Colorless to brown	
Physical State	Liquid	
Odor	Odorless	
Odor Threshold	No data available	
pH	0.3	(1N)
Melting Point/Range	10 °C / 50 °F	
Softening Point	No data available	
Boiling Point/Range	290 - 338 °C / 554 - 640.4 °F	
Flash Point	Not applicable	**Method -** No information available
Evaporation Rate	Slower than ether	
Flammability (solid,gas)	Not applicable	Liquid
Explosion Limits	No data available	
Vapor Pressure	< 0.001 mmHg @ 20 °C	
Vapor Density	3.38 (Air = 1.0)	(Air = 1.0)
Specific Gravity / Density	1.84	
Bulk Density	Not applicable	Liquid
Water Solubility	No information available	
Solubility in other solvents	No information available	
Partition Coefficient (n-octanol/water)		
Autoignition Temperature	No data available	
Decomposition Temperature	340°C	
Viscosity	No data available	
Explosive Properties	No information available	
Oxidizing Properties	No information available	

9.2. Other information

Molecular Formula	H2SO4
Molecular Weight	98.08

SECTION 10: STABILITY AND REACTIVITY

10.1. Reactivity

Yes

10.2. Chemical stability

Reacts violently with water, Hygroscopic.

10.3. Possibility of hazardous reactions

Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

10.4. Conditions to avoid

Incompatible products. Excess heat. Exposure to moist air or water.

10.5. Incompatible materials

Water. Organic materials. Strong acids. Strong bases. Metals. Alcohols. Cyanides. Sulfides.

10.6. Hazardous decomposition products

Sulfur oxides. Hydrogen.

SECTION 11: TOXICOLOGICAL INFORMATION

11.1. Information on toxicological effects

Product Information

(a) acute toxicity;

Oral Based on available data, the classification criteria are not met
Dermal Based on available data, the classification criteria are not met
Inhalation Based on available data, the classification criteria are not met

Toxicology data for the components

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Water	-		
Sulfuric acid	2140 mg/kg (Rat)		LC50 = 510 mg/m³ (Rat) 2 h

(b) skin corrosion/irritation; Category 1 A

(c) serious eye damage/irritation; Category 1

(d) respiratory or skin sensitization;

Respiratory Based on available data, the classification criteria are not met
Skin Based on available data, the classification criteria are not met

(e) germ cell mutagenicity; Based on available data, the classification criteria are not met

(f) carcinogenicity; Based on available data, the classification criteria are not met

The table below indicates whether each agency has listed any ingredient as a carcinogen
Exposure to strong inorganic mists containing sulfuric acid may cause cancer by inhalation

Component	EU	UK	Germany	IARC
Sulfuric acid				Group 1

(g) reproductive toxicity; Based on available data, the classification criteria are not met

(h) STOT-single exposure; Based on available data, the classification criteria are not met

(i) STOT-repeated exposure; Based on available data, the classification criteria are not met

Target Organs None known.

(j) aspiration hazard; Based on available data, the classification criteria are not met

Symptoms / effects,both acute and delayed Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated: Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation

SECTION 12: ECOLOGICAL INFORMATION

12.1. Toxicity

Ecotoxicity effects This product contains the following substance(s) which are hazardous for the environment. .

Component	Freshwater Fish	Water Flea	Freshwater Algae	Microtox
Sulfuric acid	LC50: > 500 mg/L, 96h static (Brachydanio rerio)	EC50: 29 mg/L/24h	-	-

12.2. Persistence and degradability No information available

12.3. Bioaccumulative potential No information available

12.4. Mobility in soil

12.5. Results of PBT and vPvB assessment No data available for assessment.

12.6. Other adverse effects

Endocrine Disruptor Information This product does not contain any known or suspected endocrine disruptors

Persistent Organic Pollutant This product does not contain any known or suspected substance

Ozone Depletion Potential This product does not contain any known or suspected substance

SECTION 13: DISPOSAL CONSIDERATIONS

13.1. Waste treatment methods

Waste from Residues / Unused Products Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification. Waste is classified as hazardous. Dispose of in accordance with the European Directives on waste and hazardous waste. Dispose of in accordance with local regulations.

Contaminated Packaging Dispose of this container to hazardous or special waste collection point.

European Waste Catalogue (EWC) According to the European Waste Catalogue, Waste Codes are not product specific, but application specific.

Other Information Waste codes should be assigned by the user based on the application for which the product was used. Do not empty into drains. Do not dispose of waste into sewer. Large amounts will affect pH and harm aquatic organisms. Solutions with low pH-value must be neutralized before discharge.

SECTION 14: TRANSPORT INFORMATION

IMDG/IMO

14.1. UN number UN1830

14.2. UN proper shipping name SULFURIC ACID

14.3. Transport hazard class(es) 8

14.4. Packing group II

ADR

14.1. UN number UN1830

14.2. UN proper shipping name SULPHURIC ACID

14.3. Transport hazard class(es) 8

14.4. Packing group II

IATA

14.1. UN number UN1830

14.2. UN proper shipping name SULFURIC ACID
14.3. Transport hazard class(es) 8
14.4. Packing group II

14.5. Environmental hazards No hazards identified

14.6. Special precautions for user No special precautions required

14.7. Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code Not applicable, packaged goods

SECTION 15: REGULATORY INFORMATION

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

International Inventories X = listed

Component	EINECS	ELINCS	NLP	TSCA	DSL	NDSL	PICCS	ENCS	IECSC	AICS	KECL
Water	231-791-2	-		X	X	-	X	-	X	X	X
Sulfuric acid	231-639-5	-		X	X	-	X	X	X	X	X

National Regulations

Component	Germany - Water Classification (VwVwS)	Germany - TA-Luft Class
Sulfuric acid	WGK 1	

Take note of Control of Substances Hazardous to Health Regulations (COSHH) 2002 and 2005 Amendment.
Take note of Dir 94/33/EC on the protection of young people at work
Take note of Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work

15.2. Chemical safety assessment

A Chemical Safety Assessment/Report (CSA/CSR) is not required (< 10 t/y)

SECTION 16: OTHER INFORMATION

Full Text of H-/EUH-Statements Referred to Under Section 3
H314 - Causes severe skin burns and eye damage
H318 - Causes serious eye damage

Legend

CAS - Chemical Abstracts Service

EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
IECSC - Chinese Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
ENCS - Japanese Existing and New Chemical Substances
AICS - Australian Inventory of Chemical Substances
NZIoC - New Zealand Inventory of Chemicals

WEL - Workplace Exposure Limit
ACGIH - American Conference of Governmental Industrial Hygienists
DNEL - Derived No Effect Level
RPE - Respiratory Protective Equipment
LC50 - Lethal Concentration 50%
NOEC - No Observed Effect Concentration
PBT - Persistent, Bioaccumulative, Toxic

TWA - Time Weighted Average
IARC - International Agency for Research on Cancer
PNEC - Predicted No Effect Concentration
LD50 - Lethal Dose 50%
EC50 - Effective Concentration 50%
POW - Partition coefficient Octanol:Water
vPvB - very Persistent, very Bioaccumulative

ADR - European Agreement Concerning the International Carriage of Dangerous Goods by Road
IMO/IMDG - International Maritime Organization/International Maritime

ICAO/IATA - International Civil Aviation Organization/International Air Transport Association

Dangerous Goods Code

MARPOL - International Convention for the Prevention of Pollution from Ships

OECD - Organisation for Economic Co-operation and Development

ATE - Acute Toxicity Estimate

BCF - Bioconcentration factor

VOC - Volatile Organic Compounds

Key literature references and sources for data

Suppliers safety data sheet, Chemadvisor - LOLI, Merck index, RTECS

Classification and procedure used to derive the classification for mixtures according to Regulation (EC) 1272/2008 [CLP]:

Physical hazards	On basis of test data
Health Hazards	Calculation method
Environmental hazards	Calculation method

Training Advice

Chemical hazard awareness training, incorporating labelling, Safety Data Sheets (SDS), Personal Protective Equipment (PPE) and hygiene.

Use of personal protective equipment, covering appropriate selection, compatibility, breakthrough thresholds, care, maintenance, fit and standards.

First aid for chemical exposure, including the use of eye wash and safety showers.

Chemical incident response training.

Creation Date	12-Nov-2010
Revision Date	19-May-2016
Revision Summary	Update to Format.

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of Safety Data Sheet

SAFETY DATA SHEET

Creation Date 12-Mar-2009 **Revision Date** 24-May-2017 **Revision Number** 6

1. Identification

Product Name **Nitric acid, Trace Metal Grade**

Cat No. : **A509-212; A509-500; A509P212; A509P500; A509SK212**

Synonyms Azotic acid; Engraver's acid; Aqua fortis

Recommended Use Laboratory chemicals.
Uses advised against Not for food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number
CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Oxidizing liquids	Category 3
Corrosive to metals	Category 1
Skin Corrosion/irritation	Category 1 A
Serious Eye Damage/Eye Irritation	Category 1

Label Elements

Signal Word
Danger

Hazard Statements
May intensify fire; oxidizer
May be corrosive to metals
Causes severe skin burns and eye damage



Precautionary Statements
Prevention
Do not breathe dust/fume/gas/mist/vapors/spray
Wash face, hands and any exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection
Use only outdoors or in a well-ventilated area
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep/Store away from clothing/ other combustible materials
Take any precaution to avoid mixing with combustibles
Keep only in original container
Wear respiratory protection
Response
Immediately call a POISON CENTER or doctor/physician
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Immediately call a POISON CENTER or doctor/physician
Skin
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
Wash contaminated clothing before reuse
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
Ingestion
IF SWALLOWED: Rinse mouth. DO NOT induce vomiting
Fire
In case of fire: Use CO2, dry chemical, or foam for extinction
Spills
Absorb spillage to prevent material damage
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Store in corrosive resistant polypropylene container with a resistant inliner
Store in a dry place
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Corrosive to the respiratory tract

3. Composition / information on ingredients

Component	CAS-No	Weight %
Nitric acid	7697-37-2	65 - 70
Water	7732-18-5	30 - 35

4. First-aid measures

General Advice Immediate medical attention is required. Show this safety data sheet to the doctor in attendance.

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Immediate medical attention is required.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Remove and wash contaminated clothing before re-use. Call a physician immediately.

Inhalation If breathing is difficult, give oxygen. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with

	a one-way valve or other proper respiratory medical device. Remove from exposure, lie down. Call a physician immediately.
Ingestion	Do not induce vomiting. Never give anything by mouth to an unconscious person. Clean mouth with water. Call a physician immediately.
Most important symptoms/effects	Causes burns by all exposure routes. Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation: Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	CO_2, dry chemical, dry sand, alcohol-resistant foam.
Unsuitable Extinguishing Media	No information available
Flash Point	Not applicable
Method -	No information available
Autoignition Temperature	No information available
Explosion Limits	
Upper	No data available
Lower	No data available
Oxidizing Properties	Oxidizer
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Thermal decomposition can lead to release of irritating gases and vapors. The product causes burns of eyes, skin and mucous membranes. Oxidizer: Contact with combustible/organic material may cause fire. May ignite combustibles (wood paper, oil, clothing, etc.).

Hazardous Combustion Products
Nitrogen oxides (NOx) Thermal decomposition can lead to release of irritating gases and vapors
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Thermal decomposition can lead to release of irritating gases and vapors.

NFPA

Health	Flammability	Instability	Physical hazards
4	0	0	OX

6. Accidental release measures

Personal Precautions	Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak. Ensure adequate ventilation. Use personal protective equipment.
Environmental Precautions	Should not be released into the environment. Do not flush into surface water or sanitary sewer system. See Section 12 for additional ecological information.
Methods for Containment and Clean Up	Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Sweep up and shovel into suitable containers for disposal.

7. Handling and storage

Handling	Use only under a chemical fume hood. Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Do not ingest. Do not breathe vapors or spray mist. Keep away from clothing and other combustible materials.
Storage	Keep containers tightly closed in a dry, cool and well-ventilated place. Do not store near

combustible materials.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Nitric acid	TWA: 2 ppm STEL: 4 ppm	(Vacated) TWA: 2 ppm (Vacated) TWA: 5 mg/m^3 (Vacated) STEL: 4 ppm (Vacated) STEL: 10 mg/m^3 TWA: 2 ppm TWA: 5 mg/m^3	IDLH: 25 ppm TWA: 2 ppm TWA: 5 mg/m^3 STEL: 4 ppm STEL: 10 mg/m^3	TWA: 2 ppm TWA: 5 mg/m^3 STEL: 4 ppm STEL: 10 mg/m^3

Legend

ACGIH *- American Conference of Governmental Industrial Hygienists*
OSHA *- Occupational Safety and Health Administration*
NIOSH IDLH: *The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health*

Engineering Measures Use only under a chemical fume hood. Ensure that eyewash stations and safety showers are close to the workstation location. Ensure adequate ventilation, especially in confined areas.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166. Tightly fitting safety goggles. Face-shield.

Skin and body protection Long sleeved clothing.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures Keep away from food, drink and animal feeding stuffs. When using, do not eat, drink or smoke. Contaminated work clothing should not be allowed out of the workplace. Provide regular cleaning of equipment, work area and clothing. Avoid contact with skin, eyes and clothing. For environmental protection remove and wash all contaminated protective equipment before re-use. Wear suitable gloves and eye/face protection.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Clear Colorless, Light yellow
Odor	Strong Acrid
Odor Threshold	No information available
pH	< 1.0 (0.1M)
Melting Point/Range	-41 °C / -41.8 °F
Boiling Point/Range	Not applicable
Flash Point	Not applicable
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	0.94 kPa (20°C)
Vapor Density	No information available
Specific Gravity	1.40
Solubility	miscible

Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	No information available
Molecular Formula	HNO3
Molecular Weight	63.01

10. Stability and reactivity

Reactive Hazard Yes

Stability Oxidizer: Contact with combustible/organic material may cause fire.

Conditions to Avoid Incompatible products. Combustible material. Excess heat. Exposure to air or moisture over prolonged periods.

Incompatible Materials Combustible material, Strong bases, Reducing agents, Metals, Powdered metals, Organic materials, Aldehydes, Alcohols, Cyanides, Ammonia, Strong reducing agents

Hazardous Decomposition Products Nitrogen oxides (NOx), Thermal decomposition can lead to release of irritating gases and vapors

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Oral LD50	Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.
Dermal LD50	Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.
Vapor LC50	Based on ATE data, the classification criteria are not met. ATE > 20 mg/l.

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Nitric acid	Not listed	Not listed	LC50 = 2500 ppm. (Rat) 1h
Water	-	Not listed	Not listed

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation Causes severe burns by all exposure routes

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Nitric acid	7697-37-2	Not listed	Not listed	Not listed	Not listed	Not listed
Water	7732-18-5	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure None known

STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation: Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Do not empty into drains. Large amounts will affect pH and harm aquatic organisms.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Nitric acid	Not listed	LC50: = 72 mg/L, 96h (Gambusia affinis)	Not listed	Not listed

Persistence and Degradability Miscible with water Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its water solubility.

Component	log Pow
Nitric acid	-2.3

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT

UN-No	UN2031
Proper Shipping Name	NITRIC ACID
Hazard Class	8
Subsidiary Hazard Class	5.1
Packing Group	II

TDG

UN-No	UN2031
Proper Shipping Name	NITRIC ACID
Hazard Class	8
Subsidiary Hazard Class	5.1
Packing Group	II

IATA

UN-No	UN2031
Proper Shipping Name	NITRIC ACID
Hazard Class	8
Subsidiary Hazard Class	5.1
Packing Group	II

IMDG/IMO

UN-No	UN2031
Proper Shipping Name	NITRIC ACID
Hazard Class	8
Subsidiary Hazard Class	5.1
Packing Group	II

15. Regulatory information

All of the components in the product are on the following Inventory lists: X = listed

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Nitric acid	X	X	-	231-714-2	-		X	X	X	X	X
Water	X	X	-	231-791-2	-		X	-	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Nitric acid	7697-37-2	65 - 70	1.0

SARA 311/312 Hazard Categories

Acute Health Hazard	Yes
Chronic Health Hazard	Yes
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	Yes

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Nitric acid	X	1000 lb	-	-

Clean Air Act Not applicable

OSHA Occupational Safety and Health Administration

Component	Specifically Regulated Chemicals	Highly Hazardous Chemicals
Nitric acid	-	TQ: 500 lb

CERCLA
This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Nitric acid	1000 lb	1000 lb

California Proposition 65 This product does not contain any Proposition 65 chemicals

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Nitric acid	X	X	X	X	X
Water	-	-	X	-	-

U.S. Department of Transportation

Reportable Quantity (RQ): Y
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security
This product contains the following DHS chemicals:

Component	DHS Chemical Facility Anti-Terrorism Standard
Nitric acid	2000 lb STQ

Other International Regulations

Mexico - Grade No information available

16. Other information

Prepared By
Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 12-Mar-2009
Revision Date 24-May-2017
Print Date 24-May-2017
Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

SAFETY DATA SHEET

Creation Date 24-Aug-2009 **Revision Date** 24-May-2017 **Revision Number** 4

1. Identification

Product Name Hydrochloric Acid

Cat No. : A144-212; A144-212LC; A144-500; A144-500LB; A144-500LC; A144-612GAL; A144C-212; A144C-212EA; A144P-19; A144P-20; A144S-212; A144S-212EA; A144S-500; A144SI-212

Synonyms Muriatic acid

Recommended Use Laboratory chemicals.
Uses advised against Not for food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Fisher Scientific UK
Bishop Meadow Rd
Loughborough, Leicestershire, LE11 5RG
Great Britain
Tel: 01509 231166

Emergency Telephone Number
CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Corrosive to metals	Category 1
Skin Corrosion/irritation	Category 1 B
Serious Eye Damage/Eye Irritation	Category 1
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Respiratory system.	

Label Elements

Signal Word
Danger

Hazard Statements
May be corrosive to metals
Causes severe skin burns and eye damage
May cause respiratory irritation



Precautionary Statements
Prevention
Do not breathe dust/fume/gas/mist/vapors/spray
Wash face, hands and any exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection
Use only outdoors or in a well-ventilated area
Keep only in original container
Response
Immediately call a POISON CENTER or doctor/physician
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Skin
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
Wash contaminated clothing before reuse
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
Ingestion
IF SWALLOWED: Rinse mouth. DO NOT induce vomiting
Spills
Absorb spillage to prevent material damage
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Store in corrosive resistant polypropylene container with a resistant inliner
Store in a dry place
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
None identified

3. Composition / information on ingredients

Component	CAS-No	Weight %
Water	7732-18-5	62-65
Hydrochloric acid	7647-01-0	35-38

4. First-aid measures

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Immediate medical attention is required.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Immediate medical attention is required.

Inhalation Move to fresh air. If breathing is difficult, give oxygen. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Immediate medical attention is required.

Ingestion	Do not induce vomiting. Call a physician or Poison Control Center immediately.
Most important symptoms/effects	Causes burns by all exposure routes. Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated: Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Substance is nonflammable; use agent most appropriate to extinguish surrounding fire.
Unsuitable Extinguishing Media	No information available
Flash Point	No information available
Method -	No information available
Autoignition Temperature	No information available
Explosion Limits	
Upper	No data available
Lower	No data available
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Corrosive Material. Causes burns by all exposure routes. Thermal decomposition can lead to release of irritating gases and vapors.

Hazardous Combustion Products
Hydrogen chloride gas
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
3	0	0	N/A

6. Accidental release measures

Personal Precautions	Use personal protective equipment. Ensure adequate ventilation. Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak. Do not get in eyes, on skin, or on clothing.
Environmental Precautions	Should not be released into the environment. See Section 12 for additional ecological information.
Methods for Containment and Clean Up	Soak up with inert absorbent material. Keep in suitable, closed containers for disposal.

7. Handling and storage

Handling	Wear personal protective equipment. Do not breathe vapors or spray mist. Do not get in eyes, on skin, or on clothing. Do not ingest.
Storage	Keep containers tightly closed in a dry, cool and well-ventilated place. Corrosives area.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Hydrochloric acid	Ceiling: 2 ppm	Ceiling: 5 ppm Ceiling: 7 mg/m^3 (Vacated) Ceiling: 5 ppm (Vacated) Ceiling: 7 mg/m^3	IDLH: 50 ppm Ceiling: 5 ppm Ceiling: 7 mg/m^3	Ceiling: 5 ppm Ceiling: 7 mg/m^3

Legend

ACGIH *- American Conference of Governmental Industrial Hygienists*
OSHA *- Occupational Safety and Health Administration*
NIOSH IDLH: *The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health*

Engineering Measures Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	pungent
Odor Threshold	No information available
pH	< 1
Melting Point/Range	-35 °C / -31 °F
Boiling Point/Range	57 °C / 135 °F @ 760 mmHg
Flash Point	No information available
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	125 mbar @ 20 °C
Vapor Density	1.27
Specific Gravity	1.18
Solubility	Soluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	1.8 mPa.s @ 15°C
Molecular Formula	HCl.H2O
Molecular Weight	36.46

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability Stable under normal conditions.

Conditions to Avoid Incompatible products. Excess heat.

Incompatible Materials Metals, Strong oxidizing agents, Bases, sodium hypochlorite, Amines, Fluorine, Cyanides, Alkaline

Hazardous Decomposition Products Hydrogen chloride gas

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions Contact with metals may evolve flammable hydrogen gas.

11. Toxicological information

Acute Toxicity

Product Information

Oral LD50 Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.

Dermal LD50 Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.

Vapor LC50 Based on ATE data, the classification criteria are not met. ATE > 20 mg/l.

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Water	-	Not listed	Not listed
Hydrochloric acid	238 - 277 mg/kg (Rat)	> 5010 mg/kg (Rabbit)	1.68 mg/L (Rat) 1 h

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation Causes burns by all exposure routes

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Water	7732-18-5	Not listed	Not listed	Not listed	Not listed	Not listed
Hydrochloric acid	7647-01-0	Not listed	Not listed	Not listed	Not listed	Not listed

IARC: (International Agency for Research on Cancer)

IARC: (International Agency for Research on Cancer)
Group 1 - Carcinogenic to Humans
Group 2A - Probably Carcinogenic to Humans
Group 2B - Possibly Carcinogenic to Humans

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure Respiratory system

STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated: Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Do not empty into drains. Large amounts will affect pH and harm aquatic organisms.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Hydrochloric acid	-	282 mg/L LC50 96 h Gambusia affinis mg/L LC50 48 h Leucscus idus	-	56mg/L EC50 72h Daphnia

Persistence and Degradability Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its water solubility.

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT

UN-No UN1789
Proper Shipping Name HYDROCHLORIC ACID
Hazard Class 8
Packing Group II

TDG

UN-No UN1789
Proper Shipping Name HYDROCHLORIC ACID
Hazard Class 8
Packing Group II

IATA

UN-No UN1789
Proper Shipping Name Hydrochloric acid
Hazard Class 8
Packing Group II

IMDG/IMO

UN-No UN1789
Proper Shipping Name Hydrochloric acid
Hazard Class 8
Packing Group II

15. Regulatory information

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Water	X	X	-	231-791-2	-		X	-	X	X	X
Hydrochloric acid	X	X	-	231-595-7	-		X	X	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule

T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Hydrochloric acid	7647-01-0	35-38	1.0

SARA 311/312 Hazard Categories

Acute Health Hazard	Yes
Chronic Health Hazard	Yes
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Hydrochloric acid	X	5000 lb	-	-

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Hydrochloric acid	X		-

OSHA Occupational Safety and Health Administration
Not applicable

Component	Specifically Regulated Chemicals	Highly Hazardous Chemicals
Hydrochloric acid	-	TQ: 5000 lb

CERCLA
This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Hydrochloric acid	5000 lb	5000 lb

California Proposition 65 This product does not contain any Proposition 65 chemicals

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Water	-	-	X	-	-
Hydrochloric acid	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ):	Y
DOT Marine Pollutant	N
DOT Severe Marine Pollutant	N

U.S. Department of Homeland Security
This product contains the following DHS chemicals:

Component	DHS Chemical Facility Anti-Terrorism Standard

Hydrochloric acid	0 lb STQ (anhydrous); 11250 lb STQ (37% concentration or greater)

Other International Regulations

Mexico - Grade No information available

16. Other information

Prepared By
Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 24-Aug-2009
Revision Date 24-May-2017
Print Date 24-May-2017
Revision Summary SDS sections updated. 2. 3. 11.

Disclaimer
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End of SDS

SAFETY DATA SHEET

Nonflammable Gas Mixture: Isobutylene / Nitrogen / Oxygen

Section 1. Identification

GHS product identifier : Nonflammable Gas Mixture: Isobutylene / Nitrogen / Oxygen

Other means of identification : Not available.

Product use : Synthetic/Analytical chemistry.

SDS # : 002103

Supplier's details : Airgas USA, LLC and its affiliates
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

24-hour telephone : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : GASES UNDER PRESSURE - Compressed gas

GHS label elements

Hazard pictograms :



Signal word : Warning

Hazard statements : Contains gas under pressure; may explode if heated.

Precautionary statements

General : Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction.

Prevention : Not applicable.

Response : Not applicable.

Storage : Protect from sunlight when ambient temperature exceeds 52°C/125°F. Store in a well-ventilated place.

Disposal : Not applicable.

Hazards not otherwise classified : None known.

Section 3. Composition/information on ingredients

Substance/mixture : Mixture

Other means of identification : Not available.

CAS number/other identifiers

CAS number : Not applicable.

Product code : 002103

Section 3. Composition/information on ingredients

Ingredient name	%	CAS number
Nitrogen	75 - 80.5	7727-37-9
oxygen	19.5 - 23.5	7782-44-7
Isobutylene	0.0001 - 1.13	115-11-7

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband. In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : Contact with rapidly expanding gas may cause burns or frostbite.

Inhalation : No known significant effects or critical hazards.

Skin contact : Contact with rapidly expanding gas may cause burns or frostbite.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion : As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.

Specific treatments : No specific treatment.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media : None known.

Specific hazards arising from the chemical : Contains gas under pressure. In a fire or if heated, a pressure increase will occur and the container may burst or explode.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide
nitrogen oxides

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill : Immediately contact emergency personnel. Stop leak if without risk.

Large spill : Immediately contact emergency personnel. Stop leak if without risk. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Avoid contact with eyes, skin and clothing. Avoid breathing gas. Empty containers retain product residue and can be hazardous. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Section 7. Handling and storage

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Keep container tightly closed and sealed until ready for use. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F).

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Nitrogen	Oxygen Depletion [Asphyxiant]
oxygen	None.
Isobutylene	**ACGIH TLV (United States, 3/2015).** TWA: 250 ppm 8 hours.

Appropriate engineering controls : Good general ventilation should be sufficient to control worker exposure to airborne contaminants.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state	:	Gas.
Color	:	Not available.
Melting/freezing point	:	-140.7°C (-221.3°F) This is based on data for the following ingredient: isobutylene. Weighted average: -211.14°C (-348.1°F)
Critical temperature	:	Lowest known value: -146.95°C (-232.5°F) (nitrogen).
Odor	:	Not available.
Odor threshold	:	Not available.
pH	:	Not available.
Flash point	:	Not available.
Burning time	:	Not applicable.
Burning rate	:	Not applicable.
Evaporation rate	:	Not available.
Flammability (solid, gas)	:	Not available.
Lower and upper explosive (flammable) limits	:	Not available.
Vapor pressure	:	Not available.
Vapor density	:	Highest known value: 1.94 (Air = 1) (isobutylene). Weighted average: 1.01 (Air = 1)
Gas Density (lb/ft ^{3})	:	Weighted average: 0.07
Relative density	:	Not applicable.
Solubility	:	Not available.
Solubility in water	:	Not available.
Partition coefficient: n-octanol/water	:	Not available.
Auto-ignition temperature	:	Not available.
Decomposition temperature	:	Not available.
SADT	:	Not available.
Viscosity	:	Not applicable.

Section 10. Stability and reactivity

Reactivity	:	No specific test data related to reactivity available for this product or its ingredients.
Chemical stability	:	The product is stable.
Possibility of hazardous reactions	:	Under normal conditions of storage and use, hazardous reactions will not occur.
Conditions to avoid	:	No specific data.
Incompatible materials	:	No specific data.
Hazardous decomposition products	:	Under normal conditions of storage and use, hazardous decomposition products should not be produced.
Hazardous polymerization	:	Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Isobutylene	LC50 Inhalation Vapor	Rat	550000 mg/m³	4 hours

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : Contact with rapidly expanding gas may cause burns or frostbite.

Inhalation : No known significant effects or critical hazards.

Skin contact : Contact with rapidly expanding gas may cause burns or frostbite.

Ingestion : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Section 11. Toxicological information

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
Nitrogen	0.67	-	low
oxygen	0.65	-	low
Isobutylene	2.34	-	low

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1956	UN1956	UN1956	UN1956	UN1956
UN proper shipping name	COMPRESSED GAS, N.O.S. (nitrogen, oxygen)	COMPRESSED GAS, N.O.S. (nitrogen, oxygen)	COMPRESSED GAS, N.O.S. (nitrogen, oxygen)	COMPRESSED GAS, N.O.S. (nitrogen, oxygen)	COMPRESSED GAS, N.O.S. (nitrogen, oxygen)
Transport hazard class(es)	2.2 	2.2 	2.2 	2.2 	2.2 
Packing group	-	-	-	-	-
Environment	No.	No.	No.	No.	No.
Additional information	-	Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2). **Explosive Limit and Limited Quantity Index** 0.125 **Passenger Carrying Road or Rail Index** 75	-	-	-

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption**: Not determined

United States inventory (TSCA 8b): All components are listed or exempted.

Clean Air Act (CAA) 112 regulated flammable substances: isobutylene

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

Section 15. Regulatory information

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Sudden release of pressure

Composition/information on ingredients

Name	%	Fire hazard	Sudden release of pressure	Reactive	Immediate (acute) health hazard	Delayed (chronic) health hazard
Nitrogen	75 - 80.5	No.	Yes.	No.	No.	No.
oxygen	19.5 - 23.5	No.	Yes.	No.	No.	No.
Isobutylene	0.0001 - 1.13	Yes.	Yes.	No.	No.	No.

State regulations

Massachusetts : The following components are listed: NITROGEN; OXYGEN (LIQUID); 2-METHYLPROPENE

New York : None of the components are listed.

New Jersey : The following components are listed: NITROGEN; OXYGEN; ISOBUTYLENE; 1-PROPENE, 2-METHYL-

Pennsylvania : The following components are listed: NITROGEN; OXYGEN; 1-PROPENE, 2-METHYL-

International regulations

International lists

National inventory

Australia : All components are listed or exempted.

Canada : All components are listed or exempted.

China : All components are listed or exempted.

Europe : All components are listed or exempted.

Japan : Not determined.

Malaysia : Not determined.

New Zealand : All components are listed or exempted.

Philippines : All components are listed or exempted.

Republic of Korea : All components are listed or exempted.

Taiwan : All components are listed or exempted.

Canada

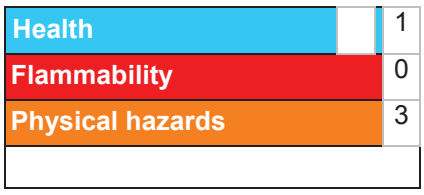
WHMIS (Canada) : Class A: Compressed gas.

CEPA Toxic substances: None of the components are listed.
Canadian ARET: None of the components are listed.
Canadian NPRI: The following components are listed: Butene (all isomers)
Alberta Designated Substances: None of the components are listed.
Ontario Designated Substances: None of the components are listed.
Quebec Designated Substances: None of the components are listed.

Section 16. Other information

Canada Label requirements : Class A: Compressed gas.

Hazardous Material Information System (U.S.A.)



Section 16. Other information

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on SDSs under 29 CFR 1910. 1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

National Fire Protection Association (U.S.A.)



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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Classification	Justification
Press. Gas Comp. Gas, H280	On basis of test data

History

Date of printing : 6/24/2016

Date of issue/Date of revision : 6/24/2016

Date of previous issue : 1/26/2016

Version : 0.02

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL 73/78 = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

References : Not available.

Indicates information that has changed from previously issued version.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

SAFETY DATA SHEET

SDS ID NO.: 0165MAR019
Revision Date: 05/22/2015

1. IDENTIFICATION

Product Name: Marathon Petroleum Performance Series Motor Oil

Synonym: American Spirit 5W-20 Motor Oil; All-Season 5W-20 Motor Oil; Performance Series 5W20 Motor Oil; American Spirit 5W-30 Motor Oil; All-Season 5W-30 Motor Oil; Performance Series 5W30 Motor Oil; American Spirit 10W-30 Motor Oil; All-Season 10W-30 Motor Oil; Performance Series 10W30 Motor Oil; American Spirit 10W-40 Motor Oil; All-Season 10W-40 Motor Oil; Performance Series 10W40 Motor Oil; American Spirit 20W-50 Motor Oil; All-Season 20W-50 Motor Oil; Performance Series 20W50 Motor Oil; 0269MAR019; 0179MAR019; 0166MAR019; 0167MAR019

Chemical Family: Motor/Lube Oil

Recommended Use: Engine Oil.
Use Restrictions: All others.

Supplier Name and Address:

MARATHON PETROLEUM COMPANY LP
539 South Main Street
Findlay, OH 45840

SDS information: 1-419-421-3070

Emergency Telephone: 1-877-627-5463

2. HAZARD IDENTIFICATION

Classification

OSHA Regulatory Status
This chemical is not considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Hazards Not Otherwise Classified (HNOC)
Not applicable

Label elements

EMERGENCY OVERVIEW

No known significant effects or critical hazards.

Appearance Brown Liquid **Physical State** Liquid **Odor** Petroleum

Precautionary Statements - Prevention
Not applicable

Precautionary Statements - Response
Not applicable

Precautionary Statements - Storage
Not applicable

Precautionary Statements - Disposal
Not applicable

3. COMPOSITION/INFORMATION ON INGREDIENTS

Motor oil is a complex mixture of highly refined lubricating oil base stocks and additives.

Composition Information:

There are no ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

4. FIRST AID MEASURES

First Aid Measures

General advice In case of accident or if you feel unwell, seek medical advice immediately (show directions for use or safety data sheet if possible).

Inhalation: Remove to fresh air and keep at rest in a position comfortable for breathing. If symptoms occur get medical attention.

Skin Contact: Wash skin with plenty of soap and water. If irritation or other symptoms occur get medical attention. Wash contaminated clothing and clean shoes before reuse.

Eye Contact: Immediately flush eyes with plenty of water. Eyelids should be held away from the eyeball to ensure thorough rinsing. Gently remove contacts while flushing. Get medical attention if irritation persists.

Ingestion: Rinse mouth out with water. If spontaneous vomiting occurs, keep head below hips, or if patient is lying down, turn body and head to side to prevent aspiration and monitor for breathing difficulty. Never give anything by mouth to an unconscious person. Keep affected person warm and at rest. If symptoms develop, seek medical attention.

Most important signs and symptoms, both short-term and delayed with overexposure

Adverse Effects: May cause eye irritation. May cause skin irritation and/or dermatitis. Symptoms may include redness, itching, and inflammation. Preexisting skin conditions and/or respiratory disorders may be aggravated by exposure to this product.

Indication of any immediate medical attention and special treatment needed

NOTES TO PHYSICIAN: Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media
For small fires, Class B fire extinguishing media such as CO2, dry chemical, foam (AFFF/ATC) or water spray can be used. For large fires, water spray, fog or foam (AFFF/ATC) can be used. Firefighting should be attempted only by those who are adequately trained and equipped with proper protective equipment.

Unsuitable extinguishing media
Do not use a solid water stream as it may scatter and spread fire.

Specific hazards arising from the chemical
The product is not combustible per the OSHA Hazard Communication Standard, but will ignite and burn at temperatures exceeding the flash point.

Hazardous combustion products
Smoke, carbon monoxide, and other products of incomplete combustion.

Explosion data
Sensitivity to Mechanical Impact No.
Sensitivity to Static Discharge No.

Special protective equipment and precautions for firefighters
Avoid using straight water streams. Water spray and foam (AFFF/ATC) must be applied carefully to avoid frothing and from as far a distance as possible. Avoid excessive water spray application. Use water spray to cool exposed surfaces from as far a distance as possible. Keep run-off water out of sewers and water sources.

NFPA: Health 1 Flammability 1 Instability 0 Special Hazards -

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions: Keep public away. Isolate and evacuate area. Shut off source if safe to do so.

Protective Equipment: Use personal protection measures as recommended in Section 8.

Emergency Procedures: Advise authorities and National Response Center (800-424-8802) if the product has entered a water course or sewer. Notify local health and pollution control agencies, if appropriate.

Environmental precautions: Avoid release to the environment. Avoid subsoil penetration.

Methods and materials for containment: Prevent further leakage or spillage if safe to do so.

Methods and materials for cleaning up: Use suitable absorbent materials such as vermiculite, sand, or clay to clean up residual liquids. Recover and return free product to proper containers.

7. HANDLING AND STORAGE

Safe Handling Precautions: Avoid contact with skin, eyes and clothing. Do not swallow. Avoid breathing vapors or mists. Use good personal hygiene practices. Wash thoroughly after handling. Use personal protection measures as recommended in Section 8. Do not cut, drill, grind or weld on empty containers since explosive residues may remain. Refer to applicable EPA, OSHA, NFPA and consistent state and local requirements.

Lifetime, continuous skin contact with used motor oils has caused skin cancer in laboratory tests. In testing, thorough washing has been found to prevent the development of skin cancer from used motor oil exposure. Avoid excessive skin contact. Exercise good personal hygiene including the removal and washing of soiled clothing and destroy used motor oil contaminated leather shoes/boots.

Storage Conditions: Store in properly closed containers that are appropriately labeled and in a cool, well-ventilated area. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Store away from incompatible materials.

Incompatible materials Strong oxidizing agents.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Notes: The manufacturer has voluntarily elected to provide exposure limits contained in OSHA's 1989 air contaminants standard in its SDSs, even though certain of those exposure limits were vacated in 1992.

Engineering measures: Local or general exhaust required when using at elevated temperatures that generate vapors or mists.

Personal protective equipment

Eye protection: Use goggles or face-shield if the potential for splashing exists.

Skin and body protection: Wear neoprene, nitrile or PVA gloves to prevent skin contact. Glove suitability is based on workplace conditions and usage. Contact the glove manufacturer for specific advice on glove selection and breakthrough times. Wear appropriate protective clothing.

Respiratory protection: Use a NIOSH approved organic vapor chemical cartridge or supplied air respirators when material produces vapors that exceed permissible exposure limits or excessive vapors are generated. Observe respirator assigned protection factors (APFs) criteria cited in federal OSHA 29 CFR 1910.134. Self-contained breathing apparatus should be used for fire fighting.

Hygiene measures: Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical State	Liquid
Appearance	Brown Liquid
Color	Brown
Odor	Petroleum
Odor Threshold	No available data.

Property	**Values (Method)**
Melting Point / Freezing Point	No available data.
Initial Boiling Point / Boiling Range	No available data.
Flash Point	> 204 °C / > 399.2 °F (Cleveland Open-Cup)
Evaporation Rate	No available data.
Flammability (solid, gas)	Not applicable.
Flammability Limit in Air (%)	
Upper Flammability Limit:	No available data.
Lower Flammability Limit:	No available data.
Vapor Pressure	No available data.
Vapor Density	No available data.
Specific Gravity / Relative Density	0.855-0.884
Water Solubility	No available data.
Solubility in other solvents	No available data.
Partition Coefficient	No available data.
Decomposition temperature:	No available data.
pH:	No available data.
Autoignition Temperature	No available data.
Kinematic Viscosity	> 40 mm2/s @ 40°C / 104°F (ASTM D445)
Dynamic Viscosity	No available data.
Explosive Properties	No available data.
Softening Point	No available data.
VOC Content (%)	No available data.
Density	No available data.

Bulk Density Not applicable.

10. STABILITY AND REACTIVITY

Reactivity The product is non-reactive under normal conditions.

Chemical stability Stable under recommended storage conditions.

Possibility of hazardous reactions None under normal processing.

Hazardous polymerization Will not occur.

Conditions to avoid Sources of heat or ignition.

Incompatible materials Strong oxidizing agents.

Hazardous decomposition products None known under normal conditions of use.

11. TOXICOLOGICAL INFORMATION

Potential short-term adverse effects from overexposures

Inhalation Overheating may produce vapors which may cause respiratory irritation, dizziness and nausea.

Eye contact Exposure to vapor or contact with liquid may cause mild eye irritation.

Skin contact May cause skin irritation. Prolonged or repeated exposure may cause dermatitis, folliculitis or oil acne.

Ingestion May cause irritation of the mouth, throat and gastrointestinal tract.

Acute Toxicological data

No information available.

Delayed and immediate effects as well as chronic effects from short and long-term exposure

This product is considered to have a low order of acute and chronic oral and dermal toxicity.

USED MOTOR OIL: Lifetime, continuous skin contact with used motor oils has caused skin cancer in laboratory tests. The combustion process produces compounds (polycyclic aromatic hydrocarbons) in motor oils that increase with use and are responsible for the cancer induction. Thorough washing has been found to prevent the development of skin cancer on animals from used motor oil exposure.

ZDDP: Zinc dialkyldithiophosphate (ZDDP) additives are primarily eye and/or skin irritants or corrosives with low acute toxicity via oral, dermal, and inhalation routes of exposure and are not skin sensitizers. In laboratory repeat dose studies by the dermal and oral routes, ZDDPs cause effects only at high doses, primarily due to irritation, in a manner similar to other irritating materials. The weight-of- evidence of genotoxicity testing indicates that ZDDPs are not mutagenic and do not cause larger chromosomal effects.

Adverse effects related to the physical, chemical and toxicological characteristics

Signs & Symptoms May cause eye irritation. Contact may cause skin dermatitis and/or irritation. Symptoms may include redness, itching, and inflammation. Repeated or prolonged skin contact may cause drying, reddening, itching and cracking.

Sensitization	Not expected to be a skin or respiratory sensitizer.
Mutagenic effects	None known.
Carcinogenicity	None known.
Reproductive toxicity	None known.
Specific Target Organ Toxicity (STOT) - single exposure	Not classified.
Specific Target Organ Toxicity (STOT) - repeated exposure	Not classified.
Aspiration hazard	Not classified.

12. ECOLOGICAL INFORMATION

Ecotoxicity	No information available. Used motor and/or lube oils can be toxic to birds and fish.
Persistence and degradability	Not expected to be readily biodegradable.
Bioaccummulation	Contains component(s) with the potential to bioaccumulate.
Mobility in soil	No information available.
Other adverse effects	No information available.

13. DISPOSAL CONSIDERATIONS

Description of Waste Residues
No information available.

Safe Handling of Wastes
Handle in accordance with applicable local, state, and federal regulations. Use personal protection measures as required.

Disposal of Wastes / Methods of Disposal
The user is responsible for determining if any discarded material is a hazardous waste (40 CFR 262.11). Dispose of in accordance with federal, state and local regulations.

Methods of Contaminated Packaging Disposal
Empty containers should be completely drained and then discarded or recycled, if possible. Do not cut, drill, grind or weld on empty containers since explosive residues may be present. Dispose of in accordance with federal, state and local regulations.

14. TRANSPORT INFORMATION

DOT (49 CFR 172.101):

UN Proper shipping name:	Not Regulated
UN/Identification No:	Not applicable
Transport Hazard Class(es):	Not applicable
Packing group:	Not applicable

TDG (Canada):

UN Proper shipping name:	Not Regulated
UN/Identification No:	Not applicable
Transport Hazard Class(es):	Not applicable

Packing group:	Not applicable

15. REGULATORY INFORMATION

US Federal Regulatory Information:

US TSCA Chemical Inventory Section 8(b):	This product and/or its components are listed on the TSCA Chemical Inventory.

EPA Superfund Amendment & Reauthorization Act (SARA):

SARA Section 302:	This product may contain component(s) that have been listed on EPA's Extremely Hazardous Substance (EHS) List:
SARA Section 304:	This product may contain component(s) identified either as an EHS or a CERCLA Hazardous substance which in case of a spill or release may be subject to SARA reporting requirements:
SARA:	The following EPA hazard categories apply to this product:
	None
SARA Section 313:	This product may contain component(s), which if in exceedance of the de minimus threshold, may be subject to the reporting requirements of SARA Title III Section 313 Toxic Release Reporting (Form R).

State and Community Right-To-Know Regulations:
The following component(s) of this material are identified on the regulatory lists below:

Canada DSL/NDSL Inventory:	This product and/or its components are listed either on the Domestic Substances List (DSL) or are exempt.
Canadian Regulatory Information:	"This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the (M)SDS contains all the information required by the Controlled Products Regulations."
NOTE:	Uncontrolled product according to WHMIS classification criteria.

16. OTHER INFORMATION

Prepared By	Toxicology and Product Safety
Revision Date:	05/22/2015

Revision Note:
Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information is intended as guidance for safe handling, use, processing, storage, transportation, accidental release, clean-up and disposal and is not considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

SAFETY DATA SHEET

SDS ID NO.: 0324MAR019
Revision Date: 05/27/2015

1. IDENTIFICATION

Product Name: Marathon Petroleum Performance Series Synthetic Motor Oil

Synonym: American Spirit Synthetic SAE 5W20 Motor Oil; Performance Series Synthetic SAE 5W20 Motor Oil; American Spirit Synthetic SAE 5W-30 Motor Oil; Performance Series Synthetic SAE 5W30 Motor Oil; American Spirit Synthetic SAE 10W-30 Motor Oil; Performance Series Synthetic SAE 10W30 Motor Oil; 0323MAR019; 0325MAR019

Chemical Family: Motor/Lube Oil

Recommended Use: Engine Oil.
Use Restrictions: All others.

Supplier Name and Address:

MARATHON PETROLEUM COMPANY LP
539 South Main Street
Findlay, OH 45840

SDS information: 1-419-421-3070

Emergency Telephone: 1-877-627-5463

2. HAZARD IDENTIFICATION

Classification

OSHA Regulatory Status
This chemical is not considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Hazards Not Otherwise Classified (HNOC)
Not applicable

Label elements

EMERGENCY OVERVIEW

No known significant effects or critical hazards.

Appearance Brown Liquid **Physical State** Liquid **Odor** Petroleum

Precautionary Statements - Prevention
Not applicable

Precautionary Statements - Response
Not applicable

Precautionary Statements - Storage
Not applicable

Precautionary Statements - Disposal
Not applicable

3. COMPOSITION/INFORMATION ON INGREDIENTS

Motor oil is a complex mixture of highly refined lubricating oil base stocks and additives. The base oil for this product can be a mixture of any of the following highly refined petroleum streams: 64741-88-4, 64742-54-7, and 64742-65-0.

Composition Information:

There are no ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

4. FIRST AID MEASURES

First Aid Measures

General advice In case of accident or if you feel unwell, seek medical advice immediately (show directions for use or safety data sheet if possible).

Inhalation: Remove to fresh air and keep at rest in a position comfortable for breathing. If symptoms occur get medical attention.

Skin Contact: Wash skin with plenty of soap and water. If irritation or other symptoms occur get medical attention. Wash contaminated clothing and clean shoes before reuse.

Eye Contact: Immediately flush eyes with plenty of water. Eyelids should be held away from the eyeball to ensure thorough rinsing. Gently remove contacts while flushing. Get medical attention if irritation persists.

Ingestion: Rinse mouth out with water. If spontaneous vomiting occurs, keep head below hips, or if patient is lying down, turn body and head to side to prevent aspiration and monitor for breathing difficulty. Never give anything by mouth to an unconscious person. Keep affected person warm and at rest. If symptoms develop, seek medical attention.

Most important signs and symptoms, both short-term and delayed with overexposure

Adverse Effects: May cause eye irritation. May cause skin irritation and/or dermatitis. Symptoms may include redness, itching, and inflammation. Preexisting skin conditions and/or respiratory disorders may be aggravated by exposure to this product.

Indication of any immediate medical attention and special treatment needed

NOTES TO PHYSICIAN: Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media
For small fires, Class B fire extinguishing media such as CO2, dry chemical, foam (AFFF/ATC) or water spray can be used. For large fires, water spray, fog or foam (AFFF/ATC) can be used. Firefighting should be attempted only by those who are adequately trained and equipped with proper protective equipment.

Unsuitable extinguishing media
Do not use a solid water stream as it may scatter and spread fire.

Specific hazards arising from the chemical
The product is not combustible per the OSHA Hazard Communication Standard, but will ignite and burn at temperatures exceeding the flash point.

Hazardous combustion products
Smoke, carbon monoxide, and other products of incomplete combustion.

Explosion data
Sensitivity to Mechanical Impact No.
Sensitivity to Static Discharge No.

Special protective equipment and precautions for firefighters
Avoid using straight water streams. Water spray and foam (AFFF/ATC) must be applied carefully to avoid frothing and from as far a distance as possible. Avoid excessive water spray application. Use water spray to cool exposed surfaces from as far a distance as possible. Keep run-off water out of sewers and water sources.

NFPA: Health 1 Flammability 1 Instability 0 Special Hazards -

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions: Keep public away. Isolate and evacuate area. Shut off source if safe to do so.

Protective Equipment: Use personal protection measures as recommended in Section 8.

Emergency Procedures: Advise authorities and National Response Center (800-424-8802) if the product has entered a water course or sewer. Notify local health and pollution control agencies, if appropriate.

Environmental precautions: Avoid release to the environment. Avoid subsoil penetration.

Methods and materials for containment: Prevent further leakage or spillage if safe to do so.

Methods and materials for cleaning up: Use suitable absorbent materials such as vermiculite, sand, or clay to clean up residual liquids. Recover and return free product to proper containers.

7. HANDLING AND STORAGE

Safe Handling Precautions: Avoid contact with skin, eyes and clothing. Do not swallow. Avoid breathing vapors or mists. Use good personal hygiene practices. Wash thoroughly after handling. Use personal protection measures as recommended in Section 8. Do not cut, drill, grind or weld on empty containers since explosive residues may remain. Refer to applicable EPA, OSHA, NFPA and consistent state and local requirements.

Lifetime, continuous skin contact with used motor oils has caused skin cancer in laboratory tests. In testing, thorough washing has been found to prevent the development of skin cancer from used motor oil exposure. Avoid excessive skin contact. Exercise good personal hygiene including the removal and washing of soiled clothing and destroy used motor oil contaminated leather shoes/boots.

Storage Conditions: Store in properly closed containers that are appropriately labeled and in a cool, well-ventilated area. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Store away from incompatible materials.

Incompatible materials Strong oxidizing agents.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Notes: The manufacturer has voluntarily elected to provide exposure limits contained in OSHA's 1989 air contaminants standard in its SDSs, even though certain of those exposure limits were vacated in 1992.

Engineering measures: Local or general exhaust required when using at elevated temperatures that generate vapors or mists.

Personal protective equipment

Eye protection: Use goggles or face-shield if the potential for splashing exists.

Skin and body protection: Wear neoprene, nitrile or PVA gloves to prevent skin contact. Glove suitability is based on workplace conditions and usage. Contact the glove manufacturer for specific advice on glove selection and breakthrough times. Wear appropriate protective clothing.

Respiratory protection: Use a NIOSH approved organic vapor chemical cartridge or supplied air respirators when material produces vapors that exceed permissible exposure limits or excessive vapors are generated. Observe respirator assigned protection factors (APFs) criteria cited in federal OSHA 29 CFR 1910.134. Self-contained breathing apparatus should be used for fire fighting.

Hygiene measures: Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical State	Liquid
Appearance	Brown Liquid
Color	Brown
Odor	Petroleum
Odor Threshold	No available data.

Property	**Values (Method)**
Melting Point / Freezing Point	No available data.
Initial Boiling Point / Boiling Range	No available data.
Flash Point	> 204 °C / > 399.2 °F (Cleveland Open-Cup) (ASTM D92)
Evaporation Rate	No available data.
Flammability (solid, gas)	Not applicable.
Flammability Limit in Air (%)	
Upper Flammability Limit:	No available data.
Lower Flammability Limit:	No available data.
Vapor Pressure	No available data.
Vapor Density	No available data.
Specific Gravity / Relative Density	0.847-0.82
Water Solubility	No available data.
Solubility in other solvents	No available data.
Partition Coefficient	No available data.
Decomposition temperature:	No available data.
pH:	No available data.
Autoignition Temperature	No available data.
Kinematic Viscosity	> 40 mm2/s @ 40°C / 104°F (ASTM D445)
Dynamic Viscosity	No available data.
Explosive Properties	No available data.
Softening Point	No available data.
VOC Content (%)	No available data.
Density	No available data.
Bulk Density	Not applicable.

10. STABILITY AND REACTIVITY

Reactivity	The product is non-reactive under normal conditions.
Chemical stability	Stable under recommended storage conditions.
Possibility of hazardous reactions	None under normal processing.
Hazardous polymerization	Will not occur.
Conditions to avoid	Sources of heat or ignition.
Incompatible materials	Strong oxidizing agents.
Hazardous decomposition products	None known under normal conditions of use.

11. TOXICOLOGICAL INFORMATION

Potential short-term adverse effects from overexposures

Inhalation	Overheating may produce vapors which may cause respiratory irritation, dizziness and nausea.
Eye contact	Exposure to vapor or contact with liquid may cause mild eye irritation.
Skin contact	May cause skin irritation. Prolonged or repeated exposure may cause dermatitis, folliculitis or oil acne.
Ingestion	May cause irritation of the mouth, throat and gastrointestinal tract.

Acute Toxicological data

No information available.

Delayed and immediate effects as well as chronic effects from short and long-term exposure

This product is considered to have a low order of acute and chronic oral and dermal toxicity.

USED MOTOR OIL: Lifetime, continuous skin contact with used motor oils has caused skin cancer in laboratory tests. The combustion process produces compounds (polycyclic aromatic hydrocarbons) in motor oils that increase with use and are responsible for the cancer induction. Thorough washing has been found to prevent the development of skin cancer on animals from used motor oil exposure.

ZDDP: Zinc dialkyldithiophosphate (ZDDP) additives are primarily eye and/or skin irritants or corrosives with low acute toxicity via oral, dermal, and inhalation routes of exposure and are not skin sensitizers. In laboratory repeat dose studies by the dermal and oral routes, ZDDPs cause effects only at high doses, primarily due to irritation, in a manner similar to other irritating materials. The weight-of- evidence of genotoxicity testing indicates that ZDDPs are not mutagenic and do not cause larger chromosomal effects.

Adverse effects related to the physical, chemical and toxicological characteristics

Signs & Symptoms	May cause eye irritation. Contact may cause skin dermatitis and/or irritation. Symptoms may include redness, itching, and inflammation. Repeated or prolonged skin contact may cause drying, reddening, itching and cracking.
Sensitization	Not expected to be a skin or respiratory sensitizer.

Mutagenic effects	None known.
Carcinogenicity	None known.
Reproductive toxicity	None known.
Specific Target Organ Toxicity (STOT) - single exposure	Not classified.
Specific Target Organ Toxicity (STOT) - repeated exposure	Not classified.
Aspiration hazard	Not classified.

12. ECOLOGICAL INFORMATION

Ecotoxicity	No information available. Used motor and/or lube oils can be toxic to birds and fish.
Persistence and degradability	Not expected to be readily biodegradable.
Bioaccummulation	Contains component(s) with the potential to bioaccumulate.
Mobility in soil	No information available.
Other adverse effects	No information available.

13. DISPOSAL CONSIDERATIONS

Description of Waste Residues
No information available.

Safe Handling of Wastes
Handle in accordance with applicable local, state, and federal regulations. Use personal protection measures as required.

Disposal of Wastes / Methods of Disposal
The user is responsible for determining if any discarded material is a hazardous waste (40 CFR 262.11). Dispose of in accordance with federal, state and local regulations.

Methods of Contaminated Packaging Disposal
Empty containers should be completely drained and then discarded or recycled, if possible. Do not cut, drill, grind or weld on empty containers since explosive residues may be present. Dispose of in accordance with federal, state and local regulations.

14. TRANSPORT INFORMATION

DOT (49 CFR 172.101):

UN Proper shipping name:	Not Regulated
UN/Identification No:	Not applicable
Transport Hazard Class(es):	Not applicable
Packing group:	Not applicable

TDG (Canada):

UN Proper shipping name:	Not Regulated
UN/Identification No:	Not applicable
Transport Hazard Class(es):	Not applicable
Packing group:	Not applicable

15. REGULATORY INFORMATION

US Federal Regulatory Information:

US TSCA Chemical Inventory Section 8(b): This product and/or its components are listed on the TSCA Chemical Inventory.

EPA Superfund Amendment & Reauthorization Act (SARA):

SARA Section 302: This product may contain component(s) that have been listed on EPA's Extremely Hazardous Substance (EHS) List:

SARA Section 304: This product may contain component(s) identified either as an EHS or a CERCLA Hazardous substance which in case of a spill or release may be subject to SARA reporting requirements:

SARA: The following EPA hazard categories apply to this product:

None

SARA Section 313: This product may contain component(s), which if in exceedance of the de minimus threshold, may be subject to the reporting requirements of SARA Title III Section 313 Toxic Release Reporting (Form R).

State and Community Right-To-Know Regulations:
The following component(s) of this material are identified on the regulatory lists below:

Canada DSL/NDSL Inventory: This product and/or its components are listed either on the Domestic Substances List (DSL) or are exempt.

Canadian Regulatory Information: "This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the (M)SDS contains all the information required by the Controlled Products Regulations."

NOTE: Uncontrolled product according to WHMIS classification criteria.

16. OTHER INFORMATION

Prepared By Toxicology and Product Safety
Revision Date: 05/27/2015

Revision Note:
Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information is intended as guidance for safe handling, use, processing, storage, transportation, accidental release, clean-up and disposal and is not considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

SAFETY DATA SHEET

Version 6.3
Revision Date 01/15/2020
Print Date 04/04/2020

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name : Naphthalene

Product Number : 147141
Brand : Aldrich
Index-No. : 601-052-00-2
CAS-No. : 91-20-3

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich Inc.
3050 Spruce Street
ST. LOUIS MO 63103
UNITED STATES

Telephone : +1 314 771-5765
Fax : +1 800 325-5052

1.4 Emergency telephone number

Emergency Phone # : +1-703-527-3887

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

Flammable solids (Category 2), H228
Acute toxicity, Oral (Category 4), H302
Carcinogenicity (Category 2), H351
Short-term (acute) aquatic hazard (Category 1), H400
Long-term (chronic) aquatic hazard (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word Warning

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Hazard statement(s)

H228	Flammable solid.
H302	Harmful if swallowed.
H351	Suspected of causing cancer.
H410	Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P210	Keep away from heat/sparks/open flames/hot surfaces. No smoking.
P240	Ground/bond container and receiving equipment.
P241	Use explosion-proof electrical/ ventilating/ lighting equipment.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P312 + P330	IF SWALLOWED: Call a POISON CENTER/doctor if you feel unwell. Rinse mouth.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
P391	Collect spillage.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

SECTION 3: Composition/information on ingredients

3.1 Substances

Molecular weight	:	128.17 g/mol
CAS-No.	:	91-20-3
EC-No.	:	202-049-5
Index-No.	:	601-052-00-2

Component	Classification	Concentration
Naphthalene		
	Flam. Sol. 2; Acute Tox. 4; Carc. 2; Aquatic Acute 1; Aquatic Chronic 1; H228, H302, H351, H400, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

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SECTION 4: First aid measures

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
Carbon oxides

5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information
Use water spray to cool unopened containers.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures
Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Avoid breathing dust.
For personal protection see section 8.

6.2 Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

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6.3 Methods and materials for containment and cleaning up

Sweep up and shovel. Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13). Keep in suitable, closed containers for disposal. Contain spillage, pick up with an electrically protected vacuum cleaner or by wet-brushing and transfer to a container for disposal according to local regulations (see section 13).

6.4 Reference to other sections

For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols.Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.
Provide appropriate exhaust ventilation at places where dust is formed.Keep away from sources of ignition - No smoking.Take measures to prevent the build up of electrostatic charge.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.
Storage class (TRGS 510): 4.1B: Flammable solid hazardous materials

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Naphthalene	91-20-3	TWA	10 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Hemolytic anemia Upper Respiratory Tract irritation Cataract Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans Danger of cutaneous absorption		

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		TWA	10 ppm 50 mg/m3	USA. NIOSH Recommended Exposure Limits
		ST	15 ppm 75 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	10 ppm 50 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
		PEL	0.1 ppm 0.5 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		Skin		

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Naphthalene	91-20-3	1-Naphthol + 2-Naphthol			ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift (As soon as possible after exposure ceases)			

8.2 Exposure controls

Appropriate engineering controls
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection
Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This

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recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection
Complete suit protecting against chemicals, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: flakes, granules Colour: white
b)	Odour	aromatic
c)	Odour Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	Melting point/range: 80 - 82 °C (176 - 180 °F) - lit.
f)	Initial boiling point and boiling range	218 °C 424 °F - lit.
g)	Flash point	80.0 °C (176.0 °F) - closed cup
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	Upper explosion limit: 5.9 %(V) Lower explosion limit: 0.9 %(V)
k)	Vapour pressure	1.3 hPa at 53.0 °C (127.4 °F) 0.04 hPa at 25.0 °C(77.0 °F)
l)	Vapour density	No data available
m)	Relative density	1.085 g/cm3 at 24.7 °C (76.5 °F)
n)	Water solubility	0.0308 g/l at 25 °C (77 °F) - OECD Test Guideline 105 - slightly soluble
o)	Partition coefficient: n-octanol/water	log Pow: 3.4 at 25 °C (77 °F)

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p)	Auto-ignition temperature	526.0 °C (978.8 °F)
q)	Decomposition temperature	No data available
r)	Viscosity	1.05 mm2/s at 81.5 °C (178.7 °F) -
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety information

Surface tension	31.8 mN/m at 100.0 °C (212.0 °F)

SECTION 10: Stability and reactivity

10.1 Reactivity
No data available

10.2 Chemical stability
Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions
No data available

10.4 Conditions to avoid
Heat, flames and sparks.

10.5 Incompatible materials
Strong oxidizing agents

10.6 Hazardous decomposition products
Hazardous decomposition products formed under fire conditions. - Carbon oxides
Other decomposition products - No data available
In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - Mouse - male - 533 mg/kg
(OECD Test Guideline 401)
LD50 Oral - Mouse - female - 710 mg/kg
(OECD Test Guideline 401)
LC50 Inhalation - Rat - male and female - 4 h - > 0.4 mg/l
(OECD Test Guideline 403)
LD50 Dermal - Rabbit - 20,000 mg/kg
Remarks: (RTECS)
No data available

Skin corrosion/irritation
Skin - Rabbit
Result: No skin irritation - 24 h
Remarks: (ECHA)

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Serious eye damage/eye irritation
Eyes - Rabbit
Result: No eye irritation - 24 h
Remarks: (ECHA)

Respiratory or skin sensitisation
Maximisation Test - Guinea pig
Result: negative
(OECD Test Guideline 406)

Germ cell mutagenicity
Mutagenicity (mammal cell test): chromosome aberration.
Chinese hamster ovary cells
Result: positive
Ames test
Salmonella typhimurium
Result: negative
OECD Test Guideline 486
Rat - male - Liver cells
Result: negative
US-EPA
Mouse - male and female - Bone marrow
Result: negative
(ECHA)

Carcinogenicity

IARC:	2B - Group 2B: Possibly carcinogenic to humans (Naphthalene)
	No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC. (Naphthalene)
NTP:	RAHC - Reasonably anticipated to be a human carcinogen (Naphthalene)
	No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP. (Naphthalene)
OSHA:	No component of this product present at levels greater than or equal to 0.1% is on OSHA's list of regulated carcinogens.

Reproductive toxicity
No data available

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

Additional Information

Repeated dose toxicity - Rat - male and female - Oral - 91 Days - No observed adverse effect level - 200 mg/kg - Lowest observed adverse effect level - 400 mg/kg

Repeated dose toxicity - Mouse - male and female - Oral - 90 Days - No observed adverse effect level - 100 mg/kg

Repeated dose toxicity - Rat - male and female - Dermal - 90 Days - No observed adverse effect level - 1,000 mg/kg

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Repeated dose toxicity - Rat - male and female - inhalation (vapour) - 90 Days - No observed adverse effect level - 300 mg/kg
RTECS: QJ0525000

Absorption into the body leads to the formation of methemoglobin which in sufficient concentration causes cyanosis. Onset may be delayed 2 to 4 hours or longer., Naphthalene is retinotoxic and systemic absorption of its vapors above 15ppm, may result in:, cataracts, optic neuritis, corneal injury, Eye irritation, Ingestion may provoke the following symptoms:, hemolytic anemia, hemoglobinuria, Nausea, Headache, Vomiting, Gastrointestinal disturbance, Convulsions, anemia, Kidney injury may occur., Seizures., Coma.
To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Heart -

SECTION 12: Ecological information

12.1 Toxicity

Toxicity to fish	flow-through test LC50 - Oncorhynchus mykiss (rainbow trout) - 1.6 mg/l - 96 h (OECD Test Guideline 203)
	flow-through test LC50 - Pimephales promelas (fathead minnow) - 7.9 mg/l - 96 h (OECD Test Guideline 203)
Toxicity to daphnia and other aquatic invertebrates	static test EC50 - Daphnia magna (Water flea) - 2.16 mg/l - 48 h (OECD Test Guideline 202)
Toxicity to algae	static test EC50 - Pseudokirchneriella subcapitata (green algae) - 2.96 mg/l - 4 h Remarks: (ECHA)

12.2 Persistence and degradability

Biodegradability	aerobic - Exposure time 28 d Result: 2 % - Not readily biodegradable. (OECD Test Guideline 302C) Result: - Not readily eliminated from water.

12.3 Bioaccumulative potential

Bioaccumulation	Cyprinus carpio (Carp) - 56 d at 25 °C(Naphthalene) Bioconcentration factor (BCF): 36.5 - 168 (OECD Test Guideline 305) Remarks: Bioaccumulation is unlikely.

12.4 Mobility in soil

No data available

12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

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12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.
Very toxic to aquatic life with long lasting effects.
An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product
Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging
Dispose of as unused product.

SECTION 14: Transport information

DOT (US)
UN number: 1334 Class: 4.1 Packing group: III
Proper shipping name: Naphthalene, refined
Reportable Quantity (RQ): 100 lbs
- Marine pollutant: yesPoison Inhalation Hazard: No

IMDG
UN number: 1334 Class: 4.1 Packing group: III EMS-No: F-A, S-G
Proper shipping name: NAPHTHALENE, REFINED
Marine pollutant : yes

IATA
UN number: 1334 Class: 4.1 Packing group: III
Proper shipping name: Naphthalene, refined

SECTION 15: Regulatory information

SARA 302 Components
No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Naphthalene	91-20-3	

SARA 311/312 Hazards
Fire Hazard, Acute Health Hazard, Chronic Health Hazard

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Massachusetts Right To Know Components

	CAS-No.	Revision Date
Naphthalene	91-20-3	

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Naphthalene	91-20-3	

New Jersey Right To Know Components

	CAS-No.	Revision Date
Naphthalene	91-20-3	

California Prop. 65 Components

	CAS-No.	Revision Date
WARNING! This product contains a chemical known to the State of California to cause cancer.Naphthalene	91-20-3	

SECTION 16: Other information

Further information

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

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Version: 6.3 Revision Date: 01/15/2020 Print Date: 04/04/2020

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SAFETY DATA SHEET

SDS ID NO.: 0157MAR019
Revision Date: 05/14/2015

1. IDENTIFICATION

Product Name: Marathon Petroleum Toluene

Synonym: Toluene; Toluol; Methyl Benzene
Chemical Family: Aromatic Hydrocarbon

Recommended Use: Solvent. Chemical intermediate. Gasoline blending.
Use Restrictions: All others. Prohibited for use in the formulation or manufacture of pesticide products.

Supplier Name and Address:

MARATHON PETROLEUM COMPANY LP
539 South Main Street
Findlay, OH 45840

SDS information: 1-419-421-3070

Emergency Telephone: 1-877-627-5463

2. HAZARD IDENTIFICATION

Classification

OSHA Regulatory Status
This chemical is considered hazardous according to the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids	Category 2
Skin corrosion/irritation	Category 2
Germ cell mutagenicity	Category 1B
Carcinogenicity	Category 1A
Reproductive toxicity	Category 2
Specific target organ toxicity (single exposure)	Category 3
Specific target organ toxicity (repeated exposure)	Category 2
Aspiration toxicity	Category 1
Acute aquatic toxicity	Category 2
Chronic aquatic toxicity	Category 3

Hazards Not Otherwise Classified (HNOC)
Static accumulating flammable liquid

Label elements

EMERGENCY OVERVIEW

Danger

HIGHLY FLAMMABLE LIQUID AND VAPOR
May accumulate electrostatic charge and ignite or explode

May be fatal if swallowed and enters airways
Causes skin irritation
May cause respiratory irritation
May cause drowsiness or dizziness
May cause genetic defects
May cause cancer
Suspected of damaging fertility or the unborn child
May cause damage to organs (nervous system, auditory system) through prolonged or repeated exposure
Toxic to aquatic life
Harmful to aquatic life with long lasting effects



Appearance Clear Liquid **Physical State** Liquid **Odor** Sweet , benzene

Precautionary Statements - Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Keep away from heat/sparks/open flames/hot surfaces. — No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools
Take precautionary measures against static discharge
Do not breathe mist/vapors/spray
Use only outdoors or in a well-ventilated area
Wash hands and any possibly exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection
Avoid release to the environment

Precautionary Statements - Response
IF exposed or concerned: Get medical attention
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
If skin irritation occurs: Get medical attention
Take off contaminated clothing and wash before reuse
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Call a POISON CENTER or doctor if you feel unwell
IF SWALLOWED: Immediately call a POISON CENTER or doctor
Do NOT induce vomiting
In case of fire: Use water spray, fog or regular foam for extinction

Precautionary Statements - Storage
Store in a well-ventilated place. Keep container tightly closed
Keep cool
Store locked up

Precautionary Statements - Disposal
Dispose of contents/container at an approved waste disposal plant

3. COMPOSITION/INFORMATION ON INGREDIENTS

Toluene is a seven carbon aromatic petroleum hydrocarbon. Contains trace amounts of xylene (<0.1%), paraffins, and cycloparaffins.

Composition Information:

Name	CAS Number	Weight %
Toluene	108-88-3	99-100
Benzene	71-43-2	0-0.25

4. FIRST AID MEASURES

First Aid Measures

General advice In case of accident or if you feel unwell, seek medical advice immediately (show directions for use or safety data sheet if possible).

Inhalation: Remove to fresh air. If not breathing, institute rescue breathing. If breathing is difficult, ensure airway is clear, give oxygen and continue to monitor. If heart has stopped, immediately begin cardiopulmonary resuscitation (CPR). Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

Skin Contact: Immediately wash exposed skin with plenty of soap and water while removing contaminated clothing and shoes. Get medical attention if irritation persists. Place contaminated clothing in closed container until cleaned or discarded. If clothing is to be laundered, inform the person performing the operation of contaminant's hazardous properties.

Eye Contact: Flush immediately with large amounts of water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Gently remove contacts while flushing. GET IMMEDIATE MEDICAL ATTENTION.

Ingestion: Do not induce vomiting because of danger of aspirating liquid into lungs, causing serious damage and chemical pneumonitis. If spontaneous vomiting occurs, keep head below hips, or if patient is lying down, turn body and head to side to prevent aspiration and monitor for breathing difficulty. Never give anything by mouth to an unconscious person. Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

Most important signs and symptoms, both short-term and delayed with overexposure

Adverse Effects: Acute: Headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue. Delayed: Dry skin and possible irritation with repeated or prolonged exposure.

Indication of any immediate medical attention and special treatment needed

NOTES TO PHYSICIAN: INHALATION: This material (or a component) sensitizes the myocardium to the effects of sympathomimetic amines. Epinephrine and other sympathomimetic drugs may initiate cardiac arrhythmias in individuals exposed to this material. Administration of sympathomimetic drugs should be avoided.

INGESTION: This material represents a significant aspiration and chemical pneumonitis hazard. Induction of emesis is not recommended.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media
For small fires, Class B fire extinguishing media such as CO2, dry chemical, foam (AFFF/ATC) or water spray can be used. For large fires, water spray, fog or foam (AFFF/ATC) can be used. Firefighting should be attempted only by those who are adequately trained and equipped with proper protective equipment.

Unsuitable extinguishing media
Do not use straight water streams to avoid spreading fire.

Specific hazards arising from the chemical
This product has been determined to be a highly flammable liquid per the OSHA Hazard Communication Standard and should be handled accordingly. Vapors may travel along the ground or be moved by ventilation and ignited by many sources such as pilot lights, sparks, electric motors, static discharge, or other ignition sources at locations distant from material handling. Flashback can occur along vapor trail. For additional fire related information, see NFPA 30 or the North American Emergency Response Guide 130.

Hazardous combustion products
Smoke, carbon monoxide, and other products of incomplete combustion.

Explosion data
Sensitivity to Mechanical Impact No.
Sensitivity to Static Discharge No.

Special protective equipment and precautions for firefighters
Firefighters should wear full protective clothing and positive-pressure self-contained breathing apparatus (SCBA) with a full face-piece, as appropriate. Avoid using straight water streams. Water may be ineffective in extinguishing low flash point fires, but can be used to cool exposed surfaces. Avoid excessive water spray application. Water spray and foam (AFFF/ATC) must be applied carefully to avoid frothing and from as far a distance as possible. Keep run-off water out of sewers and water sources.

NFPA:	Health 2	Flammability 3	Instability 0	Special Hazards -

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions: Keep public away. Isolate and evacuate area. Shut off source if safe to do so. Eliminate all ignition sources.

Protective Equipment: Use personal protective equipment (See section 8).

Emergency Procedures: Advise authorities and National Response Center (800-424-8802) if the product has entered a water course or sewer. Notify local health and pollution control agencies, if appropriate.

Environmental precautions: Avoid release to the environment. Avoid subsoil penetration.

Methods and materials for containment: Contain liquid with sand or soil.

Methods and materials for cleaning up: Use suitable absorbent materials such as vermiculite, sand, or clay to clean up residual liquids. Recover and return free product to proper containers. When recovering free liquids ensure all equipment is grounded and bonded. Use only non-sparking tools.

7. HANDLING AND STORAGE

Safe Handling Precautions: NEVER SIPHON THIS PRODUCT BY MOUTH. Use appropriate grounding and bonding practices. Static accumulating flammable liquid. Bonding and grounding may be insufficient to eliminate the hazard from static electricity. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. No smoking. Avoid repeated and prolonged skin contact. Use personal protection measures as recommended in Section 8. Use only non-sparking tools. Do not cut, drill, grind or weld on empty containers since explosive residues may remain. Refer to applicable EPA, OSHA, NFPA and consistent state and local requirements.

Hydrocarbons are basically non-conductors of electricity and can become electrostatically charged during mixing, filtering, pumping at high flow rates or loading and transfer operations. If this charge reaches a sufficiently high level, sparks can form that may ignite the vapors of flammable liquids. Sudden release of hot organic chemical vapors or mists from process equipment operating under elevated temperature and pressure, or sudden ingress of air into vacuum equipment may result in ignition of vapors or mists without the presence of obvious ignition sources. Nozzle spouts must be kept in contact with the containers or tank during the entire filling operation.

Storage Conditions: Store in properly closed containers that are appropriately labeled and in a cool, well-ventilated area.

Incompatible materials Strong oxidizing agents.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Name	ACGIH TLV	OSHA PELS:	OSHA - Vacated PELs	NIOSH IDLH
Toluene 108-88-3	20 ppm TWA	TWA: 200 ppm Ceiling: 300 ppm	100 ppm TWA 375 mg/m³ TWA 150 ppm STEL 560 mg/m³ STEL	500 ppm
Benzene 71-43-2	0.5 ppm TWA 2.5 ppm STEL Skin - potential significant contribution to overall exposure by the cutaneous route	TWA: 10 ppm (applies to industry segments exempt from the benzene standard at 29 CFR 1910.1028) TWA: 1 ppm STEL: 5 ppm (see 29 CFR 1910.1028)	25 ppm Ceiling 1 ppm TWA 5 ppm STEL	500 ppm

Notes: The manufacturer has voluntarily elected to provide exposure limits contained in OSHA's 1989 air contaminants standard in its SDSs, even though certain of those exposure limits were vacated in 1992.

Engineering measures: Local or general exhaust required in an enclosed area or when there is inadequate ventilation. Use mechanical ventilation equipment that is explosion-proof.

Personal protective equipment

Eye protection: Use goggles or face-shield if there is a potential for splashing.

Skin and body protection: Viton gloves should be used to prevent skin contact. Glove suitability is based on workplace conditions and usage. Contact the glove manufacturer for specific advice on glove selection and breakthrough times.

Respiratory protection: Approved organic vapor chemical cartridge or supplied air respirators should be worn for exposures to any components exceeding the established exposure limits. Observe respirator assigned protection factors (APFs) criteria cited in federal OSHA 29 CFR 1910.134. Self-contained breathing apparatus should be used for fire fighting.

Hygiene measures: Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes and clothing.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical State	Liquid
Appearance	Clear Liquid
Color	Colorless
Odor	Sweet , benzene
Odor Threshold	2.9 ppmv

Property	Values (Method)
Melting Point / Freezing Point	-95 °C / -139 °F
Initial Boiling Point / Boiling Range	110 °C / 231 °F
Flash Point	5 °C / 41 °F
Evaporation Rate	1.9 (Butyl Acetate = 1)
Flammability (solid, gas)	No available data.
Flammability Limit in Air (%)	
Upper Flammability Limit:	7.1
Lower Flammability Limit:	1.2

Vapor Pressure	1.03 psi @ 100°F
Vapor Density	3.1 (Air = 1)
Specific Gravity / Relative Density	0.872
Water Solubility	No available data.
Solubility in other solvents	No available data.
Partition Coefficient	No available data.
Decomposition temperature:	No available data.
pH:	Not applicable.
Autoignition Temperature	480 °C / 896 °F
Kinematic Viscosity	0.56 cSt @ 100°F
Dynamic Viscosity	No available data.
Explosive Properties	No available data.
Softening Point	Not applicable.
VOC Content (%)	No available data.
Density	No available data.
Bulk Density	Not applicable.

10. STABILITY AND REACTIVITY

Reactivity The product is non-reactive under normal conditions.

Chemical stability The material is stable at 70°F, 760 mmHg pressure.

Possibility of hazardous reactions None under normal processing.

Hazardous polymerization Will not occur.

Conditions to avoid Sources of heat or ignition.

Incompatible materials Strong oxidizing agents.

Hazardous decomposition products None known under normal conditions of use.

11. TOXICOLOGICAL INFORMATION

Potential short-term adverse effects from overexposures

Inhalation May cause irritation of respiratory tract. May cause drowsiness or dizziness. Breathing high concentrations of this material, for example, in a confined space or by intentional abuse, can cause irregular heartbeats which can cause death.

Eye contact May cause eye irritation.

Skin contact Irritating to skin. Repeated exposure may cause skin dryness or cracking.

Ingestion May be fatal if swallowed or vomited and enters airways. May cause irritation of the mouth, throat and gastrointestinal tract.

Acute Toxicological data

Name	Oral LD50	Dermal LD50	Inhalation LC50
Toluene 108-88-3	> 2000 mg/kg (Rat)	8390 mg/kg (Rabbit)	12.5 mg/L (Rat) 4 h
Benzene 71-43-2	> 2000 mg/kg (Rat)	> 5000 mg/kg (Rabbit)	> 20 mg/l (Rat) 4 h

Delayed and immediate effects as well as chronic effects from short and long-term exposure

TOLUENE: Abuse of toluene at high concentrations (e.g., glue sniffing and solvent abuse) has been associated with adverse effects on the liver, kidney and nervous system, and can cause nervous system depression, cardiac arrhythmias, and death. Studies of workers indicate long-term exposure may be related to impaired color vision and hearing. Some studies of workers suggest long-term exposure may be related to neurobehavioral and cognitive changes. Some of these effects have been observed in laboratory animals following repeated exposure to high levels of toluene. Several studies of workers suggest long-term exposure may be related to small increases in spontaneous abortions and changes in some gonadotropic hormones. However, the weight of evidence does not indicate toluene is a reproductive hazard to humans. Studies in laboratory animals indicate some changes in reproductive organs following high levels of exposure, but no significant effects on mating performance or reproduction were observed. Case studies of persons abusing toluene suggest isolated incidences of adverse effects on the fetus including birth defects. Findings in laboratory animals have been largely negative. Positive findings include small increases in minor skeletal and visceral malformations and developmental delays following very high levels of maternal exposure. Studies of workers indicate long term exposure may be related to effects on the liver, kidney and blood, but these appear to be limited to changes in serum enzymes and decreased leukocyte counts. Adverse effects on the liver, kidney, thymus and nervous system were observed in animal studies following very high levels of exposure. The relevance of these findings to humans is not clear at this time.

BENZENE: Studies of workers exposed to benzene show clear evidence that overexposure can cause cancer and other diseases of the blood forming organs including Acute Myelogenous Leukemia (AML), and Aplastic Anemia (AA), an often fatal disease. Some studies suggest overexposure to benzene may also be associated with Myelodysplastic Syndrome (MDS). Findings from a case control study of workers exposed to benzene was reported during the 2009 Benzene Symposium in Munich included an increase in Acute Myeloid Leukemias and Non-Hodgkins Lymphoid Neoplasms (NHLN) of the subtype follicular lymphoma (FL) in some occupational categories. Some studies of workers exposed to benzene have shown an association with increased rates of chromosome aberrations in circulating lymphocytes. One study of women workers exposed to benzene suggested a weak association with irregular menstruation. However, other studies of workers exposed to benzene have not demonstrated clear evidence of an effect on fertility or reproductive outcome in humans. Benzene can cross the placenta and affect the developing fetus. Cases of AA have been reported in the offspring of persons severely overexposed to benzene. Studies in laboratory animals indicate that prolonged, repeated exposure to high levels of benzene vapor can cause bone marrow suppression and cancer in multiple organ systems. Studies in laboratory animals show evidence of adverse effects on male reproductive organs following high levels of exposure but no significant effects on reproduction have been observed. Embryotoxicity has been reported in studies of laboratory animals but effects were limited to reduced fetal weight and minor skeletal variations. Benzene has been classified as a proven human carcinogen by OSHA and a Group 1 (Carcinogenic to Humans) material by IARC. The current proposed IARC classification for benzene is summarized as follows: Sufficient evidence for Acute Myeloid Leukemia; limited evidence for Acute Lymphatic Leukemia, Chronic Lymphatic Leukemia, Non-Hodgkin Lymphoma, and Multiple Myeloma.

Adverse effects related to the physical, chemical and toxicological characteristics

Signs & Symptoms Respiratory tract irritation. Nausea, vomiting, signs of nervous system depression: headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue.

Sensitization Not expected to be a skin or respiratory sensitizer.

Mutagenic effects May cause genetic defects.

Carcinogenicity Cancer designations are listed in the table below.

Name	ACGIH (Class)	IARC (Class)	NTP	OSHA
Toluene 108-88-3	Not Classifiable (A4)	Not Classifiable (3)	Not Listed	Not Listed

Benzene 71-43-2	Confirmed human carcinogen (A1)	Carcinogenic to humans (1)	Known to be human carcinogen	Known carcinogen

Reproductive toxicity Suspected of damaging fertility or the unborn child.

Specific Target Organ Toxicity (STOT) - single exposure Respiratory system. Central nervous system.

Specific Target Organ Toxicity (STOT) - repeated exposure Nervous system. Auditory system.

Aspiration hazard May be fatal if swallowed and enters airways.

12. ECOLOGICAL INFORMATION

Ecotoxicity This product should be considered toxic to aquatic organisms, with the potential to cause long lasting adverse effects in the aquatic environment.

Name	Algae/aquatic plants	Fish	Toxicity to Microorganisms	Crustacea
Toluene 108-88-3	72-hr EC50 = 12.5 mg/l Algae	96-hr LC50 <= 10 mg/l Rainbow trout	-	48-hr EC50 = 5.46-9.83 mg/l Daphnia magna 48-hr EC50 = 11.5 mg/l Daphnia magna (Static)
Benzene 71-43-2	72-hr EC50 = 29 mg/l Algae	96-hr LC50 = 5.3 mg/l Rainbow trout (flow-through)	-	48-hr EC50 = 8.76-15.6 mg/l Daphnia magna (Static)

Persistence and degradability Readily biodegradable in the environment.

Bioaccummulation Not expected to bioaccumulate in aquatic organisms.

Mobility in soil May partition into air, soil and water.

Other adverse effects No information available.

13. DISPOSAL CONSIDERATIONS

Description of Waste Residues
This material may be a flammable liquid waste.

Safe Handling of Wastes
Handle in accordance with applicable local, state, and federal regulations. Use personal protection measures as required. Use appropriate grounding and bonding practices. Use only non-sparking tools. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. No smoking.

Disposal of Wastes / Methods of Disposal
The user is responsible for determining if any discarded material is a hazardous waste (40 CFR 262.11). Dispose of in accordance with federal, state and local regulations.

Methods of Contaminated Packaging Disposal
Empty containers should be completely drained and then discarded or recycled, if possible. Do not cut, drill, grind or weld on empty containers since explosive residues may be present. Dispose of in accordance with federal, state and local regulations.

14. TRANSPORT INFORMATION

DOT (49 CFR 172.101):

UN Proper shipping name:	Toluene
UN/Identification No:	UN 1294
Transport Hazard Class(es):	3
Packing group:	II

DOT reportable quantity (lbs): 1000 pounds.

TDG (Canada):

UN Proper shipping name: Toluene
UN/Identification No: UN 1294
Transport Hazard Class(es): 3
Packing group: II
Regulated substances: 1000 pounds.

15. REGULATORY INFORMATION

US Federal Regulatory Information:

US TSCA Chemical Inventory Section 8(b): This product and/or its components are listed on the TSCA Chemical Inventory.

EPA Superfund Amendment & Reauthorization Act (SARA):

SARA Section 302: This product does not contain any component(s) included on EPA's Extremely Hazardous Substance (EHS) List.

Name	CERCLA/SARA - Section 302 Extremely Hazardous Substances and TPQs
Toluene	NA
Benzene	NA

SARA Section 304: This product may contain component(s) identified either as an EHS or a CERCLA Hazardous substance which in case of a spill or release may be subject to SARA reporting requirements:

Name	CERCLA/SARA - Hazardous Substances and their Reportable Quantities
Toluene	1000 lb final RQ 454 kg final RQ
Benzene	10 lb final RQ 4.54 kg final RQ

SARA: The following EPA hazard categories apply to this product:

Acute Health Hazard
Chronic Health Hazard
Fire Hazard

SARA Section 313: This product may contain component(s), which if in exceedance of the de minimus threshold, may be subject to the reporting requirements of SARA Title III Section 313 Toxic Release Reporting (Form R).

Name	CERCLA/SARA 313 Emission reporting:
Toluene	1.0 % de minimis concentration
Benzene	0.1 % de minimis concentration

State and Community Right-To-Know Regulations:
The following component(s) of this material are identified on the regulatory lists below:

Toluene

Louisiana Right-To-Know: Not Listed.
California Proposition 65: Developmental toxicity, initial date 1/1/91
Female reproductive toxicity, initial date 8/7/09
New Jersey Right-To-Know: SN 1866
Pennsylvania Right-To-Know: Environmental hazard
Massachusetts Right-To Know: Present
Florida Substance List: Not Listed.
Rhode Island Right-To-Know: Toxic (skin); Flammable (skin)

Michigan Critical Materials Register List:	100 lb Annual usage threshold
Massachusetts Extraordinarily Hazardous Substances:	Not Listed.
California - Regulated Carcinogens:	Not Listed.
Pennsylvania RTK - Special Hazardous Substances:	Not Listed.
New Jersey - Special Hazardous Substances:	Flammable - third degree; Teratogen
New Jersey - Environmental Hazardous Substances List:	SN 1866 TPQ: 500 lb
Illinois - Toxic Air Contaminants	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1000 lb RQ (air); 1 lb RQ (land/water)

Benzene

Louisiana Right-To-Know:	Not Listed.
California Proposition 65:	Carcinogen, initial date 2/27/87 Developmental toxicity, initial date 12/26/97 Male reproductive toxicity, initial date 12/26/97
New Jersey Right-To-Know:	SN 0197
Pennsylvania Right-To-Know:	Environmental hazard; Special hazardous substance
Massachusetts Right-To Know:	Carcinogen; Extraordinarily hazardous
Florida Substance List:	Not Listed.
Rhode Island Right-To-Know:	Toxic (skin); Flammable (skin); Carcinogen (skin)
Michigan Critical Materials Register List:	100 lb Annual usage threshold
Massachusetts Extraordinarily Hazardous Substances:	Carcinogen; Extraordinarily hazardous
California - Regulated Carcinogens:	Not Listed.
Pennsylvania RTK - Special Hazardous Substances:	Present
New Jersey - Special Hazardous Substances:	Carcinogen; Flammable - third degree; Mutagen
New Jersey - Environmental Hazardous Substances List:	SN 0197 TPQ: 500 lb
Illinois - Toxic Air Contaminants	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	10 lb RQ (air); 1 lb RQ (land/water)

Canada DSL/NDSL Inventory: This product and/or its components are listed either on the Domestic Substances List (DSL) or are exempt.

Canadian Regulatory Information: "This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the (M)SDS contains all the information required by the Controlled Products Regulations."

Name	Canada - WHMIS: Classifications of Substances:	Canada - WHMIS: Ingredient Disclosure:
Toluene	B2,D2A,D2B	0.1%
Benzene	B2,D2A,D2B	0.1%



NOTE: Not Applicable.

16. OTHER INFORMATION

Prepared By Toxicology and Product Safety
Revision Date: 05/14/2015

Revision Note:

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information is intended as guidance for safe handling, use, processing, storage, transportation, accidental release, clean-up and disposal and is not considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

SAFETY DATA SHEET

SDS ID NO.: 0158MAR019
Revision Date: 05/14/2015

1. IDENTIFICATION

Product Name: Marathon Petroleum Xylene

Synonym: Xylene; Mixed Xylenes, Dimethyl Benzene; Methyl Toluene
Chemical Family: Aromatic Hydrocarbon

Recommended Use: Solvent. Chemical intermediate. Gasoline blending.
Use Restrictions: All others.

Supplier Name and Address:

MARATHON PETROLEUM COMPANY LP
539 South Main Street
Findlay, OH 45840

SDS information: 1-419-421-3070

Emergency Telephone: 1-877-627-5463

2. HAZARD IDENTIFICATION

Classification

OSHA Regulatory Status
This chemical is considered hazardous according to the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids	Category 3
Skin corrosion/irritation	Category 2
Serious eye damage/eye irritation	Category 2A
Carcinogenicity	Category 2
Reproductive toxicity	Category 2
Specific target organ toxicity (single exposure)	Category 3
Specific target organ toxicity (repeated exposure)	Category 2
Aspiration toxicity	Category 1
Acute aquatic toxicity	Category 2
Chronic aquatic toxicity	Category 3

Hazards Not Otherwise Classified (HNOC)
Static accumulating flammable liquid

Label elements

EMERGENCY OVERVIEW

Danger

FLAMMABLE LIQUID AND VAPOR
May accumulate electrostatic charge and ignite or explode

May be fatal if swallowed and enters airways
Causes skin irritation
Causes serious eye irritation
May cause respiratory irritation
May cause drowsiness or dizziness
Suspected of causing cancer
Suspected of damaging the unborn child
May cause damage to organs (nervous system, auditory system) through prolonged or repeated exposure
Toxic to aquatic life
Harmful to aquatic life with long lasting effects



Appearance Clear Liquid **Physical State** Liquid **Odor** Sweet Aromatic

Precautionary Statements - Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Keep away from heat/sparks/open flames/hot surfaces. — No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools
Take precautionary measures against static discharge
Wear protective gloves/protective clothing/eye protection/face protection
Do not breathe mist/vapors/spray
Use only outdoors or in a well-ventilated area
Wash hands and any possibly exposed skin thoroughly after handling
Avoid release to the environment

Precautionary Statements - Response
IF exposed or concerned: Get medical attention
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
If eye irritation persists: Get medical attention
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
If skin irritation occurs: Get medical attention
Take off contaminated clothing and wash before reuse
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Call a POISON CENTER or doctor if you feel unwell
IF SWALLOWED: Immediately call a POISON CENTER or doctor
Do NOT induce vomiting
In case of fire: Use water spray, fog or regular foam for extinction

Precautionary Statements - Storage
Store in a well-ventilated place. Keep container tightly closed
Keep cool
Store locked up

Precautionary Statements - Disposal
Dispose of contents/container at an approved waste disposal plant

3. COMPOSITION/INFORMATION ON INGREDIENTS

Xylene is a mixture of eight carbon aromatic petroleum hydrocarbons composed of the three isomers of xylene (ortho, meta & para) and ethylbenzene.

Composition Information:

Name	CAS Number	Weight %
Xylene (mixed isomers)	1330-20-7	81-85
Ethylbenzene	100-41-4	15-19
Cumene	98-82-8	0-0.5
Toluene	108-88-3	0-0.3

4. FIRST AID MEASURES

First Aid Measures

General advice In case of accident or if you feel unwell, seek medical advice immediately (show directions for use or safety data sheet if possible).

Inhalation: Remove to fresh air. If not breathing, institute rescue breathing. If breathing is difficult, ensure airway is clear, give oxygen and continue to monitor. If heart has stopped, immediately begin cardiopulmonary resuscitation (CPR). Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

Skin Contact: Immediately wash exposed skin with plenty of soap and water while removing contaminated clothing and shoes. Get medical attention if irritation persists. Place contaminated clothing in closed container until cleaned or discarded. If clothing is to be laundered, inform the person performing the operation of contaminant's hazardous properties.

Eye Contact: Flush immediately with large amounts of water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Gently remove contacts while flushing. Get medical attention if irritation persists.

Ingestion: Do not induce vomiting because of danger of aspirating liquid into lungs, causing serious damage and chemical pneumonitis. If spontaneous vomiting occurs, keep head below hips, or if patient is lying down, turn body and head to side to prevent aspiration and monitor for breathing difficulty. Never give anything by mouth to an unconscious person. Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

Most important signs and symptoms, both short-term and delayed with overexposure

Adverse Effects: Acute: Headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue. Delayed: Dry skin and possible irritation with repeated or prolonged exposure.

Indication of any immediate medical attention and special treatment needed

NOTES TO PHYSICIAN: INHALATION: This material (or a component) sensitizes the myocardium to the effects of sympathomimetic amines. Epinephrine and other sympathomimetic drugs may initiate cardiac arrhythmias in individuals exposed to this material. Administration of sympathomimetic drugs should be avoided.

INGESTION: This material represents a significant aspiration and chemical pneumonitis hazard. Induction of emesis is not recommended.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media
For small fires, Class B fire extinguishing media such as CO2, dry chemical, foam (AFFF/ATC) or water spray can be used. For large fires, water spray, fog or foam (AFFF/ATC) can be used. Firefighting should be attempted only by those who are adequately trained and equipped with proper protective equipment.

Unsuitable extinguishing media
Do not use straight water streams to avoid spreading fire.

Specific hazards arising from the chemical
This product has been determined to be a flammable liquid per the OSHA Hazard Communication Standard and should be handled accordingly. May accumulate electrostatic charge and ignite or explode. Vapors may travel along the ground or be moved by ventilation and ignited by many sources such as pilot lights, sparks, electric motors, static discharge, or other ignition sources at locations distant from material handling. Flashback can occur along vapor trail. For additional fire related information, see NFPA 30 or the North American Emergency Response Guide 130.

Hazardous combustion products
Smoke, carbon monoxide, and other products of incomplete combustion.

Explosion data
Sensitivity to Mechanical Impact No.
Sensitivity to Static Discharge No.

Special protective equipment and precautions for firefighters
Firefighters should wear full protective clothing and positive-pressure self-contained breathing apparatus (SCBA) with a full face-piece, as appropriate. Avoid using straight water streams. Water may be ineffective in extinguishing low flash point fires, but can be used to cool exposed surfaces. Avoid excessive water spray application. Water spray and foam (AFFF/ATC) must be applied carefully to avoid frothing and from as far a distance as possible. Keep run-off water out of sewers and water sources.

NFPA:	Health 2	Flammability 3	Instability 0	Special Hazards -

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions:	Keep public away. Isolate and evacuate area. Shut off source if safe to do so. Eliminate all ignition sources.
Protective Equipment:	Use personal protection measures as recommended in Section 8.
Emergency Procedures:	Advise authorities and National Response Center (800-424-8802) if the product has entered a water course or sewer. Notify local health and pollution control agencies, if appropriate.
Environmental precautions:	Avoid release to the environment. Avoid subsoil penetration.
Methods and materials for containment:	Contain liquid with sand or soil.
Methods and materials for cleaning up:	Use suitable absorbent materials such as vermiculite, sand, or clay to clean up residual liquids. Recover and return free product to proper containers. When recovering free liquids ensure all equipment is grounded and bonded. Use only non-sparking tools.

7. HANDLING AND STORAGE

Safe Handling Precautions: NEVER SIPHON THIS PRODUCT BY MOUTH. Use appropriate grounding and bonding practices. Static accumulating flammable liquid. Bonding and grounding may be insufficient to eliminate the hazard from static electricity. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. No smoking. Avoid repeated and prolonged skin contact. Use personal protection measures as recommended in Section 8. Use only non-sparking tools. Do not cut, drill, grind or weld on empty containers since explosive residues may remain. Refer to applicable EPA, OSHA, NFPA and consistent state and local requirements.

Hydrocarbons are basically non-conductors of electricity and can become electrostatically charged during mixing, filtering, pumping at high flow rates or loading and transfer operations. If this charge reaches a sufficiently high level, sparks can form that may ignite the vapors of flammable liquids. Sudden release of hot organic chemical vapors or mists from process equipment operating under elevated temperature and pressure, or sudden ingress of air into vacuum equipment may result in ignition of vapors or mists without the presence of obvious ignition sources. Nozzle spouts must be kept in contact with the containers or tank during the entire filling operation.

Storage Conditions: Store in properly closed containers that are appropriately labeled and in a cool, well-ventilated area.

Incompatible materials Strong oxidizing agents.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Name	ACGIH TLV	OSHA PELS:	OSHA - Vacated PELs	NIOSH IDLH
Xylene (mixed isomers) 1330-20-7	100 ppm TWA 150 ppm STEL	TWA: 100 ppm TWA: 435 mg/m^3	100 ppm TWA 435 mg/m^3 TWA 150 ppm STEL 655 mg/m^3 STEL	900 ppm
Ethylbenzene 100-41-4	20 ppm TWA	TWA: 100 ppm TWA: 435 mg/m^3	100 ppm TWA 435 mg/m^3 TWA 125 ppm STEL 545 mg/m^3 STEL	800 ppm
Cumene 98-82-8	50 ppm TWA	TWA: 50 ppm TWA: 245 mg/m^3 Skin	50 ppm TWA 245 mg/m^3 TWA Limit applies to skin	900 ppm
Toluene 108-88-3	20 ppm TWA	TWA: 200 ppm Ceiling: 300 ppm	100 ppm TWA 375 mg/m^3 TWA 150 ppm STEL 560 mg/m^3 STEL	500 ppm

Notes: The manufacturer has voluntarily elected to provide exposure limits contained in OSHA's 1989 air contaminants standard in its SDSs, even though certain of those exposure limits were vacated in 1992.

Engineering measures: Local or general exhaust required in an enclosed area or when there is inadequate ventilation. Use mechanical ventilation equipment that is explosion-proof.

Personal protective equipment

Eye protection: Use goggles or face-shield if there is a potential for splashing.

Skin and body protection: Viton gloves should be used to prevent skin contact. Glove suitability is based on workplace conditions and usage. Contact the glove manufacturer for specific advice on glove selection and breakthrough times.

Respiratory protection: Approved organic vapor chemical cartridge or supplied air respirators should be worn for exposures to any components exceeding the established exposure limits. Observe respirator assigned protection factors (APFs) criteria cited in federal OSHA 29 CFR 1910.134. Self-contained breathing apparatus should be used for fire fighting.

Hygiene measures: Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes and clothing.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical State	Liquid
Appearance	Clear Liquid
Color	Colorless
Odor	Sweet Aromatic
Odor Threshold	0.4 ppmv

Property	**Values (Method)**
Melting Point / Freezing Point	-45 °C / -49 °F
Initial Boiling Point / Boiling Range	138-142 °C / 280-288 °F
Flash Point	27 °C / 81 °F
Evaporation Rate	0.76 (Butyl Acetate = 1)
Flammability (solid, gas)	No available data.
Flammability Limit in Air (%)	
Upper Flammability Limit:	7.0
Lower Flammability Limit:	0.9
Vapor Pressure	No available data.
Vapor Density	3.66 (Air=1)
Specific Gravity / Relative Density	0.87
Water Solubility	Insoluble
Solubility in other solvents	No available data.
Partition Coefficient	3.12-3.20 Log Kow
Decomposition temperature:	No available data.
pH:	Not Applicable
Autoignition Temperature	465 °C / 869 °F
Kinematic Viscosity	0.79 cSt @ 20°C (ASTM D7042)
Dynamic Viscosity	No available data.
Explosive Properties	No available data.
Softening Point	Not Applicable
VOC Content (%)	No available data.
Density	7.25 lbs/gal
Bulk Density	Not applicable.

10. STABILITY AND REACTIVITY

Reactivity The product is non-reactive under normal conditions.

Chemical stability The material is stable at 70°F, 760 mmHg pressure.

Possibility of hazardous reactions None under normal processing.

Hazardous polymerization Will not occur.

Conditions to avoid Sources of heat or ignition.

Incompatible materials Strong oxidizing agents.

Hazardous decomposition products None known under normal conditions of use.

11. TOXICOLOGICAL INFORMATION

Potential short-term adverse effects from overexposures

Inhalation May cause irritation of respiratory tract. May cause drowsiness or dizziness. Breathing high concentrations of this material, for example, in a confined space or by intentional abuse, can cause irregular heartbeats which can cause death.

Eye contact Irritating to eyes.

Skin contact Irritating to skin. Repeated exposure may cause skin dryness or cracking.

Ingestion May be fatal if swallowed or vomited and enters airways. May cause irritation of the mouth, throat and gastrointestinal tract.

Acute Toxicological data

Name	Oral LD50	Dermal LD50	Inhalation LC50
Xylene (mixed isomers) 1330-20-7	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 5.04 mg/L (Rat) 4 h
Ethylbenzene 100-41-4	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	17.2 mg/L (Rat) 4 h
Cumene 98-82-8	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 20 mg/L (Rat) 6 h
Toluene 108-88-3	> 2000 mg/kg (Rat)	8390 mg/kg (Rabbit)	12.5 mg/L (Rat) 4 h

Delayed and immediate effects as well as chronic effects from short and long-term exposure

XYLENES, ALL ISOMERS: Overexposure to xylene may cause upper respiratory tract irritation, headache, cyanosis, blood serum changes, nervous system damage and narcosis. Effects may be increased by the use of alcoholic beverages. Evidence of liver and kidney impairment were reported in workers recovering from a gross overexposure. Effects from Prolonged or Repeated Exposure: Impaired neurological function was reported in workers exposed to solvents including xylene. Studies in laboratory animals have shown evidence of impaired hearing following high levels of exposure. Studies in laboratory animals suggest some changes in reproductive organs following high levels of exposure but no significant effects on reproduction were observed. Studies in laboratory animals indicate skeletal and visceral malformations, developmental delays, and increased fetal resorptions following extremely high levels of maternal exposure with evidence of maternal toxicity. The relevance of these observations to humans is not clear at this time. Adverse effects on the liver, kidney, bone marrow (changes in blood cell parameters) were observed in laboratory animals following high levels of exposure. The relevance of these observations to humans is not clear at this time.

ETHYLBENZENE: Findings from a 2-year inhalation study in rodents conducted by NTP were as follows: Effects were observed only at the highest exposure level (750 ppm). At this level the incidence of renal tumors was elevated in male rats (tubular carcinomas) and female rats (tubular adenomas). The incidence of tumors was also elevated in male mice (alveolar and bronchiolar carcinomas) and female mice (hepatocellular carcinomas). IARC has classified ethyl benzene as "possibly carcinogenic to humans" (Group 2B). Studies in laboratory animals indicate some evidence of post-implantation deaths following high levels of maternal exposure. The relevance of these findings to humans is not clear at this time. Studies in laboratory animals indicate limited evidence of renal malformations, resorptions, and developmental delays following high levels of maternal exposure with evidence of maternal toxicity. The relevance of these findings to humans is not clear at this time. Studies in laboratory animals have demonstrated evidence of ototoxicity (hearing loss) following exposure levels as low as 300 ppm for 5 days. Studies in laboratory animals indicate some evidence of adverse effects on the liver, kidney, thyroid, and pituitary gland.

CUMENE: Overexposure to cumene may cause upper respiratory tract irritation and CNS depression. Studies in laboratory animals indicate evidence of respiratory tract hyperplasia, and adverse effects on the liver, kidney and adrenal glands following high level exposure. The relevance of these findings to humans is not clear at this time. Findings from lifetime laboratory rodent inhalation studies were as follows: In F344/N rats: an increased incidence of renal carcinomas and adenomas, respiratory epithelial adenomas, and interstitial cell adenomas of the testes. In B6C3F1 mice: an increased incidence of carcinomas and adenomas of the bronchi and lung, liver neoplasms, hemangiosarcomas of the spleen, and adenomas of the thyroid.

TOLUENE: Abuse of toluene at high concentrations (e.g., glue sniffing and solvent abuse) has been associated with adverse effects on the liver, kidney and nervous system, and can cause nervous system depression, cardiac arrhythmias, and death. Studies of workers indicate long-term exposure may be related to impaired color vision and hearing. Some studies of workers suggest long-term exposure may be related to neurobehavioral and cognitive changes. Some of these effects have been observed in laboratory animals following repeated exposure to high levels of toluene. Several studies of workers suggest long-term exposure may be related to small increases in spontaneous abortions and changes in some gonadotropic hormones. However, the weight of evidence does not indicate toluene is a reproductive hazard to humans. Studies in laboratory animals indicate some changes in reproductive organs following high levels of exposure, but no significant effects on mating performance or reproduction were observed. Case studies of persons abusing toluene suggest isolated incidences of adverse effects on the fetus including birth defects. Findings in laboratory animals have been largely negative. Positive findings include small increases in minor skeletal and visceral malformations and developmental delays following very high levels of maternal exposure. Studies of workers indicate long term exposure may be related to effects on the liver, kidney and blood, but these appear to be limited to changes in serum enzymes and decreased leukocyte counts. Adverse effects on the liver, kidney, thymus and nervous system were observed in animal studies following very high levels of exposure. The relevance of these findings to humans is not clear at this time.

Adverse effects related to the physical, chemical and toxicological characteristics

Signs & Symptoms Respiratory tract irritation. Nausea, vomiting, signs of nervous system depression: headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue.

Sensitization Not expected to be a skin or respiratory sensitizer.

Mutagenic effects None known.

Carcinogenicity Cancer designations are listed in the table below.

Name	ACGIH (Class)	IARC (Class)	NTP	OSHA
Xylene (mixed isomers) 1330-20-7	Not Classifiable (A4)	Not Classifiable (3)	Not Listed	Not Listed
Ethylbenzene 100-41-4	Confirmed animal carcinogen (A3)	Possible human carcinogen (2B)	Not Listed	Not Listed
Cumene 98-82-8	Not listed	Possible human carcinogen (2B)	Not listed	Not listed
Toluene 108-88-3	Not Classifiable (A4)	Not Classifiable (3)	Not Listed	Not Listed

Reproductive toxicity Suspected of damaging the unborn child.

Specific Target Organ Toxicity (STOT) - single exposure Respiratory system. Central nervous system.

Specific Target Organ Toxicity (STOT) - repeated exposure Nervous system. Auditory system.

Aspiration hazard May be fatal if swallowed or vomited and enters airways.

12. ECOLOGICAL INFORMATION

Ecotoxicity This product should be considered toxic to aquatic organisms, with the potential to cause long lasting adverse effects in the aquatic environment.

Name	Algae/aquatic plants	Fish	Toxicity to Microorganisms	Crustacea
Xylene (mixed isomers) 1330-20-7	72-hr EC50 = 11 mg/l Algae	96-hr LC50 = 8 mg/l Rainbow trout	-	48-hr LC50 = 3.82 mg/l Daphnia magna
Ethylbenzene 100-41-4	72-hr EC50 = 1.7-7.6 mg/l Algae	96-hr LC50 = 4 mg/L Rainbow trout	-	48-hr EC50 = 1-4 mg/L Daphnia magna
Cumene 98-82-8	72-hr EC50 = 2.6 mg/l Algae	96-hr LC50 = 6.04-6.61 mg/l Fathead minnow (Flow-through) 96-hr LC50 = 2.7 mg/l Rainbow trout (semi-static)	-	48-hr EC50 = 7.9-14.1 mg/l Daphnia magna (static)
Toluene 108-88-3	72-hr EC50 = 12.5 mg/l Algae	96-hr LC50 <= 10 mg/l Rainbow trout	-	48-hr EC50 = 5.46-9.83 mg/l Daphnia magna 48-hr EC50 = 11.5 mg/l Daphnia magna (Static)

Persistence and degradability Readily biodegradable in the environment.

Bioaccummulation Not expected to bioaccumulate in aquatic organisms.

Mobility in soil May partition into air, soil and water.

Other adverse effects No information available.

13. DISPOSAL CONSIDERATIONS

Description of Waste Residues
This material may be a flammable liquid waste.

Safe Handling of Wastes
Handle in accordance with applicable local, state, and federal regulations. Use personal protection measures as required. Use appropriate grounding and bonding practices. Use only non-sparking tools. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. No smoking.

Disposal of Wastes / Methods of Disposal
The user is responsible for determining if any discarded material is a hazardous waste (40 CFR 262.11). Dispose of in accordance with federal, state and local regulations.

Methods of Contaminated Packaging Disposal
Empty containers should be completely drained and then discarded or recycled, if possible. Do not cut, drill, grind or weld on empty containers since explosive residues may be present. Dispose of in accordance with federal, state and local regulations.

14. TRANSPORT INFORMATION

DOT (49 CFR 172.101):

UN Proper shipping name:	Xylenes
UN/Identification No:	UN 1307
Transport Hazard Class(es):	3
Packing group:	III
DOT reportable quantity (lbs):	100 pounds.

TDG (Canada):

UN Proper shipping name:	Xylenes
UN/Identification No:	UN 1307
Transport Hazard Class(es):	3
Packing group:	III
Regulated substances:	100 pounds.

15. REGULATORY INFORMATION

US Federal Regulatory Information:

US TSCA Chemical Inventory Section 8(b): This product and/or its components are listed on the TSCA Chemical Inventory.

EPA Superfund Amendment & Reauthorization Act (SARA):

SARA Section 302: This product does not contain any component(s) included on EPA's Extremely Hazardous Substance (EHS) List.

Name	CERCLA/SARA - Section 302 Extremely Hazardous Substances and TPQs
Xylene (mixed isomers)	NA
Ethylbenzene	NA
Cumene	NA
Toluene	NA

SARA Section 304: This product may contain component(s) identified either as an EHS or a CERCLA Hazardous substance which in case of a spill or release may be subject to SARA reporting requirements:

Name	CERCLA/SARA - Hazardous Substances and their Reportable Quantities
Xylene (mixed isomers)	100 lb final RQ 45.4 kg final RQ
Ethylbenzene	1000 lb final RQ 454 kg final RQ

Cumene	5000 lb final RQ 2270 kg final RQ
Toluene	1000 lb final RQ 454 kg final RQ

SARA: The following EPA hazard categories apply to this product:

Acute Health Hazard
Chronic Health Hazard
Fire Hazard

SARA Section 313: This product may contain component(s), which if in exceedance of the de minimus threshold, may be subject to the reporting requirements of SARA Title III Section 313 Toxic Release Reporting (Form R).

Name	CERCLA/SARA 313 Emission reporting:
Xylene (mixed isomers)	1.0 % de minimis concentration
Ethylbenzene	0.1 % de minimis concentration
Cumene	1.0 % de minimis concentration
Toluene	1.0 % de minimis concentration

State and Community Right-To-Know Regulations:
The following component(s) of this material are identified on the regulatory lists below:

Xylene (mixed isomers)

Louisiana Right-To-Know:	Not Listed.
California Proposition 65:	Not Listed.
New Jersey Right-To-Know:	SN 2014
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed.
Rhode Island Right-To-Know:	Toxic (skin); Flammable (skin)
Michigan Critical Materials Register List:	100 lb Annual usage threshold all isomers
Massachusetts Extraordinarily Hazardous Substances:	Not Listed.
California - Regulated Carcinogens:	Not Listed.
Pennsylvania RTK - Special Hazardous Substances:	Not Listed.
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	SN 2014 TPQ: 500 lb
Illinois - Toxic Air Contaminants	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1000 lb RQ (air); 1 lb RQ (land/water)

Ethylbenzene

Louisiana Right-To-Know:	Not Listed.
California Proposition 65:	Carcinogen, initial date 6/11/04
New Jersey Right-To-Know:	SN 0851
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed.
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed.
Massachusetts Extraordinarily Hazardous Substances:	Not Listed.
California - Regulated Carcinogens:	Not Listed.
Pennsylvania RTK - Special Hazardous Substances:	Not Listed.
New Jersey - Special Hazardous Substances:	Carcinogen; flammable - Third degree
New Jersey - Environmental Hazardous Substances List:	SN 0851 TPQ: 500 lb
Illinois - Toxic Air Contaminants	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1000 lb RQ (air); 1 lb RQ (land/water)

Cumene

Louisiana Right-To-Know:	Not Listed.
California Proposition 65:	Carcinogen, initial date 4/6/10
New Jersey Right-To-Know:	SN 0542
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed.
Rhode Island Right-To-Know:	Toxic (skin); Flammable (skin)
Michigan Critical Materials Register List:	Not Listed.
Massachusetts Extraordinarily Hazardous Substances:	Not Listed.
California - Regulated Carcinogens:	Not Listed.
Pennsylvania RTK - Special Hazardous Substances:	Not Listed.
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	SN 0542 TPQ: 500 lb
Illinois - Toxic Air Contaminants	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	5000 lb RQ (air); 1 lb RQ (land/water)

Toluene

Louisiana Right-To-Know:	Not Listed.
California Proposition 65:	Developmental toxicity, initial date 1/1/91 Female reproductive toxicity, initial date 8/7/09
New Jersey Right-To-Know:	SN 1866
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed.
Rhode Island Right-To-Know:	Toxic (skin); Flammable (skin)
Michigan Critical Materials Register List:	100 lb Annual usage threshold
Massachusetts Extraordinarily Hazardous Substances:	Not Listed.
California - Regulated Carcinogens:	Not Listed.
Pennsylvania RTK - Special Hazardous Substances:	Not Listed.
New Jersey - Special Hazardous Substances:	Flammable - third degree; Teratogen
New Jersey - Environmental Hazardous Substances List:	SN 1866 TPQ: 500 lb
Illinois - Toxic Air Contaminants	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1000 lb RQ (air); 1 lb RQ (land/water)

Canada DSL/NDSL Inventory: This product and/or its components are listed either on the Domestic Substances List (DSL) or are exempt.

Canadian Regulatory Information: "This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the (M)SDS contains all the information required by the Controlled Products Regulations."

Name	Canada - WHMIS: Classifications of Substances:	Canada - WHMIS: Ingredient Disclosure:
Xylene (mixed isomers)	B2,D2A,D2B	m-, o-isomers 1.0%; p-isomer 0.1%
Ethylbenzene	B2,D2A,D2B	0.1%
Cumene	B2,D2A	0.1%
Toluene	B2,D2A,D2B	0.1%



NOTE: Not Applicable.

16. OTHER INFORMATION

Prepared By Toxicology and Product Safety
Revision Date: 05/14/2015

Revision Note:

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information is intended as guidance for safe handling, use, processing, storage, transportation, accidental release, clean-up and disposal and is not considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 10.18.2017 **Revision**: 10.18.2017

Trade Name: Alconox

1 Identification of the substance/mixture and of the supplier

1.1 Product identifier

Trade Name: Alconox
Synonyms:
Product number: 1104-1, 1104, 1125, 1150, 1101, 1103, 1112-1, 1112

1.2 Application of the substance / the mixture : Cleaning material/Detergent

1.3 Details of the supplier of the Safety Data Sheet

Manufacturer
Alconox, Inc.
30 Glenn Street
White Plains, NY 10603
1-914-948-4040

Supplier

Emergency telephone number:
ChemTel Inc
North America: 1-800-255-3924
International: 01-813-248-0585

2 Hazards identification

2.1 Classification of the substance or mixture:

In compliance with EC regulation No. 1272/2008, 29CFR1910/1200 and GHS Rev. 3 and amendments.

Hazard-determining components of labeling:
Tetrasodium Pyrophosphate
Sodium tripolyphosphate
Sodium Alkylbenzene Sulfonate

2.2 Label elements:

Skin irritation, category 2.
Eye irritation, category 2A.

Hazard pictograms:



Signal word: Warning

Hazard statements:
H315 Causes skin irritation.
H319 Causes serious eye irritation.

Precautionary statements:
P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P321 Specific treatment (see supplemental first aid instructions on this label).
P332+P313 If skin irritation occurs: Get medical advice/attention.
P362 Take off contaminated clothing and wash before reuse.
P501 Dispose of contents and container as instructed in Section 13.

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 10.18.2017 **Revision**: 10.18.2017

Trade Name: Alconox

Additional information: None.

Hazard description

Hazards Not Otherwise Classified (HNOC): None

Information concerning particular hazards for humans and environment:

The product has to be labelled due to the calculation procedure of the "General Classification guideline for preparations of the EU" in the latest valid version.

Classification system:

The classification is according to EC regulation No. 1272/2008, 29CFR1910/1200 and GHS Rev. 3 and amendments, and extended by company and literature data. The classification is in accordance with the latest editions of international substances lists, and is supplemented by information from technical literature and by information provided by the company.

3 Composition/information on ingredients

3.1 Chemical characterization : None

3.2 Description : None

3.3 Hazardous components (percentages by weight)

Identification	Chemical Name	Classification	Wt. %
CAS number: 7758-29-4	Sodium tripolyphosphate	Skin Irrit. 2 ; H315 Eye Irrit. 2; H319	12-28
CAS number: 68081-81-2	Sodium Alkylbenzene Sulfonate	Acute Tox. 4; H303 Skin Irrit. 2 ; H315 Eye Irrit. 2; H319	8-22
CAS number: 7722-88-5	Tetrasodium Pyrophosphate	Skin Irrit. 2 ; H315 Eye Irrit. 2; H319	2-16

3.4 Additional Information : None.

4 First aid measures

4.1 Description of first aid measures

General information: None.

After inhalation:

Maintain an unobstructed airway.

Loosen clothing as necessary and position individual in a comfortable position.

After skin contact:

Wash affected area with soap and water.

Seek medical attention if symptoms develop or persist.

After eye contact:

Rinse/flush exposed eye(s) gently using water for 15-20 minutes.

Remove contact lens(es) if able to do so during rinsing.

Seek medical attention if irritation persists or if concerned.

After swallowing:

Rinse mouth thoroughly.

Seek medical attention if irritation, discomfort, or vomiting persists.

4.2 Most important symptoms and effects, both acute and delayed

None

4.3 Indication of any immediate medical attention and special treatment needed:

No additional information.

5 Firefighting measures

5.1 Extinguishing media

Suitable extinguishing agents:

Use appropriate fire suppression agents for adjacent combustible materials or sources of ignition.

For safety reasons unsuitable extinguishing agents : None

5.2 Special hazards arising from the substance or mixture :

Thermal decomposition can lead to release of irritating gases and vapors.

5.3 Advice for firefighters

Protective equipment:

Wear protective eye wear, gloves and clothing.
Refer to Section 8.

5.4 Additional information :

Avoid inhaling gases, fumes, dust, mist, vapor and aerosols.
Avoid contact with skin, eyes and clothing.

6 Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures :

Ensure adequate ventilation.
Ensure air handling systems are operational.

6.2 Environmental precautions :

Should not be released into the environment.
Prevent from reaching drains, sewer or waterway.

6.3 Methods and material for containment and cleaning up :

Wear protective eye wear, gloves and clothing.

6.4 Reference to other sections : None

7 Handling and storage

7.1 Precautions for safe handling :

Avoid breathing mist or vapor.
Do not eat, drink, smoke or use personal products when handling chemical substances.

7.2 Conditions for safe storage, including any incompatibilities :

Store in a cool, well-ventilated area.

7.3 Specific end use(s):

No additional information.

Safety Data Sheet

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Effective date: 10.18.2017 **Revision**: 10.18.2017

Trade Name: Alconox

8 Exposure controls/personal protection





8.1 Control parameters :

a) 7722-88-5, Tetrasodium Pyrophosphate, OSHA TWA 5 mg/m3

b) Dusts, non-specific OEL, Irish Code of Practice

(i) Total inhalable 10 mg/m3 (8hr)

(ii) Respirible 4mg/m3 (8hr)

(iii) Tetrasodium Pyrophosphate, OSHA TWA 5 mg/m3, (8hr)

8.2 Exposure controls

Appropriate engineering controls:

Emergency eye wash fountains and safety showers should be available in the immediate vicinity of use or handling.

Respiratory protection:

Not needed under normal use conditions.

Protection of skin:

Select glove material impermeable and resistant to the substance or preparation. Protective gloves recommended to comply with EN 374. Take note of break through times, permeability, and special workplace conditions, such as mechanical strain, duration of contact, etc. Protective gloves should be replaced at the first sign of wear.

Eye protection:

Safety goggles or glasses, or appropriate eye protection. Recommended to comply with ANSI Z87.1 and/or EN 166.

General hygienic measures:

Wash hands before breaks and at the end of work.

Avoid contact with skin, eyes and clothing.

9 Physical and chemical properties

Appearance (physical state, color):	White and cream colored flakes - powder	**Explosion limit lower:** **Explosion limit upper:**	Not determined or not available. Not determined or not available.
Odor:	Not determined or not available.	**Vapor pressure at 20°C:**	Not determined or not available.
Odor threshold:	Not determined or not available.	**Vapor density:**	Not determined or not available.
pH-value:	9.5 (aqueous solution)	**Relative density:**	Not determined or not available.
Melting/Freezing point:	Not determined or not available.	**Solubilities:**	Not determined or not available.
Boiling point/Boiling range:	Not determined or not available.	**Partition coefficient (n-octanol/water):**	Not determined or not available.
Flash point (closed cup):	Not determined or not available.	**Auto/Self-ignition temperature:**	Not determined or not available.
Evaporation rate:	Not determined or not available.	**Decompositio n**	Not determined or not available.

Safety Data Sheet

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Effective date: 10.18.2017 **Revision**: 10.18.2017

Trade Name: Alconox

Flammability (solid, gaseous):	Not determined or not available.	**Viscosity**:	a. Kinematic: Not determined or not available. b. Dynamic: Not determined or not available.
Density at 20°C:	Not determined or not available.		

10 Stability and reactivity

10.1 Reactivity : None

10.2 Chemical stability : None

10.3 Possibility hazardous reactions : None

10.4 Conditions to avoid : None

10.5 Incompatible materials : None

10.6 Hazardous decomposition products : None

11 Toxicological information

11.1 Information on toxicological effects :

Acute Toxicity:

Oral:

: LD50 > 5000 mg/kg oral rat - Product .

Chronic Toxicity: No additional information.

Skin corrosion/irritation:

Sodium Alkylbenzene Sulfonate: Causes skin irritation. .

Serious eye damage/irritation:

Sodium Alkylbenzene Sulfonate: Causes serious eye irritation .

Tetrasodium Pyrophosphate: Rabbit - Risk of serious damage to eyes .

Respiratory or skin sensitization: No additional information.

Carcinogenicity: No additional information.

IARC (International Agency for Research on Cancer): None of the ingredients are listed.

NTP (National Toxicology Program): None of the ingredients are listed.

Germ cell mutagenicity: No additional information.

Reproductive toxicity: No additional information.

STOT-single and repeated exposure: No additional information.

Additional toxicological information: No additional information.

12 Ecological information

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 10.18.2017 **Revision**: 10.18.2017

Trade Name: Alconox

12.1 Toxicity:

Sodium Alkylbenzene Sulfonate: Fish, LC50 1.67 mg/l, 96 hours.
Sodium Alkylbenzene Sulfonate: Aquatic invertebrates, EC50 Daphnia 2.4 mg/l, 48 hours. Sodium Alkylbenzene Sulfonate: Aquatic Plants, EC50 Algae 29 mg/l, 96 hours.
Tetrasodium Pyrophosphate: Fish, LC50 - other fish - 1,380 mg/l - 96 h.
Tetrasodium Pyrophosphate: Aquatic invertebrates, EC50 - Daphnia magna (Water flea) - 391 mg/l - 48 h.

12.2 Persistence and degradability: No additional information.

12.3 Bioaccumulative potential: No additional information.

12.4 Mobility in soil: No additional information.

General notes: No additional information.

12.5 Results of PBT and vPvB assessment:

PBT: No additional information.

vPvB: No additional information.

12.6 Other adverse effects: No additional information.

13 Disposal considerations

13.1 Waste treatment methods (consult local, regional and national authorities for proper disposal)

Relevant Information:

It is the responsibility of the waste generator to properly characterize all waste materials according to applicable regulatory entities. (US 40CFR262.11).

14 Transport information

14.1 UN Number: ADR, ADN, DOT, IMDG, IATA	None
14.2 UN Proper shipping name: ADR, ADN, DOT, IMDG, IATA	None
14.3 Transport hazard classes: ADR, ADN, DOT, IMDG, IATA	**Class:** None **Label:** None **LTD.QTY:** None

US DOT

Limited Quantity Exception: None

Bulk:
RQ (if applicable): None
Proper shipping Name: None
Hazard Class: None
Packing Group: None
Marine Pollutant (if applicable): No additional information.

Non Bulk:
RQ (if applicable): None
Proper shipping Name: None
Hazard Class: None
Packing Group: None
Marine Pollutant (if applicable): No additional information.

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 10.18.2017 **Revision**: 10.18.2017

Trade Name: Alconox

Comments: None	**Comments:** None
14.4 Packing group: ADR, ADN, DOT, IMDG, IATA	None
14.5 Environmental hazards :	None
14.6 Special precautions for user:	None
Danger code (Kemler):	None
EMS number:	None
Segregation groups:	None
14.7 Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code: Not applicable.	
14.8 Transport/Additional information:	
Transport category:	None
Tunnel restriction code:	None
UN "Model Regulation":	None

15 Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture.

North American

SARA

Section 313 (specific toxic chemical listings): None of the ingredients are listed.
Section 302 (extremely hazardous substances): None of the ingredients are listed.

CERCLA (Comprehensive Environmental Response, Clean up and Liability Act) Reportable

Spill Quantity: None of the ingredients are listed.

TSCA (Toxic Substances Control Act):

Inventory: All ingredients are listed.
Rules and Orders: Not applicable.

Proposition 65 (California):

Chemicals known to cause cancer: None of the ingredients are listed.

Chemicals known to cause reproductive toxicity for females: None of the ingredients are listed.

Chemicals known to cause reproductive toxicity for males: None of the ingredients are listed.

Chemicals known to cause developmental toxicity: None of the ingredients are listed.

Canadian

Canadian Domestic Substances List (DSL):
All ingredients are listed.

EU

REACH Article 57 (SVHC): None of the ingredients are listed.

Safety Data Sheet

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Effective date: 10.18.2017 **Revision**: 10.18.2017

Trade Name: Alconox

Germany MAK: Not classified.
EC 648/2004 – This is an industrial detergent. Contains >30% phosphate, 15-30% anionic surfactant, <5% EDTA salts
EC 551/2009 – This is not a laundry or dishwasher detergent
EC 907/2006 – Contains no enzymes, optical brighteners, perfumes, allergenic fragrances, or preservative agents

Asia Pacific

Australia

Australian Inventory of Chemical Substances (AICS): All ingredients are listed.

China

Inventory of Existing Chemical Substances in China (IECSC): All ingredients are listed.

Japan

Inventory of Existing and New Chemical Substances (ENCS): All ingredients are listed.

Korea

Existing Chemicals List (ECL): All ingredients are listed.

New Zealand

New Zealand Inventory of Chemicals (NZOIC): All ingredients are listed.

Philippines

Philippine Inventory of Chemicals and Chemical Substances (PICCS): All ingredients are listed.

Taiwan

Taiwan Chemical Substance Inventory (TSCI): All ingredients are listed.

16 Other information

Abbreviations and Acronyms: None

Summary of Phrases

Hazard statements:
H315 Causes skin irritation.
H319 Causes serious eye irritation.

NFPA: 1-0-0
HMIS: 1-0-0

Precautionary statements:
P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P321 Specific treatment (see supplemental first aid instructions on this label).
P332+P313 If skin irritation occurs: Get medical advice/attention.
P362 Take off contaminated clothing and wash before reuse.
P501 Dispose of contents and container as instructed in Section 13.

Manufacturer Statement:

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ATTACHMENT G

Work Plan/Client SH&E Requirements

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Revision 11 June 16, 2020
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NAPL MONITORING AND RECOVERY PLAN

50 Kent Avenue Property Holder Area, Brooklyn, Kings County, New York

October 2 , 2020

Quality information

Prepared by	Checked by	Verified by	Approved by
Melissa Saunders Project Manager/Environmental Scientist	Shail Pandya Associate Vice President		

Revision History

Revision	Revision date	Details	Authorized	Name	Position
DRAFT	October 2, 2020	Draft for Review		Melissa Saunders	Project Manager

Distribution List

# Hard Copies	PDF Required	Association / Company Name

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1-1 NAPL Recovery Well Summary

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Appendix A – Well Construction Logs

Appendix B – NAPL Recovery Checklist

Appendix C – Recovery Well Field Form

Appendix D – Health & Safety Plan

Appendix E – Standard Operating Procedures for NAPL Recovery

Acronym List

bgs	below ground surface
CCR	Construction Completion Report
CFR	Code of Federal Regulations
DSNY	New York City Department of Sanitation
EPA	Environmental Protection Agency
ft	feet
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
IRM	Interim Remedial Measure
MGP	Manufactured Gas Plant
NAPL	Non-Aqueous Phase Liquid
OSHA	Occupational Safety and Health Administration
NYC Parks	New York City Department of Parks & Recreation
NYSDEC	New York State Department of Environmental Conservation
PCB	Polychlorinated Biphenyl
PID	Photoionization Detector
PPE	Personal Protection Equipment
PVC	Polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
VOC	Volatile Organic Compound

1. Introduction

On behalf of National Grid, AECOM USA, Inc. (AECOM) has prepared this Non-Aqueous Phase Liquid (NAPL) Monitoring and Recovery Plan to describe NAPL monitoring and recovery activities implemented as part of the NAPL Recovery Well Interim Remedial Measure (IRM) for the 50 Kent Avenue Property Holder Area located in Brooklyn, New York as shown in **Figure 1-1**.

Routine NAPL monitoring and recovery is completed at the Site to assess NAPL levels and to ensure those levels are maintained below the top of sump of recovery wells. This NAPL Monitoring and Recovery Plan presents the following information:

- Overview of the NAPL recovery well network
- Field activities associated with monitoring of NAPL and the collection and disposal of recovered NAPL
- Data review and reporting requirements
- Periodic well maintenance considerations.

This plan shall be updated annually to address changes associated with the NAPL monitoring and recovery program (i.e. project contacts, recovery frequency, monitoring requirements).

1.1 Background

As per the approved IRM Design and Implementation Plan, 13 NAPL recovery wells were installed for the NAPL Recovery IRM in 2014 and an IRM NAPL Recovery Wells Construction Completion Report (CCR) was submitted to New York State Department of Environmental Conservation (NYSDEC) in 2015. NAPL collection began at these wells in September 2014. A soil excavation/solidification IRM was conducted from November 2015 through June 2017 and a CCR for that work was prepared and submitted to NYSDEC in 2018.

1.2 Well Maintenance, Monitoring, and Collection Completed to Date

In 2016, with NYSDEC's permission, three recovery wells (NRW-01, NRW-02, and NRW-03) located within the Site boundary along with two recovery wells (NRW-09 and NRW-11) damaged during the soil excavation/solidification IRM implementation were abandoned. The latter two wells were replaced with recovery wells NRW-09R and NRW-11R at locations selected in consultation with the NYSDEC in 2017.

Throughout and upon completion of the soil excavation/solidification IRM, NAPL collection continued from existing recovery wells at the Site. NAPL was removed by pump from the recovery wells two to three times a week to maintain the level of cumulated NAPL below the top of the well sumps. During the soil excavation/solidification IRM, sump depths were reduced at some of the recovery wells due to sedimentation and gravel falling into the well or due to damage to well casings. Based on the depth to bottom measurements collected prior to and after completion

of the soil excavation/solidification IRM, it was clear that sump capacities in recovery wells NRW-01, NRW-02, NRW-07, NRW-08, NRW-09R, NRW-11R and NRW-13 were compromised.

In 2019, sump capacities of five of the seven compromised wells were successfully restored using air lift and surge and purge methods. Attempts of obstruction removal was not successful at two NAPL recovery wells (NRW-01 and NRW-08), which resulted in decommissioning of these wells and replacing them with NRW-01R and NRW-08R, as approved by NYSDEC. For further detail regarding the 2019 recovery well rehabilitation and reinstallation effort, refer to the AECOM document titled *2019 NAPL Recovery Well Rehabilitation and Reinstallation Report,* dated September 2019 (AECOM, 2019).

1.3 Recovery Well Network and Recovery Program

Currently, a total of 10 NAPL recovery wells comprise the Site well network, namely: NRW-01R, NRW-02, NRW-06, NRW-07, NRW-08R, NRW-09R, NRW-10, NRW-11R, NRW-12 and NRW-13. Eight NAPL recovery wells are located along North 12th Street, and two NAPL recovery wells are located along North 11th St (North 11th Street and North 12th Street are hereinafter referred to as “the Site”) as shown in **Figure 1-2** attached. NAPL monitoring and recovery events are currently undertaken once a week at the Site and include the following activities:

- Measurement of depth of recovery wells
- Measurement of NAPL thickness in each recovery well
- Recovery of NAPL from wells as required
- Evaluation of NAPL collected in each well sump
- Containerization and off-Site disposal of recovered NAPL.

Whilst it is noted that NAPL recovery events are currently undertaken once a week, NAPL recovery data may indicate that the frequency of NAPL recovery events may be reduced. This will be assessed through ongoing data review as discussed in **Section 3.1**.

Further detail regarding field activities associated with NAPL recovery is provided in the following sections.

1.4 Recovery Well Construction

Each well is six inches in diameter and screen intervals were generally determined based on depths where NAPL contamination was observed during the well drilling process. The bottom of the screen was located at the top of a clay layer at approximately 50 to 60 feet below grade surface (ft bgs). A five-foot long sump was installed into the clay layer, beneath the lowest screened zone, for collection of NAPL. The well construction logs are included in **Appendix A**.

Table 1-1 presents a summary of the depths of each well and the screen intervals.

Table 1-1

NAPL Recovery Well Summary

Recovery Well	Well Depth (ft)	Stainless Steel Screen Intervals bgs (ft)	PVC Screen Intervals bgs (ft)	Stainless Steel Sump Depth bgs (ft)
NRW-01R	58.5	8.5-28.5, 38.5-53.5	---	53.5-58.5
NRW-02	65	20-30, 35-60	---	60-65
NRW-06	67	12-27, 52-62	---	62-67
NRW-07	63	13-18, 38-58	---	58-63
NRW-08R	60.5	10.5-25.5, 35.5-55.5	---	55.5-60.5
NRW-09R	58	10-20, 30-55	---	55-60
NRW-10	55	15-50	---	50-55
NRW-11R	57	---	28-58	58-63
NRW-12	60	20-55	---	55-60
NRW-13	60	---	20-55	55-60

Each well is constructed with a 6-inch diameter by 5-foot long stainless-steel sump; 6-inch diameter, schedule 40 PVC, 0.020-slot continuous wire-wrap screen and/or a 6-inch diameter, stainless-steel, 0.020-slot continuous wire-wrap screen or combination thereof; and a 6-inch diameter, schedule 40 PVC solid riser to grade. Well sumps and screens have been constructed using stainless steel to improve durability and mitigate well degradation caused by NAPL.

2. Field Activities

This section describes the activities that shall be performed during each NAPL monitoring and recovery event. To assist in compliance with health and safety requirements as well as the performance of the tasks below, a checklist is provided in **Appendix B**. The Recovery Well Field Form provided in **Appendix C** is to be completed for each event.

2.1 Health and Safety

The work to be performed under this plan will occur in an area of soil and groundwater contamination as well as the area impacted with NAPL. All work shall be performed in accordance with the latest revision of the Health and Safety Plan (HASP). The current HASP is provided in **Appendix D**.

2.2 Site Access

North 12th Street is secured by locking entrance gate with chains and padlocks. If the gate is not secured with an AECOM- or National Grid-supplied lock, field personnel will coordinate with the New York City Department of Parks and Recreations (NYC Parks) to obtain the keys necessary to gain access to North 12th Street. Keys shall be returned to the person and place where the keys were obtained. Copies of the keys will be requested and made by the field personnel.

NYC Parks contact for the Site and keys:

Mary Salig
North Brooklyn Park Director NYC Parks
Bushwick Inlet Park
86 Kent Avenue
Brooklyn, NY 11211
Office (718) 218-6130
Cell (646) 739-3181

2.3 Site Mobilization

Currently, there is no storage allowed at the Site after field work. Therefore, an off-Site storage facility has been rented for storage of equipment. Prior to work, drums shall be purchased from a local dealer and the equipment shall be retrieved from the storage unit and transported to the Site. Gasoline may not be stored in the storage space, so gasoline for the generator, if the Waterra Hydrolift collection technique is used, must be purchased locally prior to commencement of field work. Purchase only enough gasoline to perform one day's worth of work (approximately 0.5 gallons).

2.4 Well Gauging

The recovery wells are currently gauged for NAPL during scheduled recovery events once a week. For each well, the presence of NAPL is measured using NAPL detection equipment or weighted string. Depth to bottom measurements are also collected for all recovery wells to assess well depth and sump capacity.

The frequency of gauging will be determined based on the accumulation rate of NAPL. **Section 3.1** describes the ongoing data review process that is implemented to inform decision making regarding the frequency of NAPL gauging.

2.5 NAPL Recovery

NAPL recovery events are currently undertaken once a week in conjunction with well gauging. This frequency is designed to prevent overflow of sumps, using accumulation rates based on data collected during recent gauging events.

NAPL collection is performed immediately following gauging activities, unless 1) no NAPL is observed during gauging or 2) the measured NAPL level in the well plus the anticipated accumulation, based on recently collected data, will be less than the height of the sump by the next recovery event.

Approximate volume of NAPL expected is calculated based on the gauging data prior to NAPL removal. NAPL is recovered via pumping using a peristaltic pump or an inertial hydrolift pump (i.e., a Waterra Pump), with the extracted NAPL directed into a drum. Extraction continues until relatively NAPL-free liquid is recovered.

2.6 Storage and Disposal

NAPL shall be collected directly into drums or consolidated into drums that shall be disposed of off-Site daily, unless permission is obtained for on-Site storage. National Grid's current contractor for disposal arrangements is as follows:

George Paolillo
Veolia North America
3001 Burns Avenue, Wantagh NY 11793
1 Eden Lane, Flanders NJ 07836
Office 516-221-8300
Cell 201-874-5390

Schedule for daily pick-up must be made four (4) days or more in advance. Pick-up shall also be confirmed by field personnel the day before the NAPL collection event. Drums with NAPL are not be left unattended at the Site prior to pick-up unless the field personnel have to use the restrooms located in the Parks Building, two blocks south of the Site. The drums shall be properly labeled and secured and the Site gates locked prior to taking the restroom break.

2.7 Standard Operating Procedures for NAPL Recovery

Standard Operating Procedures for NAPL recovery are provided in **Appendix E**.

2.8 Waste Characterization

An initial gauging event took place prior to NAPL recovery activities as well as the collection of an initial sample for disposal characterization on September 12, 2014.

AECOM gauged the amount of NAPL present in each well, and collected a composite sample from two wells that had the greatest amounts of NAPL present, and submitted this for analysis for the following parameters:

- Flash Point
- pH
- Resource Conservation and Recovery act (RCRA) (8 metals)
- Volatiles and semi-volatiles
- Polychlorinated biphenyls (PCBs)

The results of this analysis determined that the NAPL is characterized as hazardous waste based on its ignitability (Flash Point) and toxicity. Unless future analyses change this designation, the NAPL drums shall be labeled as hazardous. PPE and other plastic waste derived from the gauging and recovery activities are not hazardous and shall be clearly labeled as non-hazardous waste.

3. Data Review and Reporting

3.1 Data Review

NAPL monitoring and recovery data is uploaded weekly and maintained in a dedicated project file. Once a month, a data review will be undertaken to assess:

- NAPL thickness in each recovery well and trends (i.e. stable, increasing or decreasing thickness)
- Sump capacity (i.e. stable or decreasing length)
- Well depth (i.e. stable or decreasing depth)
- Well condition (i.e. potential casing damage or blockage)

In addition to the above, NAPL collection rates are to be reviewed to determine if the well screen is damaged or clogged which may prevent the inflow of NAPL.

The outcomes of the monthly data review will be used to inform decision making regarding:

- The frequency of gauging and recovery events (based on the accumulation rate of NAPL)
- The requirements for well maintenance (if any).

A reduction in recovery frequency may be recommended for select recovery wells on a case by case basis should it be demonstrated that NAPL levels:

- Are stable or decreasing; and
- Can be maintained below the top of sump for the designated timeframe.

Section 4.0 provides detail with regard to actions to be taken should the data review identify the need for well maintenance.

3.2 Quarterly NAPL Monitoring and Recovery Report

AECOM will prepare quarterly NAPL Monitoring and Recovery reports that will include the following:

- Presented in cumulative table format:
  - NAPL gauging data
  - Recovered volumes
  - Total well depths.
- Graphs showing:
  - NAPL thickness in each well from commencement of monitoring through to the end of the subject monitoring quarter.
  - Volume of liquid recovered during each event from commencement of monitoring through to the end of the subject monitoring quarter
  - Cumulative volume of liquid recovered since commencement of monitoring.

NAPL Monitoring and Recovery reports will be delivered to NYSDEC in January (for the quarter ending December), April (for the quarter ending March), July (for the quarter ending June) and October (for the quarter ending September).

It is noted that the activities and outcomes of periodic well maintenance (refer **Section 4.0**) will be reported in a comprehensive standalone report which will be submitted to NYSDEC for review.

4. Periodic Recovery Well Maintenance

Periodic recovery well maintenance is required to maintain sufficient well yield to promote NAPL recovery and mitigate NAPL migration. Of note is that well screens can become clogged by NAPL over time which may prevent the inflow of NAPL.

Based on the outcomes of the data review described in **Section 3.1**, it may be considered necessary to undertake well rehabilitation to restore screen functionality and sump capacity. In addition, should it be determined or suspected that recovery wells are compromised and no longer functioning as intended, it may be necessary to undertake well decommissioning and reinstallation activities in order to maintain an adequate well network for NAPL recovery.

Prior to the commencement of well maintenance activities, a Work Plan will be submitted to NYSDEC for review and approval. An overview of well maintenance activities that may be required is provided in the following sections.

4.1 Recovery Well Rehabilitation

Based on well rehabilitation works completed at the Site in 2019 (AECOM, 2019), it is likely that rehabilitation will be accomplished by re-development to remove sediment from the well sumps. However, well rehabilitation may also be required to remove NAPL blockages and restore screen functionality.

Recovery well rehabilitation methods will be assessed on a case by case basis. As discussed in AECOM, 2019, well redevelopment has previously been achieved using a combination of two methods, namely; surge and pump and/or air lifting.

Following well development, wells are to be gauged to provide confirmation that the well has been successfully rehabilitated. It is noted that should redevelopment using surge and pump and/or air lifting not be successful, consideration should be given to the implementation of additional rehabilitation measures or well decommissioning (refer **Section 4.2**).

4.2 Recovery Well Decommissioning

In the event that wells are damaged and need to be decommissioned, wells will be decommissioned in accordance with NYSDEC's CP-43, Groundwater Monitoring Well Decommissioning Policy.

4.3 Recovery Well Installation

In summary, the sequence of work for installation of the NAPL recovery wells will be as follows:

- Removal of hardstand surface at the designated location
- Hand-clearing of well locations to 5ft bgs
- Advancement of soil borings and well installation
- Installation of flush-mount well boxes at each well location
- Development of wells
- Surface restoration.

Recovery wells are to be constructed with:

- 6-inch diameter by 5-foot long stainless-steel sumps;
- 6-inch diameter, 0.020 slot continuous wire-wrap screen (62 square inches open area per foot of screen); and
- 6-inch diameter Schedule 40 PVC solid riser to grade.

After a minimum period of 24-hours post-installation, each well will be developed using a combination of surge and pump and air lift procedures to remove drilling fluids and fine-grained material from the sump, well screen, and filter pack to enhance connectivity with the surrounding aquifer.

5. References

AECOM.2019. NAPL Recovery Well Rehabilitation and Reinstallation Report, dated September 2019.

NYSDEC.2009.CP-43: Groundwater Monitoring Well Decommissioning Policy, dated November 3, 2009.

Figures



Source: Google Earth Pro - © 2012 Google

APPROXIMATE SCALE IN FEET

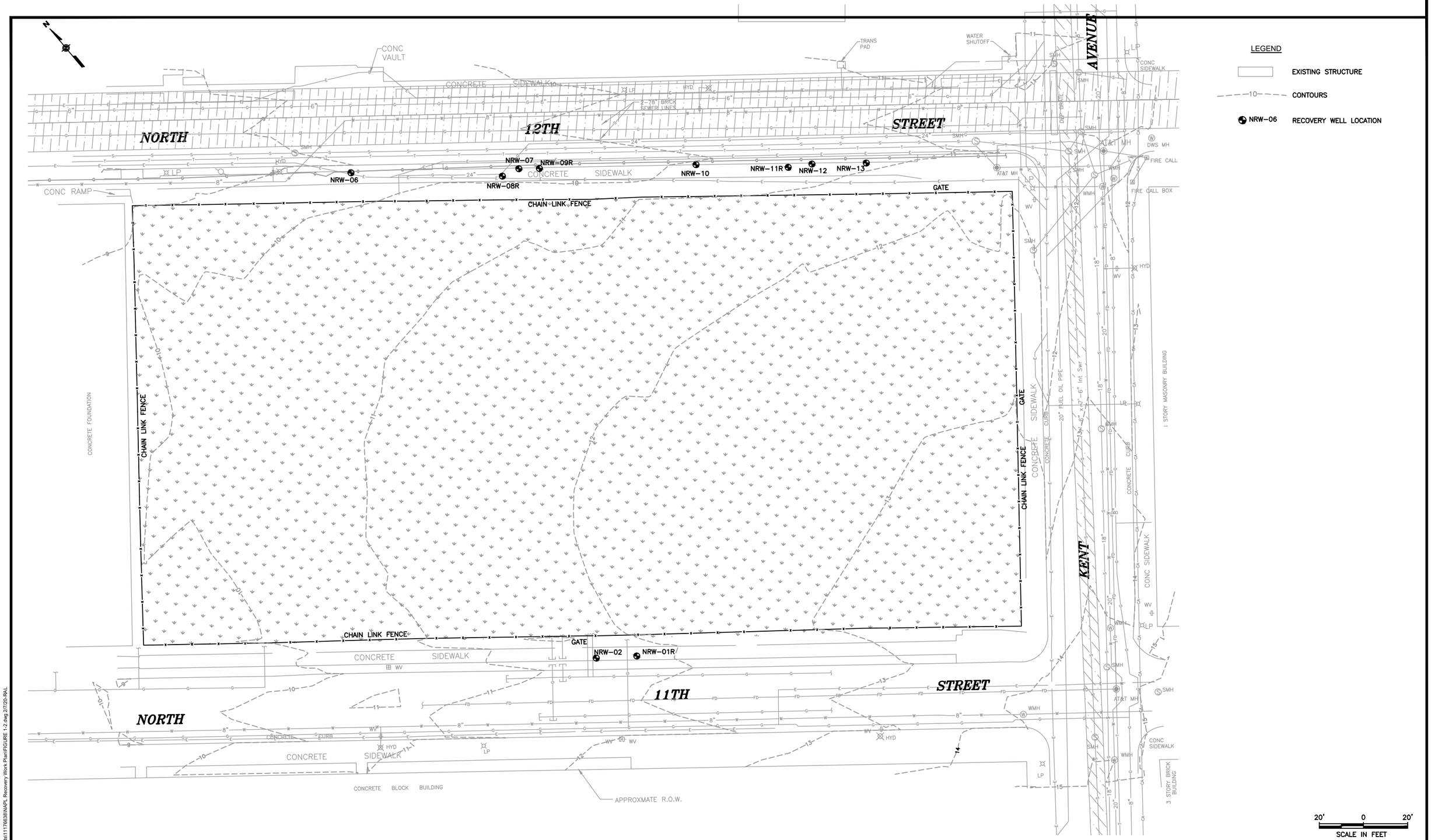
2000 0 2000

AG20745-111176638-071812-GCM

AECOM

50 KENT AVENUE PARCEL OF THE
WILLIAMSBURG WORKS FORMER MGP SITE
BOROUGH OF BROOKLYN, NEW YORK
SITE LOCATION MAP

FIGURE 1-1



LEGEND

- EXISTING STRUCTURE
- 10 CONTOURS
- NRW-06 RECOVERY WELL LOCATION

20' 0 20'
SCALE IN FEET

AECOM

NATIONAL GRID
FORMER WILLIAMSBURG MGP SITE
BROOKLYN, KINGS COUNTY, NEW YORK

NAPL MONITORING AND
RECOVERY PLAN

NAPL RECOVERY WELL LOCATIONS

DATE: FEBRUARY 2020

FIGURE 1-2

\\URSBuffalo.us.ie.urs\Buffalo\Projects\41177683\NAPL Recovery Work Plan\FIGURE 1-2.dwg 2/7/20-RAL

Appendices

Appendix A – Well Construction Logs

AECOM

Boring Log

BORING NO. : NRW-01R

PROJECT:	National Grid Williamsburg	**SHEET:** 1 OF 3	
PROJECT LOCATION:	Midpoint of N 11th St, w of Kent Ave/~20' from NRW-02	**JOB NO. :**	
CLIENT:	National Grid	**TOTAL DEPTH OF BOREHOLE:**	60 ft. bgs
DRILLING CONTRACTOR:	ADT	**GROUND ELEVATION:**	
DRILLING METHOD:	Sonic	**DATE STARTED:**	5/14/2019
DRILL RIG TYPE:	Fraste XL Max	**DATE FINISHED:**	5/21/2019
DRILL BIT SIZE/TYPE:	5" Sonic Core	**DRILLER:**	Tony Palomeque
SAMPLING METHOD(S):	5' Sonic Cores	**GEOLOGIST:**	M Dascoli & R Doshi
		REVIEWED BY:	

DEPTH FEET	STRATA	VISUAL IMPACT	SAMPLE	PID (ppm)	RECOVERY (inches)	USCS	MATERIAL DESCRIPTION	REMARKS	WELL CONSTRUCTION
0					60"	FILL	Sidewalk/ concrete 0'-5' Handcleared 0'-5' FILL - dk brown coarse, angular gravel with fine- coarse sand, few silt at 2' moderate mothball-like odor, dark gray color at 3' water seeping in from the sides. Boulder		FLUSH MOUNT PROTECTIVE CASING AND LOCKABLE CAP
-5				391	32"	MH	5'-7' Dk gray SILT, few fine-med sand & some gravel & brick pieces @ 6.5'- light brown NAPL stringer, 35% saturation	Wet	20 ft of 6" STAINLESS STEEL SCREEN SLOT SIZE: 0.020"
			1	780		SP	7'-10' med brown fine SAND, few silt & gravel @ 9'- med brown NAPL stringer, 40% saturation	Dry	SCH.40 PVC Casing, Stainless Steel Screens, statinless steel sump 6" Inch Diameter
				1123					
-10				284	32"	CL	10'-12' dense, med brown silty CLAY, few gravel 12'-12.5' med dense, med brown fine-med SAND, few silt		BENTONITE (BENSEAL) INSTALLED
			2	485					
				1445		SP	12.5'-14.5' loose, dk brown- black fine SAND with dk brown NAPL of 75-100% saturation, strong mothball-like odors	Wet	
				>15000					
				>15000			14.5'-15' med brown very fine SAND w/ black staining, burnt odor	Dry	
-15				676	36"	GP	15'-20' no odor in soil, drilling water has mothball-like odor 15'-16' dk brown very fine-fine SAND with mica & silt	Wet	
			3	1582		ML	16'-17' loose, dk gray, fine-coarse angular GRAVEL, with some cobbles and some silt 17'-20' very dense, medium brown, SILT with few clay and few fine to medium sand		SAND PACK #0
-20				141	51"	CL	20'-25' no odors in soil, drilling water has mothball-like odor 20'-22.5' medium dense, medium red-brown CLAY	Dry	20 ft of 6" STAINLESS STEEL SCREEN SLOT SIZE: 0.020"
			4	77					
				359			22.5'-23.5' dense, medium brown silty CLAY with few fine-med sand and few fine gravel, trace coarse gravel		
				288					
-25				1406			23.5'-25' dense, same as above with red-brown		

COMMENTS:

BORING NO. : NRW-01R

Boring Log

AECOM

PROJECT:	National Grid Williamsburg
PROJECT LOCATION:	Midpoint of N 11th St, w of Kent Ave/~20' from NRW-02
CLIENT:	National Grid
DRILLING CONTRACTOR:	ADT
DRILLING METHOD:	Sonic
DRILL RIG TYPE:	Fraste XL Max
DRILL BIT SIZE/TYPE:	5" Sonic Core
SAMPLING METHOD(S):	5' Sonic Cores

BORING NO. :	NRW-01R
SHEET:	2 OF 3
JOB NO. :	
TOTAL DEPTH OF BOREHOLE:	60 ft. bgs
GROUND ELEVATION:	
DATE STARTED:	5/14/2019
DATE FINISHED:	5/21/2019
DRILLER:	Tony Palomeque
GEOLOGIST:	M Dascoli & R Doshi
REVIEWED BY:	

DEPTH FEET	STRATA	VISUAL IMPACT	SAMPLE	PID (ppm)	RECOVERY (inches)	USCS	MATERIAL DESCRIPTION	REMARKS	WELL CONSTRUCTION
-25			5	767 1382 >15000 >15000 >15000	60"		and med brown banding at 25'- boulder 25'-26' same as 23.5-25' 26'- 30' very dense, medium gray CLAY with some silt at 27-27.5' lense of dk gray fine SAND with 100% NAPL saturation at 27.5' - 27.75' Iron colored staining, with some fine sand, 50% saturation at 28'-30' with few fine-coarse angular gravel		
-30			6	52.6 680 134 142 177	48"		30'-35' very dense, med gray CLAY with some silt, few fine to medium angular gravel throughout at 31' - cobble at 35' - boulder	Wet	TIME RELEASE BENTONITE PELLETS 10 ft of 6" STAINLESS STEEL SCREEN SLOT SIZE: 0.020"
-35			7		25"	ML	35'-40'- Mothball-like odors throughout interval. No free product. 35'-36.5' CLAY with some silt and little sand 36.5'-40' very dense, gray SILT with few sand, few gravel/ cement-like pieces.	Saturation Level Not Recorded	
-40			8	870 2300 1325 1600	36"	SP ML	40'-41.5' fine SAND with few silt, few gravel and mica, mothball- like odors 41.5'-43.5' brown fine SAND with some silt, mothball-like odors 43.5'-44.5' gray fine SAND with some silt and mica. Trace blebs of brown NAPL visible, strong mothball-like odor. 44.5'-45' light gray SILT with some sand, strong mothball-like odor		
-45			9	>1000 715 695	32"	SP	45'-46' very fine SAND with mica. 90% NAPL saturation, strong mothball-like odor. 46'-48.5' brown very fine SAND with some silt and mica. 35% NAPL saturation. Mothball-like odor. 48.5'-50' fine SAND with mica and trace silt. 20% NAPL saturation.		SAND PACK #0 15 ft of 6" STAINLESS STEEL SCREEN SLOT SIZE: 0.020"
-50									

COMMENTS:

BORING NO. : NRW-01R

Boring Log

AECOM

PROJECT:	**National Grid Williamsburg**	**BORING NO. :**	**NRW-01R**
PROJECT LOCATION:	**Midpoint of N 11th St, w of Kent Ave/~20' from NRW-02**	**SHEET:**	**3 OF 3**
CLIENT:	**National Grid**	**JOB NO. :**	
DRILLING CONTRACTOR:	**ADT**	**TOTAL DEPTH OF BOREHOLE:**	60 ft. bgs
DRILLING METHOD:	**Sonic**	**GROUND ELEVATION:**	
DRILL RIG TYPE:	**Fraste XL Max**	**DATE STARTED:**	5/14/2019
DRILL BIT SIZE/TYPE:	**5" Sonic Core**	**DATE FINISHED:**	5/21/2019
SAMPLING METHOD(S):	**5' Sonic Cores**	**DRILLER:**	Tony Palomeque
		GEOLOGIST:	M Dascoli & R Doshi
		REVIEWED BY:	

DEPTH FEET	STRATA	VISUAL IMPACT	SAMPLE	PID (ppm)	RECOVERY (inches)	USCS	MATERIAL DESCRIPTION	REMARKS	WELL CONSTRUCTION
-50			10	15000 640 690 129 30	40"	ML CL	50'-51' find SAND. 100% black NAPL saturation. 51'-52.5' SAND with few silt. 35% black NAPL saturation. 52.5'-53.5' brown SILT with some clay. Faint petroleum-like and mothball-like odors. 53.5'-55' grayish brown CLAY with some silt. No odors noted.		
-55			11	3.0 2.0	60"	SP	55'-57.5' hard, grayish brown CLAY. No odors noted. 57.5'-59' brown SAND with some silt and clay. No impacts. 59'-60' hard, dark gray CLAY. No impacts.		5 ft of 6" STAINLESS STEEL SOLID PIPE SUMP*Centrali Installed at 56' bgs TIME RELEASE BENTONITE PELLETS
-60				5.0		CL			

COMMENTS:

BORING NO. : NRW-01R

URS Corporation

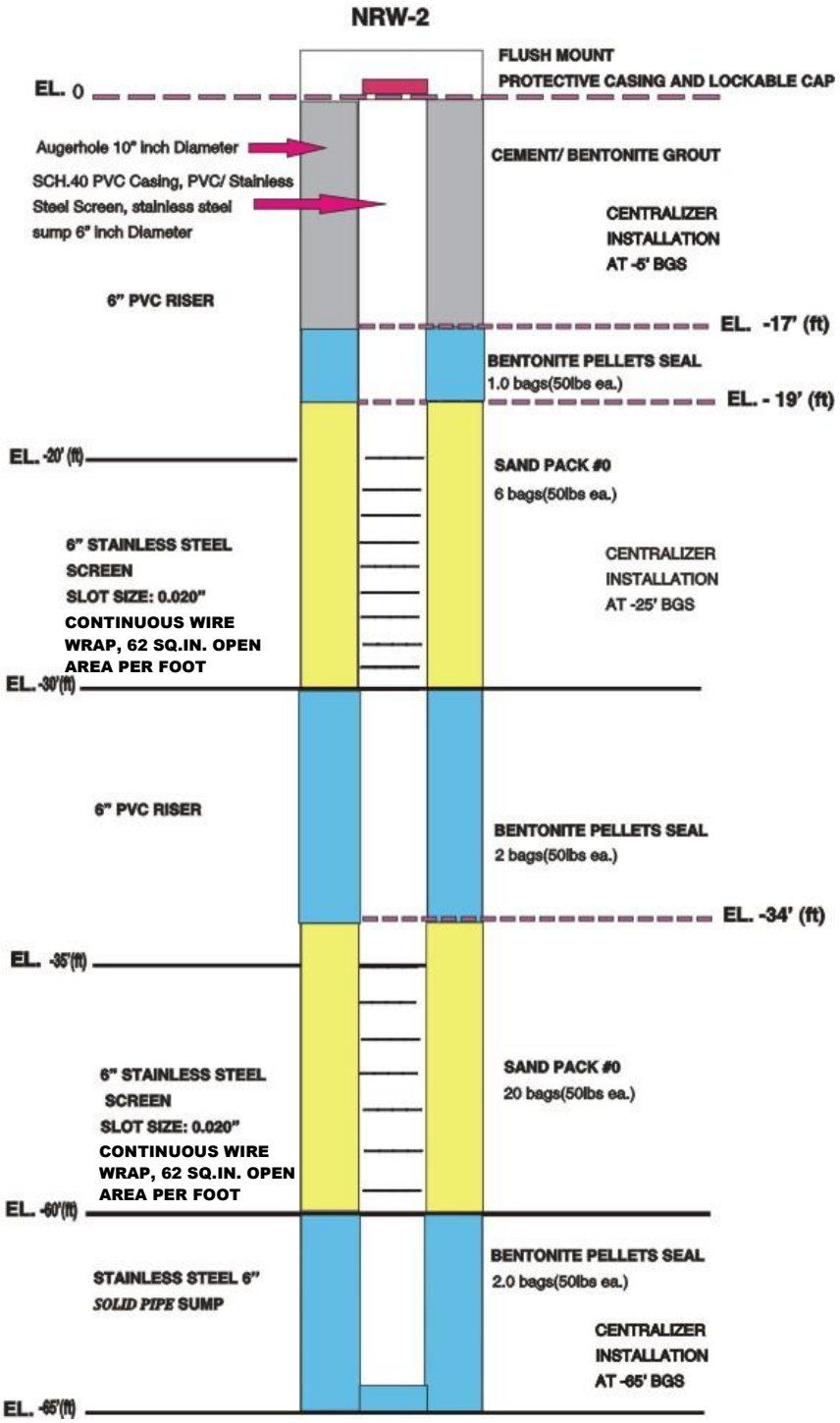
Client: National Grid

Location: 50 Kent Ave.,
Williamsburg, Brooklyn, New York
Project No.11176638.00019

DRILLING SUMMARY

GEOLOGIST: ANDREAS PAPANEOCLEOUS
DRILLING COMPANY: CASCADE
DRILLER: JOHN GRAGLIA
DRILLING RIG TYPE: SONIC
DATE: 03-17-2014

Recovery Well Construction Details



URS

50 KENT AVENUE PROPERTY, BROOKLYN KINGS COUNTY, NEW YORK

URS Corporation

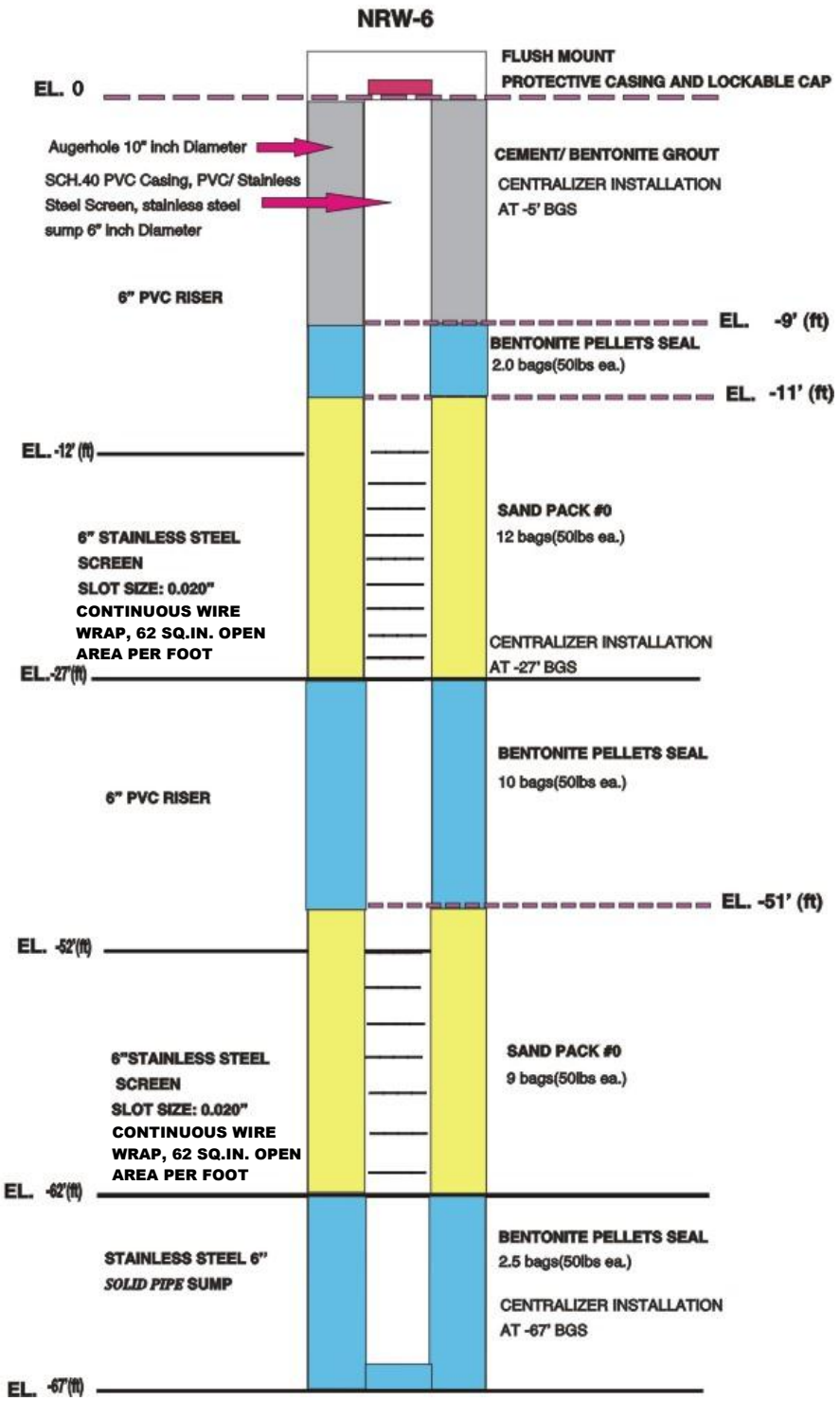
Client: National Grid

Location: 50 Kent Ave.,
Williamsburg, Brooklyn, New York
Project No.11176638.00019

DRILLING SUMMARY

GEOLOGIST: ANDREAS PAPANEOCLEOUS
DRILLING COMPANY: CASCADE
DRILLER: JOHN GRAGLIA
DRILLING RIG TYPE: SONIC
DATE: 04-02-2014

Recovery Well Construction Details



URS Corporation

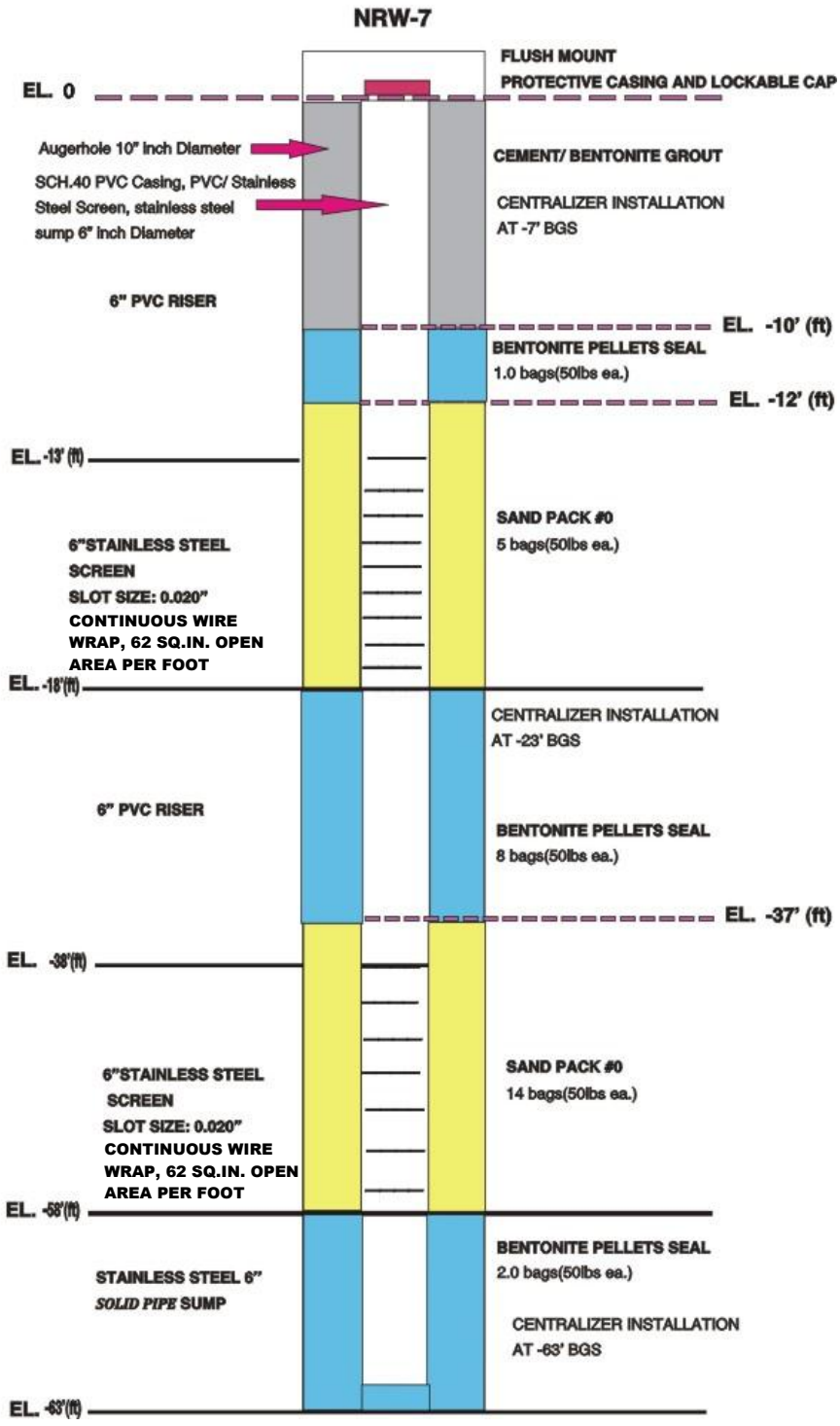
Client: National Grid

Location: 50 Kent Ave.,
Williamsburg, Brooklyn, New York
Project No.11176638.00019

DRILLING SUMMARY

GEOLOGIST: ANDREAS PAPANEOCLEOUS
DRILLING COMPANY: CASCADE
DRILLER: JOHN GRAGLIA
DRILLING RIG TYPE: SONIC
DATE: 04-03-2014

Recovery Well Construction Details



AECOM

Boring Log

BORING NO. : NRW-08R

PROJECT:	National Grid Williamsburg
PROJECT LOCATION:	Mid-way down N 12th St, west of Kent Ave.
CLIENT:	National Grid
DRILLING CONTRACTOR:	ADT
DRILLING METHOD:	Sonic
DRILL RIG TYPE:	Fraste XL Max
DRILL BIT SIZE/TYPE:	5" Sonic Core
SAMPLING METHOD(S):	5' Sonic Cores

SHEET: 1 OF 3	
JOB NO. :	
TOTAL DEPTH OF BOREHOLE:	60 ft. bgs
GROUND ELEVATION:	
DATE STARTED:	5/142019
DATE FINISHED:	5/24/2019
DRILLER:	Tony Palomeque
GEOLOGIST:	M Dascoli & R Doshi
REVIEWED BY:	

DEPTH FEET	STRATA	VISUAL IMPACT	SAMPLE	PID (ppm)	RECOVERY (inches)	USCS	MATERIAL DESCRIPTION	REMARKS	WELL CONSTRUCTION
0					60"	FILL	4" Sidewalk/ concrete 0'-5' Handcleared 0'-5' FILL - medium brown sand and silt, trace brick with some gravel and few cobbles, no odor or staining noted at 4' with medium gray color		FLUSH MOUNT PROTECTIVE CASING AND LOCKABLE CAP
-5			1	0.2 0.2 0.3 11.5 25.6	55"	ML	5'-10' medium gray, soft 5'-9' SILT with few sand and clay, trace gravel 9'-10' same as above with some clay, with black silt, possible staining 10'-12' same as above	Wet Dry	15 ft of 6" STAINLESS STEEL SCREEN SLOT SIZE: 0.020" BENTONITE (BENSEAL) INSTALLED
-10			2	44.3 29.0 50.0 109 131	45"	SP ML	12'-12.4' 4" layer of fine SAND with 100% NAPL saturation, dark brown NAPL, burnt, acrid odor 12.4'- 15' alternating layers of brown and black, very soft, SILT, some clay, trace sand and gravel	Wet Dry	SCH.40 PVC Casing, Stainless Steel Screens, statinless steel sump 6" Inch Diameter
-15			3	15.0 49.5 217 196 925	31"		15'-17' dark gray SILT 17'-18' possible weathered rock with mica and silt, mothball-like odor 18'-19.5' crushed boulder, dry 19.5'-20' medium brown, very fine SAND & SILT, strong mothball-like odor, about 15% NAPL	Wet	SAND PACK #0 15 ft of 6" STAINLESS STEEL SCREEN SLOT SIZE: 0.020"
-20			4	290 151 307 234 75.1	48"	SP/ML CL	20'-21' Hard, medium brown CLAY, trace gravel, dry 21'-22.5' dark brown, stained, very fine SAND, trace medium sand, 20% NAPL saturation, strong mothball-like odor 22.5'-25' same as 20'-21' (Hard, medium brown CLAY, trace gravel, dry) at 23.5'-25' with some coarse gravel and trace cobble	Dry	
-25									

COMMENTS:

BORING NO. : NRW-08R

AECOM

Boring Log

BORING NO. : NRW-08R

PROJECT:	National Grid Williamsburg
PROJECT LOCATION:	Mid-way down N 12th St, west of Kent Ave.
CLIENT:	National Grid
DRILLING CONTRACTOR:	ADT
DRILLING METHOD:	Sonic
DRILL RIG TYPE:	Fraste XL Max
DRILL BIT SIZE/TYPE:	5" Sonic Core
SAMPLING METHOD(S):	5' Sonic Cores

SHEET:	2 OF 3
JOB NO. :	
TOTAL DEPTH OF BOREHOLE:	60 ft. bgs
GROUND ELEVATION:	
DATE STARTED:	5/142019
DATE FINISHED:	5/24/2019
DRILLER:	Tony Palomeque
GEOLOGIST:	M Dascoli & R Doshi
REVIEWED BY:	

DEPTH FEET	STRATA	VISUAL IMPACT	SAMPLE	PID (ppm)	RECOVERY (inches)	USCS	MATERIAL DESCRIPTION	REMARKS	WELL CONSTRUCTION
-25			5	27.8 21.6 167.1 6.3 24.8	60"		25'-28' dark gray, CLAY, few gravel, stiff, dry, no odor at 27'-30' chemical-like odor noted 28'- 29' very stiff, brick red CLAY, dry 29'-30' hard, dark gray CLAY, few coarse gravel		
-30			6	2.5 2.6 2.8 3.0 3.1	40"		30' - 35' hard, dark gray CLAY, few gravel		
-35			7	28 7.2 77.9 11.3 36.3	48"	SP CL	35'-35.5' Boulder 35.5'-38' dark brown very fine SAND and few silt, few mica, faint chemical-like odor 38'-40' hard, dark gray CLAY, some fine to coarse gravel	Wet Saturation Level Not Recorded	
-40			8	538 366 988 736 658	38"	SP	40'-45' medium brown very fine SAND with few silt, very strong mothball-like odor throughout @ 43.5'-43.75' dark brown NAPL, ~20% saturation @ 44.5'-45' medium brown NAPL, ~20%, with layer of black staining		SAND PACK #0
-45			9	1270 618 1154 2065 1726	41"	ML SP	45'-50' very loose, medium brown, very strong mothball-like odor 45'-47' SILT with mica, 5% NAPL saturation 47'-47.25' sub-rounded coarse SAND, 50% lt brown NAPL sat. 47.25'-49' very fine SAND with few medium-coarse sand, 50% light brown NAPL saturation 49'-50' find SAND, with some silt, staining, 100% dark brown NAPL saturation		TIME RELEASE BENTONITE PELLETS 20 ft of 6" STAINLESS STEEL SCREEN SLOT SIZE: 0.020" 20 ft of 6" STAINLESS STEEL SCREEN SLOT SIZE: 0.020"
-50									

COMMENTS:

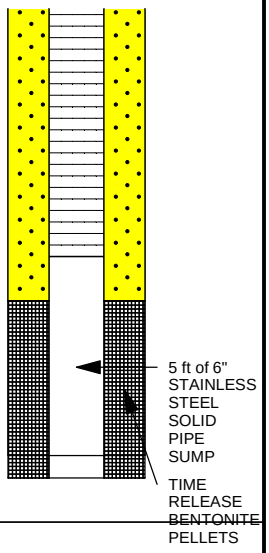
BORING NO. : NRW-08R

Boring Log

AECOM

		BORING NO. :	NRW-08R
PROJECT:	National Grid Williamsburg	SHEET: 3 OF 3	
PROJECT LOCATION:	Mid-way down N 12th St, west of Kent Ave.	JOB NO. :	
CLIENT:	National Grid	TOTAL DEPTH OF BOREHOLE:	60 ft. bgs
DRILLING CONTRACTOR:	ADT	GROUND ELEVATION:	
DRILLING METHOD:	Sonic	DATE STARTED:	5/142019
DRILL RIG TYPE:	Fraste XL Max	DATE FINISHED:	5/24/2019
DRILL BIT SIZE/TYPE:	5" Sonic Core	DRILLER:	Tony Palomeque
SAMPLING METHOD(S):	5' Sonic Cores	GEOLOGIST:	M Dascoli & R Doshi
		REVIEWED BY:	

DEPTH FEET	STRATA	VISUAL IMPACT	SAMPLE	PID (ppm)	RECOVERY (inches)	USCS	MATERIAL DESCRIPTION	REMARKS	WELL CONSTRUCTION
-50			10	340.8 391 386.6 99.9 51.6	55"	ML	50'-55' strong mothball-like odor 50'-52' medium gray very fine SAND with 15% light brown NAPL saturation @51'-51.5' with 50% NAPL saturation 52'-54' dark gray SILT @52.5'- 1/2" of very fine SAND with 100% dk brown NAPL sat. 54'-55' medium brown very find SAND with some silt		
-55			11	470 62.3 30.5 12.5 12.0	50"	SP CL	55'-56.5' loose, medium brown, very find SAND, trace silt 56.5'- 61.5' hard CLAY of various colors- medium brown with red and white streaking throughout		
-60									



COMMENTS:

BORING NO. : NRW-08R

DRILLING SUMMARY

Geologist:
J. Christopher

Drilling Company:
ADT

Driller:
G. Rivera

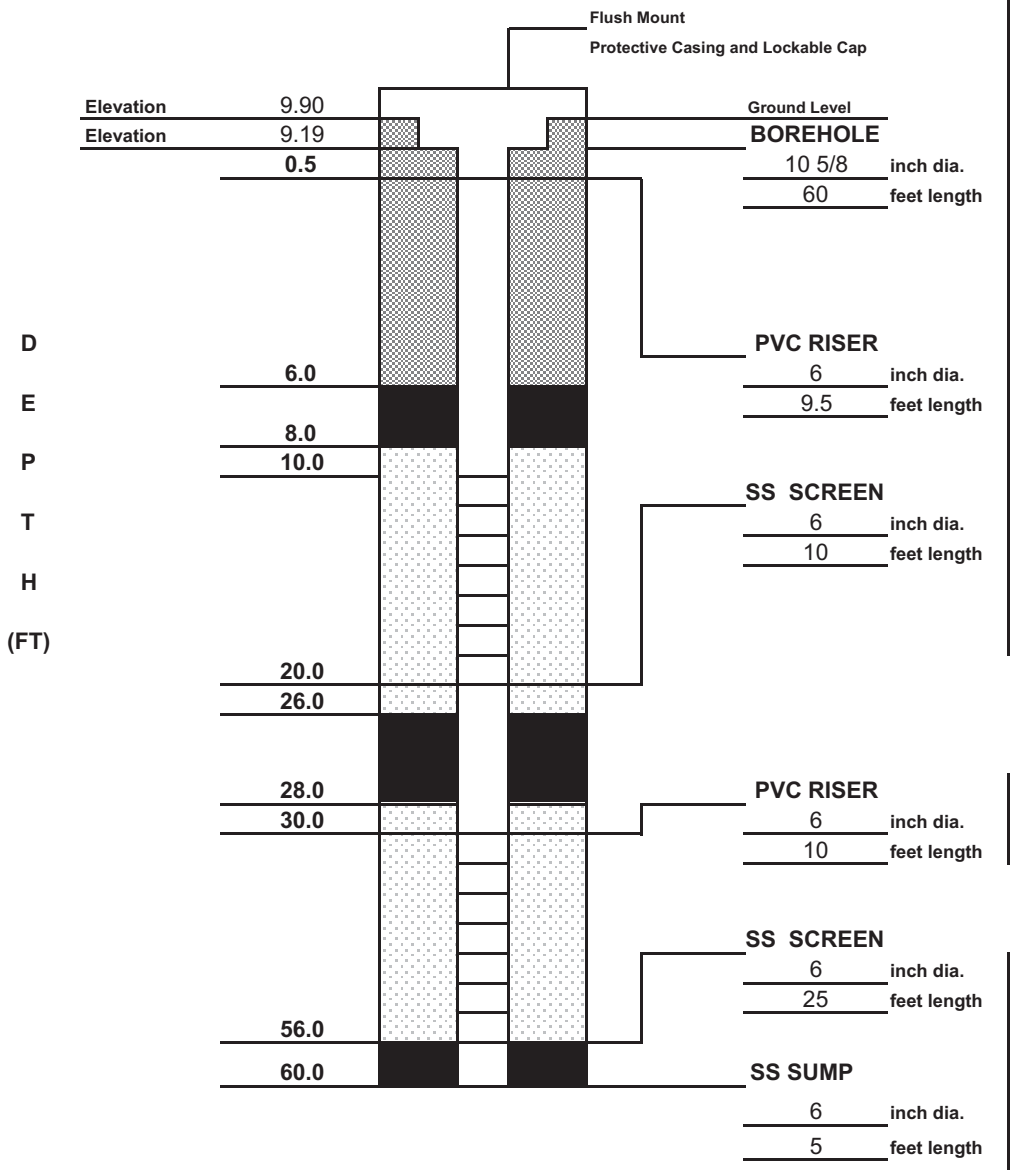
Rig Make/Model:
Fraste Sonic XL Max 250 MS

Date:
3/28/17

GEOLOGIC LOG

Depth(ft.)	Description
	See Boring Log for Lithologic Description.

WELL DESIGN



CASING MATERIAL		*SCREEN MATERIAL*		*FILTER MATERIAL*		
Surface:	12" Flush mount steel grade box	**Type:**	6" Continuous Wrap Stainless Steel	**Type:** #0 Sand	**Setting:**	8.0-26.0 ft 28.0-56.0 ft
Riser:	6" Schedule 40 PVC	**Slot Size:**	0.020"	*SEAL MATERIAL*		
				Type: Bentonite Chips	**Setting:**	6.0-8.0 ft 26.0-28.0 ft 56.0-60.0 ft

COMMENTS:
Seal Material

Bentonite Chips: 6'-8'/26'-28'/56'-60'

LEGEND

- Concrete
- Bentonite
- Silica Sandpack

Client: **National Grid**	**Williamsburg Works** **Former MGP Site**	**Project No.:** **J1144**
Sevenson	**MONITORING WELL CONSTRUCTION DETAILS**	**Well Number:** **NRW-09R**

URS Corporation

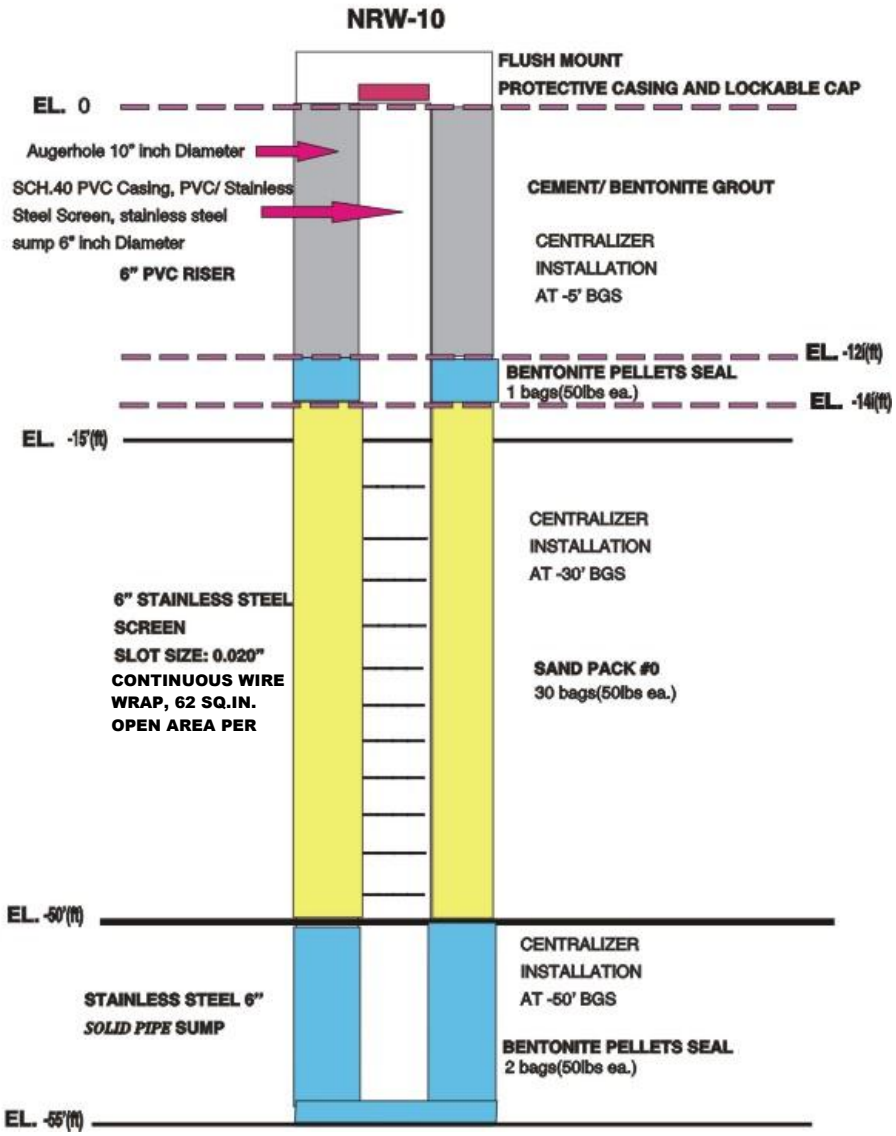
Client: National Grid

Location: 50 Kent Ave.,
Williamsburg, Brooklyn, New York
Project No.11176638.00019

DRILLING SUMMARY

GEOLOGIST: ANDREAS PAPANEOCLEOUS
DRILLING COMPANY: CASCADE
DRILLER: JOHN GRAGLIA
DRILLING RIG TYPE: SONIC
DATE: 03-20-2014

Recovery Well Construction Details



DRILLING SUMMARY

Geologist:
M. Dascoli

Drilling Company:
ADT

Driller:
G. Rivera

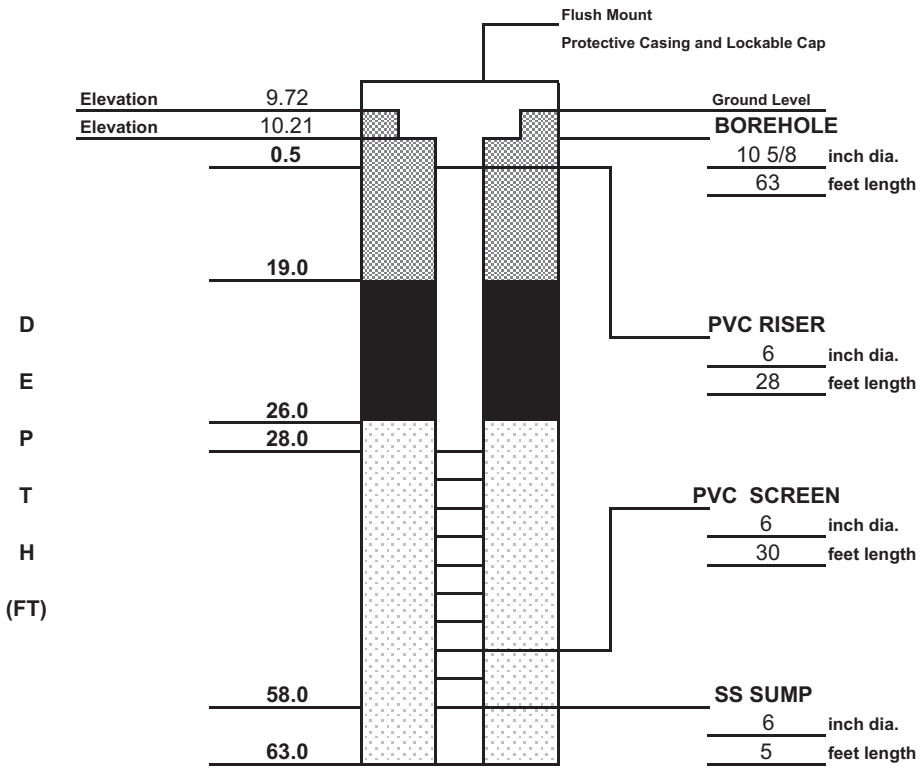
Rig Make/Model:
Fraste Sonic XL Max 250 MS

Date:
3/24/17

GEOLOGIC LOG

Depth(ft.)	Description
	See Boring Log for Lithologic Description.

WELL DESIGN



CASING MATERIAL

Surface: 12" Flush mount

Riser: 6" Schedule 40 PVC

SCREEN MATERIAL

Type: 6" Continuous Wrap Stainless Steel

Slot Size: 0.020"

FILTER MATERIAL

Type: #0 Sand **Setting:** 26.0-63.0 ft

SEAL MATERIAL

Type: Bentonite Chips **Setting:** 19.0-26.0 ft

COMMENTS:

LEGEND

Concrete

Bentonite

Silica Sandpack

Client: National Grid	**Williamsburg Works** **Former MGP Site**	**Project No.:** J1144
Sevenson	**MONITORING WELL CONSTRUCTION DETAILS**	**Well Number:** NRW-11R

URS

50 KENT AVENUE PROPERTY, BROOKLYN KINGS COUNTY, NEW YORK

URS Corporation

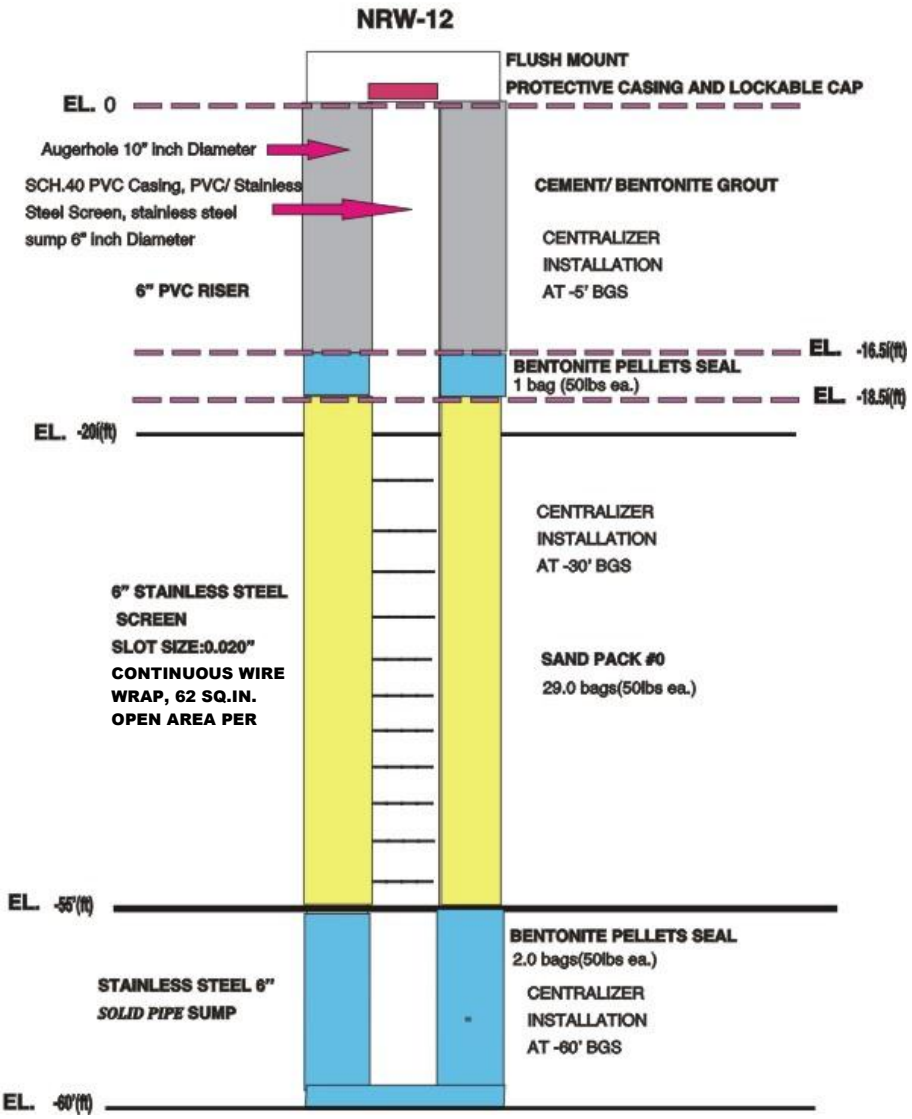
Client: National Grid

Location: 50 Kent Ave.,
Williamsburg, Brooklyn, New York
Project No.11176638.00019

DRILLING SUMMARY

GEOLOGIST: ANDREAS PAPANEOCLEOUS
DRILLING COMPANY: CASCADE
DRILLER: JOHN GRAGLIA
DRILLING RIG TYPE: SONIC
DATE: 03-27-2014

Recovery Well Construction Details



URS Corporation

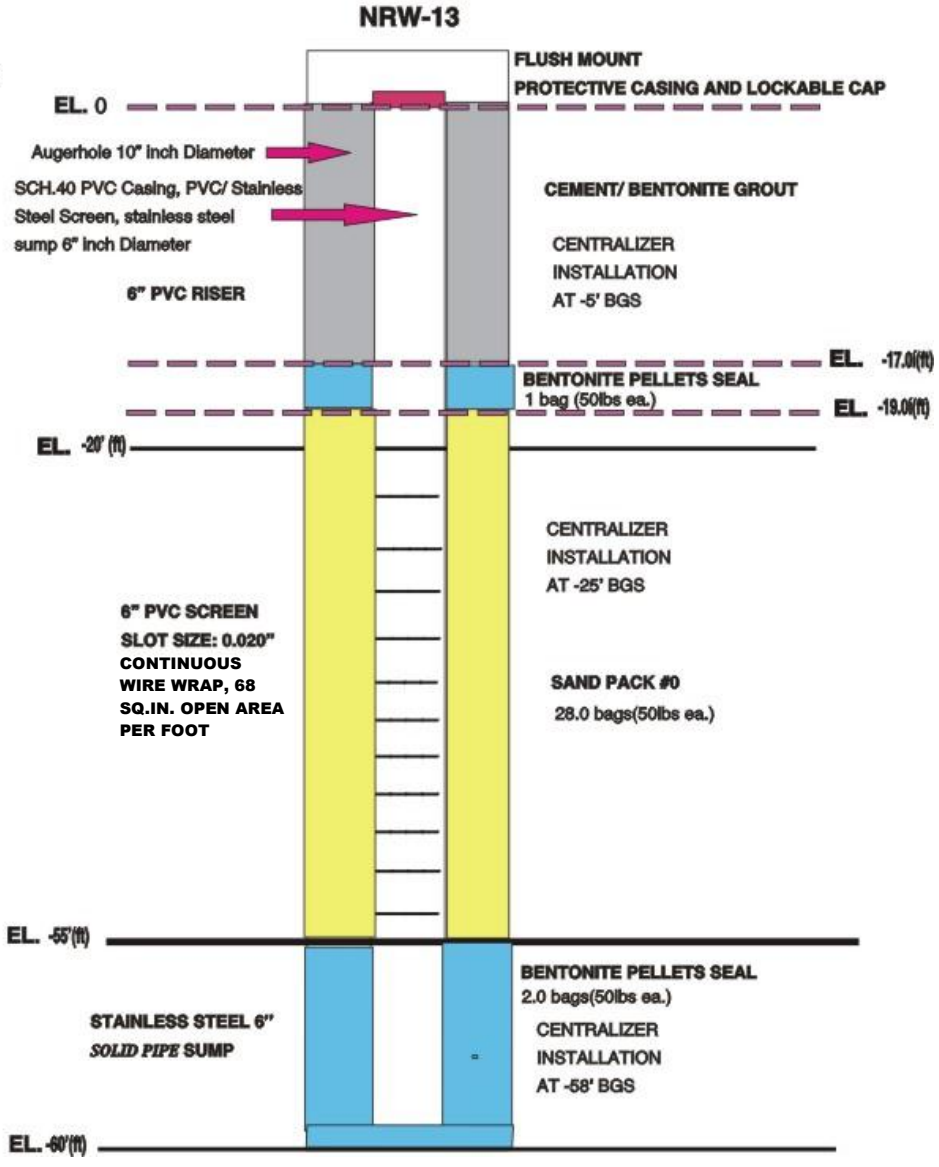
Client: National Grid

Location: 50 Kent Ave.,
Williamsburg, Brooklyn, New York
Project No.11176638.00019

Recovery Well Construction Details

DRILLING SUMMARY

GEOLOGIST: ANDREAS PAPANEOCLEOUS
DRILLING COMPANY: CASCADE
DRILLER: JOHN GRAGLIA
DRILLING RIG TYPE: SONIC
DATE: 03-28-2014



Appendix B – NAPL Recovery Checklist

AECOM Imagine it. Delivered.

NAPL Recovery Checklist

Date: _____ Day: _____ Prepared By: _____

Action Items	Yes	No	NA	Comment/Reason
Fuel generator				
Ensure field equipment is hired as required and is in good working order.				
Pick up drums.				
Check field consumables are in adequate supply and re-order as required.				
Inform your Site point of contact when you get to the Site and check in routinely during the day.				
Note down arrival time, date, weather, and objective in the field book.				
Review tasks for the day and associated hazards. Note down safety topic for the day in the field book. Complete Task Hazard Assessment.				
Calibrate PID and note down readings for 0 and 100 in the book.				
Put poly and absorbent pads around the well to be gauged and pumped.				

Action Items	Yes	No	NA	Comment/Reason
Wear all appropriate PPE, including Tyvek while working with NAPL.				
Gauge wells and note Well ID, NAPL thickness (measure coating on the string with a tape), and depth to bottom in the field book.				
Refer to available sump height for each well and remove NAPL from the wells that require pumping. Note which wells were pumped in the field book.				
Measure height of NAPL in the drum after removing NAPL from each sump (use either (1) a steel yard stick and decon following use, or (2) a weighted string and measure against a tape for accurate reading). Do this after each well to inform the calculation of volume recovered from each well. Note this in the field.				
Note down if there are any issues or observations at the Site, or with NAPL gauging or recovery and inform the Project Manager.				
Label drums appropriately.				
Note how many product and PPE drums were created.				
Note down time of drum pick up.				
Call your Site point of contact when you leave the Site.				

Action Items	Yes	No	NA	Comment/Reason
Scan or take pictures of field notes and forms and send to the Project Manager at the end of the day.				

Appendix C – Recovery Well Field Form

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RECOVERY WELL FIELD FORM
50 KENT AVENUE PROPERTY

AECOM TECH: _____
AECOM TECH: _____
DATE: _____
WEATHER: _____

SAFETY MEETING
ATTENDEES: _____

TOPICS COVERED _____

	Gauging Details				Recovery Details				
Recovery Well	**Date of Gauging**	**Depth to Water (ft)**	**Product Thickness w/ String (ft)**	**Measured Well Depth (ft)**	**Total Liquid Removed (gal)**	**Volume of Water in Tube (gal)**	**Product Removed (gal)**	**DNAPL Thickness, After Recovery (ft)**	**Comments/Observations**
NRW-01R									
NRW-02									
NRW-06									
NRW-07									
NRW-08R									
NRW-09R									
NRW-10									
NRW-11R									
NRW-12									
NRW-13									
					TOTAL PRODUCT REMOVED		***0.0***		

Notes:
All depths are recorded as feet below Top of Riser, unless otherwise noted.
x - No Data
NM - Not Measured
NA - No Access
NP - No Product
ND - Not Detected

Appendix D – Health & Safety Plan

Appendix E – Standard Operating Procedures for NAPL Recovery

Standard Operating Procedures for NAPL Recovery

Waste Containers

- On the day before the NAPL recovery event, talk to waste hauler to confirm drum pick up. Do not recover NAPL if drum pickup cannot be scheduled.
- Empty drums shall be picked up from a local dealer on the morning of the NAPL gauging and recovery event.
- Two additional drums shall be maintained in the off-site rented storage area in case the local drum dealer does not have drums in stock for a day.
- Since there is no on-site storage, drum pick up shall be scheduled with advanced notice for the same day as the NAPL recovery event.

Well Gauging

Equipment needed

- Screwdriver and 15/16” ratchet to open wells (and drums)
- Interface Probe (IP), 100’
- Cotton string with a stainless-steel weight on bottom
- Environment-friendly cleaning products and supplies for cleaning NAPL off of equipment (e.g., Simple Green)
- Plastic sheeting and oil absorbent pads

Steps

- Set up PID (for worker protection)
- Don required PPE (nitrile gloves, safety glasses, etc.)
- Lay down spill pads around well
- Open well
- Using an IP or weighted string, measure NAPL thickness, if present
- Once per month, use IP or weighted steel tape to measure depth to bottom of well
- Record measurements
- Lower string down slowly until it hits the bottom, but don’t allow string to slacken as the measurement may be skewed
- Wind string back up and measure length of product staining on string
- Record measurement
- Decontaminate tape, weight and IP, as needed
- Cut off stained string and reattach weight
- Close and secure well

NAPL Recovery

Equipment Needed- General

- Rental truck or van to hold equipment
- Hand truck (for moving drums when stored on-site)
- At least two 5-gallon containers or 55-gallon drums with closable tops
- Appropriate tubing
- Screwdriver and ratchet to open wells
- Environment-friendly cleaning products (for cleaning NAPL from equipment)
- Plastic sheeting and oil absorbent spill pads
- Heavy duty garbage bags
- Weighted bailer and string
- Drum wrench with 15/16” bit
- Traffic safety barriers/cones and caution tape
- In winter: Snow shovels, salt, non-slip footwear

Needed for Peristaltic Purging

- Peristaltic pump with two external batteries (rental)
- Tubing for peristaltic pump
- Hose clamps for intake and discharge on pump

Needed for Waterra Purging

- Waterra pump (rental)
- Generator (rental)
- Tubing and check valves for Waterra pump
- Extension cord
- Spare check valves

Peristaltic Purge Steps

- Lay 6 mil plastic sheeting and place equipment on it
- Don PPE, including poly-coated Tyvek suit or Tyvek apron with sleeves if there are concerns for heat exhaustion
- Set up cones and lay out plastic and spill pads around well
- Open well
- Set up 55-gallon drum or 5-gallon buckets, with spill pad underneath bucket or edges of drum
- Set up peristaltic pump powered by external battery or car battery
- Connect hose to dedicated tubing and secure hose clamps
- Insert tubing into bucket or drum and secure with a clamp
- Turn on the pump and pump well until product is pumped out- until water being pumped out is relatively NAPL free (during pumping: reduce odors by covering well and bucket)
- Disconnect and pack up equipment, clean area if needed

- Record volume of liquid removed by using markings on side of container or measure with weighted string (1” in a 55-gallon drum = 1.6 gallons)
- Close up bucket or drum and well.

Waterra Purge Steps

- Lay 6 mil plastic sheeting and place equipment on it
- Don PPE, including poly-coated Tyvek suit or apron
- Set up cones and lay out plastic and spill pads around well
- Open well
- Set up 55-gallon drum or 5-gallon buckets with spill pad underneath
- Set up wooden stand and Waterra pump
- Start generator and connect extension cord to Waterra
- Insert tubing into bucket or drum and secure with a clamp
- Turn on pump and pump well until product is pumped out- until water being pumped out is relatively NAPL free
- Disconnect and pack up equipment, clean area if needed
- Record volume of liquid removed by using markings on side of container or measure with weighted string (1” in a 55-gallon drum = 1.6 gallons)
- Close up bucket or drum and well.

Containerization Steps

- All efforts shall be made to prevent spills, splashes, or drips of NAPL onto ground or personnel.
- Spill pads and plastic sheeting shall be laid on the ground around the NAPL recovery wells and pumping activities.
- Direct all extracted NAPL to a 55-gallom drum.
- Drums shall be moved from well location to well location using a hand truck.
- A 5-gallon bucket may be utilized in lieu of a drum for select wells:
    - The 5-gallon buckets shall be fully closed prior to transport to the drum.
    - The contents must be transferred to a 55-gallon drum using a peristaltic pump or siphon pump to reduce splashing.
    - The 5-gallon buckets shall be wiped with a spill pad at the end of each collection event to remove NAPL.

After NAPL Recovery

- Put impacted waste, i.e. used PPE and supplies, in a heavy duty trash bag. Impacted waste should be placed in dedicated 55-gallon drum for disposal at the end of each event. Transfer recovered liquid from buckets to 55-gallon drums by using a peristaltic pump or siphon pump working as cleanly as possible.
- If the drums are left at the Site unattended for some time (i.e. while taking a break to use the restrooms), attach an appropriate Hazardous Waste Label to each NAPL drum and secure them by closing the drum lid, moving them to the side of the road inside the fenced area, and locking the access gate.
- Generator’s address, and Generator’s EPA ID #:

The Brooklyn Union Gas Co. d/b/a National Grid NY One MetroTech Center

Brooklyn, NY 11201

EPA ID # NYD986872265

- Site name and address:

  Williamsburg Works Manufactured Gas Plant (MGP) Site

  50 Kent Avenue

  Brooklyn, NY 11249

- Since there is not an on-site storage area, drum pick-ups MUST occur on the same day as the NAPL recovery.
- Clean-off IP, equipment, and vehicle as needed with environment-friendly cleaning supplies.
- Call equipment rental company to end equipment rental.

End of Event

- Return cleaned vehicle and arrange for rental equipment pick-up.
- Assign one person to enter data electronically.

FOREWORD

National Grid's vision is to be a world-class safety organization with zero injuries every day. This includes working to help ensure the safety of our employees, contractors and the community. National Grid is committed to delivering operational excellence, including excellent levels of safety internally and in cooperation with the external contractors we rely on.

The Executive Safety Committee provides review and input for Safety Policies and Procedures through the Safety Policies and Procedures Subcommittee.

The Safety department is the owner of this procedure and is responsible for maintaining and implementing this procedure, soliciting comments from stakeholders and revising as necessary.

This document, "Contractor Safety Requirements", represents the current contractor safety requirements that are unique to operations and various functional groups at National Grid. This document does not specifically reference actions that are required by OSHA, other laws, rules, or regulations. These are requirements that should be understood by the contractor and contractor compliance with all applicable federal, state and local laws, rules, and regulations is expected by National Grid as a contractual condition.

Questions regarding this procedure should be referred to the National Grid Safety Department.

This document will be updated as necessary to communicate all aspects of National Grid's contractor safety to bidders, current contractors and to reflect changes in National Grid's Safety Policies and Procedures.

Date of Review/Revision:

Revision	Date	Description
1	08/5/2004	Initial
2	3/2/2005	Additions
3	01/30/2007	Additions
4	08/01/2008	Additions
5	08/01/2010	Additions
6	02/01/2011	Audit recommendations included

Date of Review/Revision Continued:

Revision	Date	Description
7	09/11/2013	Additions included OH; technical changes; Compliance Monitoring; Ethics; Job Briefs
8	11/02/2015	Additions include Audit & IA recommendations; ISN alignment; technical changes, 1910. 269 updates
9	8/17/2016	Format update and technical changes
10	3/29/2017	Additions to sections 2.2.6 and 6.5
11	2/26/2018	Process Safety, PM&CC Electric and PM&CC Vegetation Additions
12	3/12/2019	Contaminated Site Work Additions
13	10/24/2019	Job brief, Hi-Vis clothing, ladder use, and air gap revisions

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14	1/13/2020	Hi-Vis clothing and ladder use revisions; Fatigue Risk Addition in HASPs
15	3/10/2021	EH rated work boot and Dielectric (DI) footwear definitions and requirements; OSHA 1910.136(a) reference; requirement not to wear loose clothing; Hi-Vis vest or garment requirements
16	3/24/2021	One HASP form, Safety Guide & Decision Tree; HASP revisions; self-assessments; qualifications; and notice of subcontractors

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1.0 CONTRACTOR SAFETY AT NATIONAL GRID

1.1 Definitions

Adverse Public Impact
Incident that disrupts service to the public or results in adverse public reaction.

Bulk Commodity Transportation
Activities involved in the movement of bulk commodities via truck, rail, plane or water vessel onsite and offsite on behalf of National Grid that if released could have safety and / or environmental consequences. Examples include but are not limited to: gasoline, oil, boiler chemicals, LNG, Nitrogen.

Compliance Assessments (CAs)
An act of observing and engaging in discussion with employees at a job site or work area locations. Compliance Assessments are documented using the Compliance Assessment checklist for each segment of operation and are not considered anonymous. Compliance Assessments are utilized to comply with internal policy and external regulatory requirements.

Contracted Services
Contracted Services refers to any activity that is conducted by an organization or individual under the terms of a purchase order or through other financial arrangements (Procurement Card or credit card) between a National Grid representative and a contractor. Contracted services may include all types of construction and maintenance services, tree trimming, building maintenance and demolition, electrical structure dismantling, site restoration, engineering design, recycling and waste disposal, drilling, rigging, electrical, and utility pole/structure maintenance.

Contractor
An independent person or company that undertakes a contract to provide materials or labor to perform a service or do a job and are responsible for the safety of his/her employees and subcontractors.

Contractor Orientation
Contractor orientation is intended to serve as a resource in order to provide the contractor with the tools necessary to educate their employees and subcontractors. The session is not intended to train the contractor management, their employees or subcontractors. The extent and content of the orientation session shall be commensurate with the scope and type of the contractor's activities.

Effective Safety Discussion (ESD)
A discussion with an individual or group about their safety programs, issues or concerns (safety plans, tools, equipment, procedures, etc.). They are safety discussions amongst employees that share similar work environments…office to office, field to field

Dielectric (DI) Footwear
This term describes either boots or overshoes that are labeled in accordance with ASTM F1117, marked clearly and permanently with the name of the manufacturer or supplier, the size and AC voltage rating. The footwear shall meet dielectric strength testing prescribed in ASTM F1116. Dielectric footwear shall have a minimum rating of 15kV.

EH Rated Work Boot
ASTM F2413 EH rated work boots are the minimum foot protection standard. This boot protects against impact, compression, and low voltage exposure.

Health & Safety Plan (HASP)
Contractors who perform high or medium risk-ranked services shall submit a project-specific HASP prior to the start of the project. In this plan, the contractor shall identify all significant tasks, their anticipated hazards and mitigation steps.

Hazardous Conditions
A condition that can and is rectified immediately by the person who identified the hazard.

Incident
An unplanned event that has a human component and results in or could potentially result in harm to people, damage to property and/or adverse public impact.

Incident Management System (IMS)
National Grid's online incident management tool that allows the company to report safety, environmental and asset-related incidents, perform incident analysis, generate safety reports and monitor the organization's safety performance.

ISNetworld, Inc. (ISN or ISN System)
Third party contractor that is a global resource for connecting Hiring Clients with safe and reliable contractors and is a contractor information management system currently contracted with National Grid.

Job Brief
A planned interactive discussion that covers, but is not limited to, potential hazards associated with the job including situational awareness (assets or other items

which may impact the job at hand), work procedures involved, special precautions, and personal protective equipment requirements. The discussion should include all contractor employees, sub-contractors and team members working on a job that occurs just prior to a job, task or project. A new job brief shall be conducted for each of the following events: prior to a change in planned work specific to the job site, changes in weather conditions, extended breaks (i.e. lunch breaks) or when a new worker or company joins the crew. When possible and reasonably practical, a National Grid Representative should be present at contractor job briefings. Truck drivers for daily, non-hazardous material deliveries such as stone, gravel, concrete material or porta john cleaning are exempt from completing a job brief unless there are potential hazards associated to the driver or delivery. A National Grid representative shall talk to the driver to determine if a job brief is needed.

Major Hazard Asset (MHA)
A class of assets at National Grid, including Compressed Natural Gas (CNG), Gas Transmission (≥ 125 psig), Power Generation sites, Liquefied Natural Gas (LNG) plants, and LNG Trucking, in which any condition, or set of conditions, presents potential for a major accident to occur. Also referred to as process safety assets.

Major Accident
An event involving the release of potentially dangerous materials, the sudden and uncontrolled release of large amounts of energy (such as fires and explosions), or both. These can have catastrophic effects and can result in multiple injuries and fatalities, as well as substantial reputational, economic, property, and environmental damage

Operator Qualification (OQ)
As defined in the Code of Federal Regulations, Transportation, 49 Subpart 192.801 through 192.809 and/or DOT pipeline qualified for gas contractors doing work at National Grid. Additional state requirements pursuant to the state the contractor is working may be required.

Process Safety Management
Method of focusing and mitigating concerns of major hazards impacting safety, environmental damage and business losses. It is an organized effort to identify and analyze the significance of hazardous situations associated with a process or activity to aid management in making critical safety decisions

Project Representative
National Grid Owner's Representative or designee who is assigned to certain contracted projects and communicates regularly with the contractor during the course of the contracted service. This person also ensures the work is being performed in accordance with the contract, including the safety requirements.

Purchase Order (P.O.)
An agreement/contract between National Grid and a contractor to provide services and/or materials. The P.O. is set up by Procurement. The term "Contract" and "P.O." are similar and may be used interchangeably. A "Blanket P.O." is set up for contractors whose work is on-going. A "one-time P.O." is set up for project work.

Qualified Electrical Worker
Those who are knowledgeable in the construction and operation of the electric power generation, transmission and/or distribution equipment involved, along with the associated hazards.

Qualified Gas Worker
Any contractor who performs covered tasks in accordance with National Grid's Operator Qualification Program and the Northeast Gas Association are required to be knowledgeable and meet all regulatory standards.

Risk Assessment
A risk assessment is the process of identifying hazards and calculating or ranking the associated risks according to: the likelihood of occurrence, the severity of the harm from the hazard, and the amount of time of exposure to the hazard.

Safety Observer
A person who is responsible for alerting the work team to any potential unsafe conditions or lack of compliance with approved work practices, procedures or guidelines.

Transportation Advisor
Third party agency specializing in federal and company mandated drug and alcohol testing programs.

1.2 Introduction

Safety performance is a prime consideration in the selection of contractors. National Grid will stipulate safety performance requirements and responsibilities in our contracts, purchase orders (POs) and will hold the contractor accountable for meeting the contractual requirements.

National Grid's goal is to establish a long-term working relationship with contractors who share the same safety values and demonstrate those values through their work performance.

Contractor safety at National Grid involves three broad areas:

1. **The Contractor Procurement (Selection) Process**
   Contractor safety begins with the selection of contractors who have demonstrated a strong safety record. National Grid will complete a review during the procurement process that involves determining a contractors' risk and the scope(s) of work involved. National Grid currently uses ISNetworld, Inc. as a third (3rd) party assessment process for assisting with contractor procurement. The 3rd party entity will vet and continually monitor individual contractors' compliance with applicable safety and/or risk and insurance program requirements.

2. **Safety Communication**
   Safety communication covers all the avenues and forums in which National Grid and the contractor communicates safety. Communication begins early in the bidding phase and is on-going as an integral part of the contractor-customer relationship. The goal is to ensure clarity, transparency and to limit misunderstandings.

3. **Safety Compliance**
   Safety compliance is the process of ensuring that the necessary technical provisions of the contract are being followed. National Grid will assign a project representative or other designee to provide guidance and oversight. The Contractor is responsible for their employees and subcontractors and shall be held accountable for ensuring compliance with all applicable safety rules while working on National Grid property, rights of way (ROWs) and our assets. Primary contractors are required to notify National Grid of any subcontractors and ensure that there is an appropriate contractual relationship in place in line with the terms and conditions of their contract.

1.3 Risk Ranking of Work

1. National Grid characterizes and ranks risk by the scopes of work performed. The categories are classified as high, medium or low risk. Prior to being considered for work at National Grid, contractors who perform High or Medium Risk work must be pre-qualified in ISN. See Appendix A for more information regarding the National Grid Contractor Risk Matrix.

2. Activities that are designated as "high risk" means that catastrophic event can result if safety measures are not followed. Activities designated as "medium" risk present certain opportunities for moderate to significant injuries, property or reputational damage, and/or loss of service and/or possibly business continuity. Activities designated as "low" risk may still require safety compliance and control measures, although the contractor

performing the work does not necessarily need to be enrolled in ISN, if that is the only classification of work that contractor performs for National Grid.

3. The designation High Risk, Medium Risk, or Low Risk, refers only to the inherent risk associated with the work activity and is not an opinion on the ability of a contractor to work safely.

4. If ,at any time, the risk changes from low to medium/high, per the risk matrix, then the medium/high risk process shall be followed. It's the contractor's responsibility to identify if the risk changed and to escalate to National Grid personnel.

5. The Procurement Agent will notify the bidder/contractor at the beginning of the procurement process if their contracted service has been ranked as high or medium risk.

1.4 Bidder Information Request – High and Medium Risk Work

1. Any contractor bidding on high or medium risk work shall be required to complete a questionnaire regarding the Contractor's safety program, compliance and history of occupational illnesses and injuries (ISNetworld New Vendor Onboarding application form, located on the ISNetworld website). Contractors will also be required to demonstrate in ISN that all employees, including subcontractors, are qualified to perform the scope of services.

2. ISNetworld then thoroughly reviews contractors' qualifications against a prerequisite list of National Grid criteria. National Grid has established that contractors performing high or medium risk work MUST HAVE and MAINTAIN a grade of "C" or better in the ISN system to perform work and services for National Grid. ISN will track and manage the National Grid pre-qualified contractor bidder lists. This bidder list is the first step for a contractor in establishing a working relationship with National Grid. For active ISN contractors, ISN will request updated information monthly. Contractors who do not have a current PO, contract, or authorized scope of work with National Grid will be considered as a Prospective bidder and will be asked to submit information quarterly. It is understood that insurance may not be maintained within National Grid standards, however, once a contractor is awarded a contract, proper and adequate insurance must be provided to ISNetworld to achieve a passing grade. Lack of insurance or inadequate insurance is an immediate "F" grade in the ISN system per National Grid criteria.

3. Project representatives may request an exemption or variance from requiring a contractor to be placed in ISNetworld for various reasons. A Supplier Exemption Request form (located in the safety policies and procedures section of Grid:home) shall be completed, documented and signed by the business unit VP and Corporate Safety Director prior to contract award.

4. The information that the Bidder provides National Grid via ISN serves as the basis for assessing safety qualification. For this reason, it is important for contractors to maintain transparency throughout the process. National Grid and ISN will review all submitted information. Any effort in avoiding complete disclosure will disqualify the Bidder from bidding work at National Grid.

1.5 Safety Compliance

1. National Grid representatives evaluate contractor compliance by conducting routine site visits, Compliance Assessments (CA's), Effective Safety Discussion (ESD) visits and attending periodic contractor safety meetings. Contractors should also perform and document safety self-assessments to ensure compliance to federal, state, local and National Grid regulations. This combined effort enhances, solidifies safety compliance and has the added benefit of quality control / quality assurance of the work performed.

2. Contractors bidding on new work shall provide worker qualifications to the National Grid procurement representative via the "Bidder Information Request" form and/or ISN National Grid On-boarding form.

3. If a safety violation is observed by a National Grid representative, the violation will be discussed with the contractor at the time of discovery.

4. Contractor employees enrolled in ISNetworld that are involved in any accident, incident or significant near-miss event, will be required to lead an investigation and root cause determination process. In addition, the contractor must implement corrective actions and establish measures to prevent a recurrence through an incident investigation process and document the details within ISN.

5. Individual contractor personnel who habitually violate any safety rules should be identified, and the contractor should remove the individual(s) from the project. National Grid reserves the right to remove any contractor employee(s) who violate safety rules or procedures; pose a safety risk to themselves, other contractors; our employees; or the general public.

6. If a contractor is observed to be operating in a manner that creates an imminent danger to persons or property, it is the responsibility of all individuals observing the hazard to cease the hazardous operation impacted until the issue has been resolved to the satisfaction of National Grid, the Owners Representative or Safety Representative.

7. Contracts/POs shall require the contractor to immediately forward any citations, notices, or OSHA reportable cases per 29 CFR 1904.39 from a National Grid project, upon receipt to the appropriate project representative and/or ISN. The project representative shall distribute copies of the citation or notice to senior management, Safety, Procurement, and the Legal Department.

8. Willful and/or repeat violations of safety requirements by the contractor may be considered a breach of the contract and reason for contract termination.

9. If the contractor's overall safety performance is viewed as being unsatisfactory or noncompliant with contract provisions, and if the contractor is unwilling to demonstrate satisfactory program improvement, the result may be considered a breach of the contract and reason for contract termination.

10. National Grid project managers and/or construction supervisors shall document safety compliance by completing a "Contractor Performance Evaluation" for each project. This documents both positive and negative safety performance or behaviors and this feedback will be used in the decision process for awarding future contracts.

2.0 GENERAL SAFETY REQUIREMENTS

2.1 Introduction

1. All contractors are required, and expected to comply with all applicable requirements of the Occupational Safety and Health Administration (OSHA), and all other applicable federal, state and local laws, ordinances, regulations, and other project and site-specific permits unless superseded by identified National Grid procedures.

2. This document represents policies and safety-related work methods unique to National Grid and they may be more stringent than OSHA regulations. Contractors must follow these requirements as well as their own rules or regulations that meet or exceed OSHA and other regulatory requirements.

3. National Grid will provide more detailed information and guidance regarding specific procedures prior to commencement of work.

4. Per OSHA 1910.136(a) general requirements, the employer shall ensure that each affected employee uses protective footwear when working in areas where there is a danger of foot injuries due to falling or rolling objects, or objects piercing the sole, or when the use of protective footwear will protect the affected employee from an electrical hazard, such as a static-discharge or electric-shock hazard, that remains after the employer takes other necessary protective measures.

2.2 Applicability

Applies to: All contractors, as needed

1. In any contracted task, where a safety observer is required, it is the responsibility of the contractor to provide that person and ensure that he/she is qualified to perform the role when needed.

2. A 4:1 pitch shall be maintained when using an extension ladder or the ladder shall be tied off and/or secured and 3 points of contact shall be maintained by the climber. If both hands are needed to perform work, then fall protection is required.

3. Although not preferred, if hard hats are worn backwards, the suspension adjuster must always face the rear. Class E hard hats are required for all electrical work.

4. ASTM F1117 Dielectric (DI) footwear is required when:
    - Workers on the ground are working within 50’ of the master ground connection point to earth.
    - Operating a wire trailer and pulling/tensioning machine.
    - Operating a winch truck or reel trailer with its payout in an energized area that may result in inadvertent contact.
    - Hand digging in close proximity to energized cables within the tolerance zone.
    - Making repairs in a trench to a faulted primary cable without de-energizing any adjacent energized primary cables within close proximity.
    - Using approved live line tools to move energized primary cables in a trench.
    - If removing underground cable rubber covering or arc suppression blankets from an energized cable.

- Working within minimum approach distance (MAD) of downed electrical wires or foot patrolling for such wires.
- If setting poles in proximity to energized lines or equipment and using truck controls from the ground.

5. National Grid expects that all cargo will be secured in accordance with U.S. DOT requirements.

    - As of January 2004, the Federal Motor Carrier Safety Administration (FMCSA) within the U.S. DOT published Cargo Securement Rules 393.100-136 Subpart I – Protection Against Shifting and Falling Cargo.

6. Chaps are required to be worn by ANY person using a chainsaw to make a cut on the ground or assisting in that cut and within striking distance. Other situations where cut off machines are used, chaps designed for the purpose of providing durable protection from abrasion, spatter and sparks from cutting ferrous metals shall be required; however, a hazard assessment should be completed to determine the need. Always use proper cutting techniques and push blades away from the body when using tools that may slip or inadvertently make contact with the leg. Never leave any equipment running while not in use.

7. All applicable contractors must meet the requirements of drug and alcohol testing in accordance with FMCSA DOT 49 CFR Part 40 and Pipeline and Hazardous Materials Safety Administration (PHMSA) DOT 49 CFR Part 199. National Grid shall monitor contractor compliance to the drug and alcohol regulatory requirements through Transportation Advisor or ISNetworld as needed.

8. Contractors who drive regularly in delivery of service for National Grid shall:

    a. Have a safe motor vehicle operations policy which must be communicated to their employees before they begin driving for company business. The contractor is expected to follow National Grid's *Safe Motor Vehicle Operations* policy to include the following:
        - Prior to moving any vehicle, the driver shall perform a "circle of safety" inspection. This is to confirm not any person, animal, equipment, or property will be injured or damaged when the vehicle is moved.

        - Drivers should back into or pull through a parking space so that when you re-enter the vehicle, the first move is forward.

- No driver shall use a hand-held mobile telephone while driving a vehicle for National Grid business.

- The driver shall eliminate or minimize sources of potential driving distractions to include, eating, smoking, reading, writing, grooming, use of any electronic devices, mirror or seat adjustment. These shall be done when the vehicle is not in motion.

b. Comply with all requirements of all federal, state and local regulations regarding safe motor vehicle operations.

c. Ensure that new and existing employees have a valid Driver's License in accordance with requirements of specific job duties and classification/type of the vehicle they are operating. Contractors must have an acceptable driving record. If their driving record is unacceptable, the driver shall not be permitted to operate a vehicle on behalf of National Grid.

d. Provide vehicles in safe operating condition, in accordance with federal state and local regulations. The vehicle should be equipped with proper safety equipment as appropriate for the vehicle type and its intended use.

e. Track and evaluate any vehicular accidents or incidents experienced by their employees. Corrective actions, such as driver coaching, corrective action driver training and medical/vision tests should be recommended and acted upon where appropriate. All accidents or near misses while performing work for National Grid shall be communicated to the National Grid project representative or designee and documented in the ISN system.

f. For more information, contact a National Grid representative for a copy of the National Grid Safety Policy *Safe Motor Vehicle Operations*

9. All contractors that require the use of heavy equipment shall ensure that competent, appropriately licensed, skilled and qualified personnel are in control of this equipment at all times. In addition, contractors shall ensure the following:

    - Equipment is inspected for safety and use at the beginning of the work period of shift. All failing or defective equipment and components shall be removed from service.

- Equipment is under the control of trained operators who are always aware of their location and the locations/presence of persons working near the equipment, its swing zones and blind spots.

- Operators shall ensure that no loose clothing, including safety vests, or jewelry is present that could inadvertently get caught on equipment controls.

- Equipment is kept free of debris, water, oil, grease, mud or anything that could create a slip/fall hazard inside the cab.

- Keep hands, feet, and clothing away from power-driven and moving parts.

- Equipment cab windows should be kept clean and free of mud, ice, snow and/or fog for maximum visibility.

- Never carry passengers on heavy equipment or any equipment unless it is equipped to do so.

- Ensure that stabilizers are extended prior to starting a task.

- Before making a swing, operators shall always look out the windows and mirrors for confirmation that the area is clear. If visual confirmation is impaired or the operator is unsure due to weather, lighting or other interferences, the operator shall cease operation until an independent spotter can check the swing area and confirm it is clear.

- All excavations shall have signs posted, demarcation and controlled to prevent unauthorized persons from entering and falling inadvertently into the excavation. Excavations shall only be opened under the supervision of a competent person for excavation.

- All pot holing/test holing and exploratory excavations shall utilize vacuum excavation whenever near known or the possibility of unknown hazards such as live electrical or gas conveyances. When using vacuum excavation in combination with air blowing/air knife tools, all persons in the immediate area shall be wearing safety glasses in addition to a full face shield.

- No one is to work under a suspended load.
- Never use a bucket to lift personnel.
- Ensure stabilizers are in the upright and stored position before moving equipment.
- Operators shall not leave heavy equipment running unless the following requirements are met:
    - Parking break is engaged and wheels are chocked (if applicable)
    - Surroundings create no hazard of unqualified personnel entering unattended equipment
    - Vehicles and equipment idling limited to that designated state and local environmental regulations (generally, 3 to 5 minutes maximum). See table below for additional information

Region	Vehicles	Idling Limit	Exemptions Include
New York	Diesel trucks	5 minutes	• Traffic conditions • Temperatures < 25°F and motionless for two hrs • Hybrid electric engine charging battery vehicles • To provide power to auxiliary sources
NYC	All Motor vehicles	3 minutes	• Emergency vehicles • Loading/unloading • Temperatures <40°F
New Hampshire	Diesel/ Gas vehicles	5 minutes >32°F 15 minutes -10°F to 32°F No Limit <-10°F and no nuisance created	• Traffic conditions • Emergency vehicles takeoff power for auxiliary uses • Vehicles being serviced or repaired • Operated solely to defrost windshield
Massachusetts	All Motor Vehicles	5 minutes	• Vehicles being serviced or repaired • Vehicles in operation for which associated power is needed • Delivery vehicle in which engine power is needed
Rhode Island	Diesel Motor Vehicles	5 minutes	• Traffic conditions • Operate defrosting, heating, or cooling equipment to ensure health and safety of the driver or passenger. • Temperatures between 0 & 32°F - 15 minutes per hour. If < 0°F idling as needed for heat • To provide power to auxiliary sources • Vehicles being serviced or repaired
Vermont	All Motor Vehicles	5 minutes within any 60-minute period	• Emergency/public safety vehicles while engaged in "official operations" • Idling necessary to operate safety equipment • Vehicles in operation for which associated power is needed • Vehicles being serviced or repaired

- All lifts that occur on National Grid properties, ROWs or near critical assets require formal lifting plans developed by the contractor and reviewed with the National Grid project representative. Some lifts will also require formal critical lifting plans and this may include PE or geotechnical assessments to ensure a stable lifting base for the crane or other apparatus.

10. All temporary, metal fencing installed or located under transmission lines shall be grounded and have signage according to National Grid grounding standards. Contact a National Grid representative for a copy of the Engineering Documents ST 03.05.001ST 03.06.001 and SP 08.00.001.

3.0 ADMINISTRATIVE SAFETY REQUIREMENTS

3.1 Worker Qualification Assurance

1. In order to meet National Grid safety requirements, the contractor must describe how workers, including subcontractors, are qualified. The contractor must supply information concerning the type of skills assessment performed, training programs and how they ensure that employees demonstrate competencies. National Grid reserves the right to review this information and request additional training requirements. All documents shall be uploaded and maintained in the ISN system for high/medium contractors. For work on process safety assets, the contractor shall ensure all workers and sub-contractors are trained and receive appropriate refresher training to maintain their appropriate level of certification and qualifications needed to perform work safely.

2. For low-risk contractors who perform activities that require PPE, which excludes office-based contractors and/or consultants, or other non-physical low-risk contractors, the contractor is required to watch an on-boarding video annually prior to any jobs starting for that year. The contractor employees and subcontractors are required to watch the video to be clear on safety expectations. Contractor to ensure that any new employees performing services for National Grid watch the on-boarding video if they hadn't watched it in the annual release. A link to the video can be obtained from the Project Representative.

3. Medium/high risk contractors shall complete an annual in-person on-boarding hosted by National Grid supervisor or project manager. The on-boarding shall emphasize required qualifications, HASP requirements, and requirements on revisions to HASPs when changes to the scope of work on the site or changes to risk occur. The National Grid supervisor or project

manager are to conduct the on-boarding and determine the appropriate material to be used to communicate and emphasize the expectations.

4. Contractors shall conduct their own safety self-assessments.

Periodic field visits and/or verbal contact shall be conducted by the National Grid supervisor or project manager who are familiar with the work and existing scope. The National Grid supervisor or project manager shall review the work performed during the field checks and/or verbal contact and can ask the contractor to provide qualifications upon request.

During the field visits/verbal contacts, National Grid supervisor or project manager shall also review existing HASPs and/or job briefs as applicable for current work scope and require any revisions based on observations. The field checks/contacts are to be documented using Compliance Assessments, Contractor Evaluations, or ESDs.

If HASP or job brief does not cover observed hazards and risk mitigation, work shall be stopped until a revised HASP or job brief and approval of the revision occurs, which is required before work can continue.

The frequency of the field visits/verbal contacts are based on risk perception of the job, including variability of conditions, and if there is greater chance of serious injury or fatality based on high-energy presence (gravity, pressure, energy). Higher volume of visits should be conducted if it's a new contractor, based on contractor's performance (review IMS, Compliance Assessments, etc.), or if variations exist including: change in project scope, weather, change in crew and/or subcontractors, change in equipment on site, new high energy factors are present (greater chance of SIF), and long duration job.

5. The contractor shall provide management personnel qualifications through resumes or other documents. National Grid may interview and/or approve management personnel if considered necessary.

6. For work on Process Safety assets (Gas Transmission, Generation, LNG, LNG Transportation and CNG), contractors shall provide a description of their experience in the business asset and specific tasks including similar projects, lists of licenses/certifications, and references from previous similar projects. Contractors shall be made knowledgeable of National Grid process safety requirements that are relevant to their specific work activities by the business hiring them.

3.2 Meetings

Applies to: All contractors; as needed

1. The pre-bid meeting is coordinated by National Grid Procurement to provide bidders with an opportunity to become acquainted with contractual requirements and specific safety issues concerning the project, including company-specific safety rules and known site conditions.
   a. For contractors working on Major Hazard Assets, contractual language including designation of site medical facilities, locker rooms, bathrooms, etc. should be discussed by the project team with the contractor at this time.
2. At this time, Procurement will notify the prospective bidders of the following:
   a. If they are required to submit a project safety plan (HASP) prior to the pre-construction meeting
   b. The cost of specific safety equipment, practices and personal protective equipment shall be factored into their bid/proposal.

3.3 Project Health & Safety Plan (HASP)

Applies to: Contractors performing high or medium risk work

All HASPs shall be submitted to the National Grid project owner for review and approval before work commences. The National Grid project owner shall ensure the HASP meets National Grid criteria and includes all aspects of the project prior to a review by Field Safety (if applicable). The project owner shall review the HASP. Field Safety shall also review the HASP after the business conducts its review only if the work is unique, there's a new project manager or supervisor, the work involves PHAs, or there's unfamiliarity with the project or safety standards.

If changes are required, a new HASP shall be created and rereviewed.

If the scope of work on the job site changes from the approved HASP, work shall be stopped. The HASP shall be revised and rereviewed by National Grid Business (Field Safety review as applicable), and work can continue once the revised HASP has been reviewed for risk controls of changed scope. Until the HASP is updated work shall remain stopped. Failure to update the HASP will be considered a violation of safety requirements in line with section 1.5. It's the contractor's responsibility to inform National Grid personnel if the scope changes.

1. Contractors who perform high or medium risk-ranked services shall submit a project-specific HASP plan prior to the start of the project and/or at pre-construction meeting. The HASP is to be followed by the contractor's employees and its subcontractors.

2. At a minimum, the HASP shall include the following elements:

   a. Roles and Responsibilities

   b. Scope of Work

   c. For contractors working on Major Hazard Assets - List of all equipment contractor is expected to use in work activities and indication that it meets regulatory and National Grid requirements

   d. For contractors working on Major Hazard Assets - List of contractor materials to be brought onto work site for review and approval by National Grid

   e. Task and hazard identification and risk assessment of the hazards

   f. Hazard mitigation/control procedures and work methods

   g. Incident investigation and reporting

   h. Compliance and monitoring

   For an example of a HASP, a National Grid representative can provide related policies and procedures under the *Contractor Safety* website in Grid:home.

3. The following requirements shall be included in the HASP for all work at contaminated sites. The HASP shall be site-specific and meet the requirements of 29 CFR 1910.120(b)(4)(ii). The HASP must include at a minimum:

   a. A safety and health risk or hazard analysis for each site task and operation

   b. Personal Protective Equipment to be used by employees for each of the site tasks and operations

   c. Medical surveillance requirements

d. Frequency and types of air monitoring and personnel monitoring to be used

e. Site control measures

f. Decontamination procedures

g. An emergency response plan for safe and effective responses to emergencies, including the necessary PPE and other equipment

The contractor/National Grid project representative shall contact the Environmental Department for guidance on site requirements and to initiate any required regulatory notifications.

For contractors performing bulk commodity transportation activities, a risk assessment including the potential consequences, frequency and safeguards to be used shall be performed and included in the HASP. If a preexisting National Grid requirement is in place for managing bulk commodity transportation activities, one shall follow those requirements, with no additional risk assessment being required.

Every contracted and subcontracted employee, including those working alone, performing work on the project shall review the HASP to ensure steps in the plan are adhered to in order to mitigate hazards during the pre-job orientation. These mitigation steps shall be incorporated into all work plans and job briefs.

Truck drivers for daily, non-hazardous material deliveries such as stone, gravel, concrete material or porta john cleaning are exempt from completing a job brief unless there are potential hazards associated to the driver or delivery. A National Grid representative shall talk to the driver to determine if a job brief is needed.

In addition, all workers shall sign an attendance sheet during the pre-job orientation that they have reviewed the plan, will adhere to the mitigation steps and they fully understand the plan. This document will be kept at the job site and available for review as needed and if requested by any National Grid representative, or any other parties.

A. Roles and Responsibilities

The HASP shall identify who is providing project oversight and how they are qualified. For example, if the work requires excavation, there must be someone on-site who is qualified as an excavation competent person.

For multi-employer work-sites, the general contractor is responsible for all their employees and subcontractors. The safety plan shall clearly state this responsibility.

If requested to do so, Contractors shall designate a competent person to participate in or conduct a process hazard analysis (PHA) regarding a portion or the entirety of the project. National Grid will not be responsible for training the contractor on the PHA methodology.

B. Scope of Work

The Contractor shall clearly and briefly state the scope of work as provided by National Grid. The plan must specifically address the project or services requested by National Grid.

C. Task and Hazard Identification and Risk Assessment

The contractor shall perform a risk assessment by identifying all significant tasks, the anticipated hazards and hazard mitigation procedures.

If, at any time, the risk level changes on the job site, the contractor is to stop work until a revised HASP or job brief is created and discussed on site and reviewed by National Grid personnel.

Contractors performing work where their employees are exposed to fatigue, shall assess fatigue risk in their HASPs and identify the mitigations they will take to manage the risk to their employees.

The contractor's cost to provide adequate safety measures and to comply with National Grid requirements must be considered and budgeted in the bid/proposal.

D. Hazard Mitigation Procedures and Work Methods

For each hazard, the contractor shall specify measures that will be taken to eliminate, control or mitigate these hazards.

A table below is an example of a method to simply and clearly organize and present the task, hazard, and mitigation steps:

Location: Substation Yard		
Task	**Hazard**	**Mitigation Steps**

Material Handling	Contact with overhead energized lines/equipment	Off load in the clear and have a safety observer present

E. Incident Investigation and Reporting

All work related incidents involving injury or illness to employees, the public or property damage (including contractor vehicle accidents) shall be reported to the National Grid project representative and documented in the ISN system.

F. Compliance Monitoring

To ensure that both contractor employees and subcontractors will achieve safety compliance, jobs with over 100 workers at any point in time or in excess of $1 million will require a full time safety professional hired by the contractor. This safety professional must be qualified, competent and be on site anytime work is performed. Qualifications of this safety representative must be acceptable to National Grid prior to hire by the contractor and may be documented in the ISN system.

For other jobs that don't meet the above criteria, contractors shall monitor jobs in line with their safety management system.

G. Environmental Compliance

Unless otherwise specified and based on the scope of work, any potential environmental risks shall be determined and addressed by the contractor following all applicable National Grid procedures. For more information, contact a National Grid representative regarding Environmental Procedure No.6 *Contracted Services* and Environmental Procedure No.25 Appendix A, *Environmental Screening Checklist.*

3.4 Contractor Orientation/Pre-Construction Meeting

Applies to: All contractors, as needed

1. A National Grid project representative, construction supervisor, or other designated National Grid representative may hold a contractor orientation or pre-construction meeting prior to the start of a project/service. Other attendees may include; the Safety department, Environmental representatives, as well as contractor management as needed.

2. It is intended to serve as a method to provide the contractor with the tools necessary to educate their employees and subcontractors on National Grid's procedures and requirements. The session is not intended to train the contractor management, their employees or subcontractors.

3. All contractors are required to attend a National Grid orientation program specific to the type of work they will be performing. Contractor management representation shall also be present meeting and all documentation of attendance shall be kept at the job site and available to any National Grid representative. For visitors and contractors working on Major Hazard Assets, site orientation shall at a minimum include the following:

   - General site hazards
   - Specific hazards involved in each task the employee may perform
   - Safety policies and work rules, including Process Safety policies
   - Location of emergency equipment like fire extinguishers, eyewash stations, and first-aid supplies
   - Smoking regulations and designated smoking areas if applicable
   - Steps to take following an accident or injury
   - Proper reporting of emergencies, accidents, and near misses
   - Selection, use, and care of personal protective equipment
   - Emergency evacuation procedures, routes, and security systems
   - Safe housekeeping rules
   - Safe use of tools and equipment
   - Hazardous materials in use and location of safety data sheets

   Site access shall not be granted to contract employees working on process safety assets until orientation is conducted.

4. The contractor's Project Health & Safety Plan will be discussed at this meeting including a final review of the safety hazards checklist to ensure proper hazard identification and mitigation plan has been implemented.

5. These hazard mitigation measures shall be reviewed and work shall not commence until these hazards have been adequately addressed. The National Grid project representative will discuss the methods by which compliance will be achieved to National Grid safety requirements with the contractor.

6. An Emergency Call List shall be exchanged with the National Grid project representative for high or medium risk projects or as applicable. This list must contain 24-hour contact information for key contractor and project personnel, including the project representative and Safety representatives. This list should be distributed to all concerned, as determined by the project team, prior to the start of work. For contractors working on process safety assets who have an emergency response role, the emergency response plan shall be updated to clarify the contractor's role in the event of an emergency on site.

7. For routine maintenance services, a review of associated safety issues and specific facility issues, restrictions or practices, such as evacuation procedures, shall be discussed with the contractor upon initial hiring. Any changes in the facility that may affect the safety of contractor or National Grid employees or third parties must be communicated immediately.

8. Upon completion of the contractor orientation or preconstruction meeting, the contractor management official shall certify in writing that: (1) the contractor has been informed of National Grid safety requirements; (2) that employees and subcontractors have the appropriate qualifications to perform the work, and; (3) the contractor agrees to comply with all applicable safety requirements. The certification shall be completed annually in ISNetworld as an acknowledgement of the above requirements.

3.5 Job Safety Briefs

Applies to: All contractors; as needed

1. Job safety briefs shall be documented in writing. Written job safety briefs, permits, and/or plans shall be available at the job site for inspection and retained for 30 days after the job is completed.

2. National Grid reserves the right to perform a safety stand-down with any contractor for purposes including, but not limited to: recent injuries, incidents or near misses; identified hazards at job site or equivalent, and for other reasons to communicate with the contractor crew.

3. Each crew shall conduct these job safety briefs prior to commencing work at the job location. A new job brief is required when there are changes to the day's work order or plan, when there are changes in weather conditions, when a new worker or company joins the crew, and if the crew members take any extended breaks (i.e. lunch breaks). Working alone: A contractor working alone need not conduct a job brief; however, the contractor must review the hazards associated with the job as if a formal job brief had been performed.

4. Each worker must have the opportunity to voice concern. The work cannot begin until each worker signs off on the job safety brief stating that they have discussed the work, raised any questions, and agree with the plan.

5. Visitors to the work site shall be asked to read and sign the job brief acknowledging they understand contents. Contractors shall review the job brief and discuss the elements of the hazards and mitigation steps with each visitor prior to entering the job site. If a visitor refuses to sign, the general foreman will note it on the brief and will not allow the visitor to enter.

6. SITE SIGNAGE: An assessment of the work site should be conducted by the National Grid project representative overseeing the work with the contractor to determine if site signage will be needed to protect site visitors, the public or any other persons entering the work site. If Site Signage is required at the site, the signage shall be posted at the main entrance to the work site. The sign shall direct all visitors to check in with the Person in Charge (PIC), be escorted to the designated safe area and advised of all work currently in progress. The visitor is expected to comply with all related safety requirements and sign off on the Job Brief before entering the work site.

3.6 Safety Meetings

1. In addition to job safety briefs, the contractor shall have regular safety meetings with their employees and subcontractors. Contractors performing high or medium risk work shall have weekly safety meetings, while low risk contractors, at a minimum, shall have safety meetings monthly and attendance must be documented.

2. The safety meetings shall include the following topics: statistics, incidents, near misses, updates on old business and new business raised. It will include the round table discussion by the workers and the action items discussed. Meeting minutes must be documented and shall include specific action items, their due dates, persons responsible and a completion date. This documentation shall be available for inspection during the project period, and for 30 days after the project is completed. For contractors working on Process Safety assets, meeting minutes from contractor shall be shared and discussed with National Grid site management.

3. Routine Safety meetings/calls between National Grid and the Contractor shall be coordinated on a regular basis. Safety meetings may include but are not limited to ESD/Compliance Assessments, Safety Briefs, Safety Day discussions and regularly scheduled calls to promote safety and best safety practices. Contractors working on Process Safety assets for more than 6 months shall schedule leadership visits to discuss process safety topics.

4. Contractors are to perform their own safety self-assessments.

5. Contractors working on process safety assets for greater than three (3) months, or as needed, shall hold project planning meetings to discuss short term and long term work items. Project planning meetings shall include safety performance monitoring against project targets and should include a National Grid SHE representative for jobs on Major Hazard Assets in addition to a National Grid site representative.

3.7 Incident Investigation

Applies to: All contractors (regardless of risk ranking)

1. All contractors are required to report any work-related incidents involving injury or illness to employees, the public or property damage to the National Grid project representative. The first priority is to ensure that anyone injured receives medical treatment. Examples of incidents may include, but is not limited to: injury, property damage, adverse public impact, near miss, a hazardous condition and road traffic collisions (RTC).

2. Contractors will then be responsible to perform an incident investigation immediately following the incident and document root cause/corrective actions in the ISN system and to National Grid.

Incident Response Steps

In the event of an incident, the contractor shall provide details of the incident to National Grid that follows the steps below.

1. Contractor supervisor collects basic information about the incident from the employee or witnesses:
    - What happened?
    - Who and how many people were injured?
    - What treatment was administered?
    - What was the nature and seriousness of the injury?
    - Where did the incident occur?
    - When did the incident occur (date, time of day)?
    - Were there any witnesses?

2. Contractor supervisor immediately calls the project representative or other National Grid point of contact. All incidents shall be entered into the Incident Management System (IMS) as soon as possible by the National Grid project representative or National Grid designee. When dialing 1-866-322-5594, the caller will be prompted to select option 2 for anything other than an employee injury.

3. Contractor shall conduct an investigation within 24 hours of the incident that will identify contributing factors and root cause analysis relating to the incident and the corrective actions that will be taken to prevent future occurrence. This information will be documented in the ISN system.

4. Contractor vehicle accidents occurring during the performance of work will also be investigated and reported to National Grid.

Other Reporting

National Grid may periodically request the following annualized data for all work activities limited to National Grid operations:

- Lost Time Incident (LTI) rate for workers
- Restricted Work rate
- OSHA Recordable Incident (ORI) rate

4.0 TECHNICAL SAFETY REQUIREMENTS

4.1 Personal Protective Equipment (PPE) Requirements – General

Applies to: All contractors (regardless of risk ranking)

1. The contractor and their employees, including subcontractors are expected to follow the same rules and protocols as National Grid personnel. Basic PPE attire at construction sites and other similar work zones include, at a minimum:

   - Hard hat
   - ASTM F2413 EH rated safety shoes
   - Safety glasses with side shields
   - Any contractor who is exposed to vehicular traffic shall wear ANSI 107 certified class 3 hi-vis vest or garment.
   - All contractors who are exposed to vehicular traffic and are exposed to energized electrical equipment or live gas are required to wear ANSI 107, class 3 hi-vis vest or garment, that also meets ASTM 1506 FR standard with a minimum Arc rating of HRC 1. All FR vests must be lime green/yellow. When FR clothing is required the FR vest shall be worn over appropriately rated FR clothing. Please reference the Gas PPE Matrix.
   - All contractors that are exposed to vehicular traffic, but will never be exposed to energized electrical equipment or live gas shall wear at a minimum ANSI certified class 3 vest or garment that is orange OR wear the FR vest in lime green/yellow.
   - ASTM 1506, HRC Category 1 FR vests must be in lime green or yellow. Any vest that does not meet the ASTM 1506, HRC 1 FR rating must be orange.

Storm contractors that do not have a Contractor of Choice contract should follow their existing practices and rules. All other contractors shall refer to the US Department of Transportation's Manual on Uniform Traffic Control Devices (MUTCD) to determine the correct class of hi-vis clothing / vests.

2. The contractor shall ensure that their employees and subcontractors use protective safety toe footwear when working in areas where there is a danger of foot injuries due to falling or rolling objects, or objects piercing the sole, and where such employee's feet are exposed to electrical hazards. In

addition, during inclement weather conditions or adverse events, the addition of anti-slip footwear or outer foot wear may be appropriate.

3. Guidance for additional PPE is referenced in other sections of this document.

4.2 Flame Resistant Clothing Requirements

Applies to: All contractors; as needed

1. Flame Resistant (FR) clothing shall be worn when personnel work on energized equipment/lines or when distance and position will expose the worker to electric arc or flame hazards. FR clothing shall also be worn during live gas work as outlined in the gas PPE Matrix (Gas Policy SHE01001) and within LNG operations locations as required. FR clothing also includes arc- resistant rain gear. This additional ensemble may also be required as part of the job for contractor personnel. Contact a National Grid representative for a copy or to view the PPE matrix.

2. FR clothing shall be worn as the outermost layer of clothing and when workers measure voltages, test or ground electrical equipment/lines.

3. FR clothing shall be worn when work requires the use of rubber protective equipment or the use of insulated live line tools.

4. FR clothing shall be worn when workers control/operate electrical equipment over 50 volts at the device location or are within 10 feet of equipment which is being physically operated/ worked on by another worker.

5. Visitors are not required to wear FR clothing in substations or production plants unless they are engaged in electrical work. The National Grid project representative will be able to determine whether FR clothing will be required based on the specific contractor task. Note: Gas contractor FR requirements may differ slightly. Please refer to National Grid PPE Matrix for Gas operations within Gas Policy SHE01001 as needed.

6. FR clothing shall meet a minimum arc rating of 8 cal/cm^2 (HRC 2) for energized electrical equipment unless otherwise specified based on increased potential exposure as indicated in the Arc Flash Tables in H-807 *Arc Flash Analysis and Mitigation* program.

7. Additional FR clothing protection is required when performing work on the distribution system in NY North and New England (legacy National Grid) stations. Contact a National Grid representative for a copy. (NG

Employees: If the link does not work, copy and paste the URL into your internet browser) Arc Flash Awareness and Mitigation (sharepoint.com)

8. Contractors who may be involved with tasks requiring the implementation of this program shall be informed by National Grid. Contractors will be required to follow all aspects of OSHA and any other applicable regulation as it applies to the tasks they perform.

4.3 Rubber Gloves and Sleeves

1. Rubber glove use is required for work on all electrical apparatus at 50 Volts or greater. Rubber gloves shall be donned before the worker leaves the ground and shall be worn until the worker returns to the ground (commonly referred to as “ground to ground”, “cradle to cradle”)
2. Class 0 gloves are required for exposures up to 1000 Volts.
3. Class 2 gloves are required for voltages between 1000-15,000 Volts.
4. Rubber sleeves must be worn where work is conducted within the MAD of primary electrical apparatus that is not tested, de-energized and grounded.
5. For voltages 23 kV and above, workers can use specialized equipment or work practices as long as these workers have been appropriately trained and qualified. National Grid may request training records from the contractor.
6. Rubber glove exceptions for specific jobs (other than those listed in this section) are permitted only with the dated, written approval of a Division Director.
7. It is the contractor’s responsibility to wear class 2 rubber gloves when grounding trucks or equipment due to a possible difference in potential.

Exceptions

No rubber gloves are required:

- When working in a properly established equi-potential zone.
- When the operator remains at the same potential as the equipment by being off the ground and on the equipment.

- When a qualified worker performs transmission "hot stick" work on lines 69 kV or greater and no other energized wires are on the pole or structure below the worker.

- When work is performed on transmission structures carrying only energized conductors (115kV and above) and the Live Line Techniques are not being employed. While performing these activities, the worker shall utilize conductive clothing such as conductive gloves, boots, leg straps and/or any other applicable conductive clothing.

- When climbing a steel structure to perform structural reinforcements while maintaining MAD from energized conductors or apparatus.

- When climbing a steel structure to access an area that has been properly grounded.

4.4 Isolation of Energized Apparatus

1. **Non-Reclosing Criteria and Live-Line Maintenance and Construction:** The appropriate interrupting devices (breakers, reclosers, circuit switches, etc.) will be placed on NON-RECLOSING in accordance with National Grid tagging procedures.

2. **Tagging Out Lines or Apparatus**

   The National Grid Construction Supervisor or designee shall coordinate all switching and tagging in accordance with the most current EOP on Clearance and Control.

   Upon receipt of Clearance, the project representative will present the Contractor's Person in Charge with the "Contractor Permission to Work Form" (Form NG0060), which states the specific apparatus that has been de-energized and that certain device(s) are tagged in the Protective Position and will remain so until the Contractor's Person in Charge informs the construction supervisor or designee of the completion of the work utilizing the "Contractor Completion of Work" section of the "Contractor Permission to Work" form.

   The original transferred copy needs to be returned after the completion of work section is filled out & signed. In some cases the tailboard is outside & is susceptible to elements & damage; a copy shall be utilized in the field instead of the original.

No work will be performed until the "Contractor Permission to Work Form" is received from the construction supervisor stating that the equipment has been de-energized and a clearance to work has been given. The Contractors Permission to Work Form and a written grounding plan shall be attached to the crews Job Briefing and be kept at the work location.

After the "clearance" is received from the National Grid Construction Supervisor, the various substation conductor bus and equipment to be worked will be tested and "Grounds" installed. Grounds shall be rated for the fault current of the line/equipment being grounded. (Note: Rubber Gloves and FR clothing are required when installing and removing grounds). The contractors "Person in Charge" (Construction Supervisor/General Foreman) shall be responsible for determining the location and number of grounds.

Vehicles and equipment may utilize a single 4/0 cu for grounding inside the substation. Employees working on de-energized lines and equipment shall always work between grounds.

Prior to the application of any personal protective grounds, the circuit to be worked on must be tested for the presence of voltage using an approved potential detector. The worker must verify the detector is in operating order prior to and after testing for voltage. MAD must be maintained during the testing, and appropriate PPE shall be worn. Testing for voltage shall be done at the point where the grounding devices are to be attached. All phases of the circuit to be worked on shall be tested at each location that grounds are installed.

When an Air Gap is required to create a work zone, the component (a tap) shall be removed in whole from the system unless removal of the component is impracticable or creates an additional hazard based on National Grid management in charge of the job. If the component (a tap) is deemed impracticable to be removed in whole it shall be disconnected from one end, isolated from all other conductors and properly secured to ensure accidental energization will not create a hazard. When National Grid switches out lines or apparatus, any grounds that may be installed shall only be considered a visual reference, and shall not be considered a means to protect the Contractor's employees. The Contractor is responsible to install their personal grounds, in accordance with all OSHA, Federal, State and local safety procedures. National Grid may provide guidance on the minimum size of the grounds to be used based on circuit available fault current. Refer to *Electric Operating Procedure D002,* for applicable grounding size. Ground rods shall be fully driven into the earth away from

the workers and work area. T-Bar ground rods are not to be used on National Grid property.

The National Grid Construction Supervisor shall review the contractor's plan for the quantity and locations of grounds, ensuring that the work the contractor is performing is between grounds, covering all potential sources. All three phases shall be grounded. (In stations, from each phase to the station ground grid). Grounds shall be placed as close to the work area as reasonably possible, between the work area and all potential sources of inadvertent energization. A copy of the grounding plan shall be kept with the job safety brief.

It is the contractor's responsibility to account for all their grounds. The contractor shall provide, maintain, and enforce a ground tracking program suitable to National Grid. In the instance of a zone expanding/collapsing, remaining grounds shall be listed on the Contractor Permission to Work Form and verbally communicated to the construction supervisor.

3. Grounding Mobile Equipment

When mobile equipment requires grounding, it shall be solidly grounded by means of appropriate sized copper cable while using rubber gloves. The cable shall be fastened to a securely attached clean metallic portion of the equipment, or shall be fastened to a grounding stud provided for the purpose at one end and an adequate ground at the other end.

Non insulated booms such as digger derricks that have the possibility of encroaching the MAD shall be grounded and barricaded. The ground is to trip the circuit and the barricade is to protect anyone who may become in contact with the truck during this energization.

4. Minimum Approach Distance (MAD)

Refer to OSHA 29 CFR 1910.269 for more information and details regarding qualified and unqualified workers.

4.5 Appointment of a Safety Observer

A safety observer shall be required if an employee (operator) determines that it is difficult to accurately determine the distance between the equipment (minimum approach distance) and energized parts. The Safety Observer shall never be a substitute for minimum approach distance (MAD), personal protective equipment

(PPE), insulate/isolate techniques or work area identification as a form of employee protection.

The person in charge of the work (contractor or National Grid), shall appoint a qualified employee or employees to perform the task of a safety observer. The personal in charge shall:

1. Ensure a documented job brief is completed and includes the name of the safety observer, additional subjects such as the location of gas lines, energized equipment, in or adjacent to the work area and the limits of any de-energized work area
2. Discuss the scope of work and communication techniques used to warn or notify the equipment operator of hazardous conditions.
3. Communicate any changes to work and job completion to the safety observer
4. Select another safety observer if there is a need for the existing observer to have break in service.

The safety observer is a qualified employee who has been appointed by the person in charge based on the hazard assessment and the job brief. The safety observer shall:

1. Observe the worker performing the task/activity until all hazards have been eliminated or the task/activity has been completed
2. Have shown proficiency in the task/activity being observed and have a full understanding of the job and the hazards associated with the task/activity.
3. Remain continuously focused on the task/activity being performed and not perform or assist any other job activities while observing the worker performing the task/activity
4. Notify the person in charge if there is a need to have a break in service. Work must stop until a new observer is appointed or the safety observer returns.

A safety observer shall also be required when a critical lift is being performed. A critical lift plan shall be required during the following circumstances:

1. An object is lifted over energized apparatuses or assets where a failure of the lifting equipment or rigging could result in a significant safety hazard or cause significant disruption in service to National Grid customers.
2. The crane or other lifting apparatus is anticipated to be operated above 80% of its rated capacity for the specific load chart for the lift.

3. A man basket (pinned or suspended) is to be utilized. All fall protection rules shall be followed when in a man basket.
4. Two cranes will be used in concert to lift a single object
5. Internal substation construction involving all power transformers, control houses, capacitor banks and transmission breakers.
6. Lifts in LNG or Gas plants where a hazard assessment or job brief identifies a significant risk.
7. The lifted load will be less than twice the minimum approach distance (MAD) of the nearest energized part. Until a qualified electrical worker confirms the MAD, loads and equipment shall maintain a 20 foot distance. Once nominal voltage is established, the MAD will be according to OSHA tables.
8. The lifted load is hoisted over buildings or the general public.

4.6 Work Zone Traffic Control

1. If work activity is on or near a road, the contractor and their subcontractors shall comply with all applicable parts of the most current US Department of Transportation's Manual on Uniform Traffic Control Devices (MUTCD), state, local Work Zone Traffic Control requirements and the National Grid Work Zone Traffic Control Manual. Please contact your National Grid representative for a copy of the manual found in the Safety Homepage on the Grid:home.

2. If pedestrian traffic is disrupted, pedestrians should be provided with a path that is reasonably safe, convenient and accessible. Pedestrians should not be led into conflicts with work site vehicles, equipment or operations.

3. If working in areas covered by state permits issued to National Grid, contractors shall comply with the provisions (work practices and notifications) of the permit language. These permits must be available on the job site upon request.

4.7 Qualified Gas Worker

Applies to gas projects/activities

1. Gas contractor employees will be operator qualified as required and defined according to the Code of Federal Regulations, Transportation, 49, Subpart 192.801 through 192.809.

2. Until these qualified employees have demonstrated proficiency in the work practices involved, they are considered employees undergoing on-the-job training and must be under the direct supervision of a qualified person at all times. According to the definition of a "qualified employee", the employee also must have demonstrated an ability to perform work safely at his or her level of training.

3. National Grid requires contractors with gas qualified employees to provide documentation on how they qualify their workers.

4. Additionally any qualifications' of contractor personnel shall be in full accordance with the Company's Operator Qualification written plan, (OQ Plan) Refer to the most current list of covered tasks in accordance with National Grids' Operator Qualification Program and the Northeast Gas Association, (NGA).

4.8 Qualified Electrical Worker

Applies to electrical projects/activities

1. According to 1910.269(a)(2)(ii), a qualified electrical employee must be trained and competent in the following prior to starting work:

    - The skills and techniques necessary to distinguish exposed live parts of electrical equipment
    - The skills and techniques necessary to determine the nominal voltage of exposed live parts
    - The MAD specified in 1910.269 corresponding to the voltages to which the qualified employee will be exposed
    - The proper use of special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools for working on or near exposed energized parts of electrical equipment

2. Until these qualified employees have demonstrated proficiency in the work practices involved, they are considered employees undergoing on-the-job training and must be under the direct supervision of a qualified person at all times. According to the definition of a "qualified employee", the employee also must have demonstrated an ability to perform work safely at his or her level of training.

3. National Grid requires contractors with electrically qualified employees to provide documentation on how they qualify their workers.

4.9 Qualifying Non-Electrical Worker

Applies to: All qualifying non-electrical contractors working near energized lines and equipment; as needed

1. The contractor shall provide orientation for non-electrical workers entering and working within restricted areas such as a substation and those working near energized lines and equipment.

2. The information provided to these workers must meet the requirements of paragraph 1910.269(a)(2)(ii). However, the orientation and training may not be as comprehensive as the qualified electrical worker would be.

   They must know:

   - What is safe and not safe to touch in the specific areas they will be entering;
   - The maximum voltage of the area;
   - The MAD for the maximum voltage within the area;
   - Proper use of personal protective equipment and in the work practices necessary for performing their specific work assignments within the area.

3. Until these workers have demonstrated proficiency in the work practices involved, they are considered to be employees undergoing on-the-job training and must be under the direct supervision of a qualified person at all times.

4.10 Asbestos, Lead and other Hazardous Materials

1. Asbestos and lead materials associated with electrical and gas equipment includes, but is not limited to: cement-type cable covering, cable wrap, wire coatings, coal tar pipe wrap, and transite panels and conduits. Asbestos and lead materials may also be present in building materials including but not limited to: paint, mastics, caulking, insulation and roofing materials.

2. Where asbestos and other hazardous material is present and likely to be disturbed, the National Grid project representative and contractor shall coordinate how the asbestos, lead or other hazardous materials will be

managed and shall consult National Grid's Safety & Environmental department as appropriate.

3. Removal of this material must be done by individuals specifically trained and qualified to handle asbestos and lead. Refer to National Grid Safety Procedures, F-615, F-617 and F-619 for guidance on asbestos and lead handling and removals. For more information, contact a National Grid representative for a copy of these procedures.

Note: Contractors who will encounter asbestos or lead as part of their work shall reference in their safety plan how they will address this hazard.

4.11 Lift Plans for Work Near Energized Electrical Equipment

1. All work involving hoists, cranes or other lifting equipment **within 10' of energized electrical equipment** must have a detailed lift plan/procedure.

2. As a minimum Lift Plans shall include the following:

    a. Designated Operator and Signal person

    b. Detailed travel and flight path that ensures the boom and material being raised is controlled 100% of the time and will maintain the appropriate clearance

    c. Designated cover up and isolation to ensure employee and equipment safety in the event of an unplanned action or failure

    d. Emergency action plan with detailed instructions to respond to unplanned/uncontrolled event during the lift or positioning of the lifting equipment.

    e. Documented load weight and equipment lifting limits

    f. Rigging equipment and methods that will be used during the lifting. Sign off/approval from the management official responsible for the work

4.12 Fall Protection

1. Fall protection or fall restriction devices shall be used when working at heights over 4 feet. When using portable straight and extension ladders,

three points of contact shall be maintained. If 3 points of contact cannot be maintained a work positioning belt is required.

Step ladders shall be set up on level and stable surfaces, fully open with braces locked. Work positioning belts are not required for properly set up step ladders.

2. All fall protection shall be inspected before use each day to determine if equipment is in good working condition. Defective equipment shall not be used and shall be removed from service.

3. A worker may enter or exit an aerial lift (at heights above four (4) feet) provided that fall protection such as guardrails or a fall arrest system is used while the worker moves between the lift and the working surface. Before any such transfer is made, the employee shall be properly tied-off to an adequate support, the pole or structure prior to and in the direction of the transfer.

Exceptions to fall protection shall be in accordance with Federal & State requirements.

4.13 Herbicide Application

1. Vegetation spraying shall be conducted unescorted only by contractor employees who have been designated as a Qualified Electrical Worker, where applicable.

2. The spray applicator shall have ID cards issued by Security with background checks available from the contractor.

3. National Grid management shall require a schedule of the spraying in their areas.

4. Once spraying begins, the contractor must contact local management on a daily basis to inform them of progress or changes to the schedule.

5. The contractor shall post all stations with dated signs indicating when the station was sprayed. These signs should not inhibit access to the station.

6. The contractor shall ensure that any stored materials and equipment do not get covered with “overspray”. Overspray represents a substantial safety hazard and cannot be allowed.

7. When applying herbicides, contractor employees shall wear appropriate PPE in accordance with product labels.

5.0 UNDERGROUND OPERATIONS WORK

In addition to the other requirements referenced in this document, this section covers requirements that are specific to underground operations work.

5.1 PPE Requirements

All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0.

5.2 Enclosed Space Assessment, Ventilation, Entry and Rescue

Refer to the National Grid EOP-UG006 *Underground Inspection and Maintenance* and National Grid Safety Procedure I-902 *Enclosed Space Procedure* for more information regarding enclosed space requirements.

1. Contractors are required to follow all procedures in this document in regards to enclosed spaces (manholes, sidewalk vaults, etc.), including assessment, ventilation, entry and rescue.

2. Each enclosed space shall be tested prior to removing manhole lids and entry. Atmospheric testing shall be continuous for the duration of the entry using a calibrated, industry approved atmospheric tester.

3. When performing hot lead work or when indicated by atmospheric monitoring, engineering controls such as forced mechanical ventilation shall be used when working in National Grid manholes at all times.

4. All contractors who are qualified electrical workers will treat these spaces as “enclosed spaces” and follow non-entry rescue provisions.

5. In some situations a boom is allowed for retraction from an enclosed space. Refer to Safety Procedure I-902 for more information.

6. Steel cable or wire rope for non-entry rescue is prohibited.

5.3 Equipment Safety Inspection

1. Inspect underground facilities (manholes, vaults, hand holes, splice boxes, junction boxes, pad mount transformers, switchgear and submersible equipment, etc.) each time a crew performs work at one of these facilities. All separable components in these facilities shall be inspected by infrared instrumentation. A National Grid representative can provide details from the

National Grid EOP-UG001 *Infrared – Non-Contact Thermometer Inspection Requirement for Underground Equipment* for more information.

2. The infrared (IR) thermometer or camera shall, at a minimum, have a range of -25°F to 1400°F with a plus or minus 1% accuracy. For more details and current operating procedures, contact a National Grid representative regarding EOP UG001.

3. The format for data collected shall follow the National Grid EOP UG006 *Underground Inspection and Maintenance* requirements. Please contact a National Grid representative for more information.

4. "Touch Potential" testing of metal street lighting poles is required as a part of any maintenance work. For more information, a National Grid representative can provide a copy of the National Grid EOP G016 *Elevated Equipment Voltage Testing* and National Grid Work Methods Bulletin #04-26 *Touch Potential Testing of Metal Street Lighting Poles.*

5. Touch Potential testing results shall be recorded on the job safety brief and the manhole inspection form which shall be given to the National Grid Construction Supervisor or designee.

6. All contractors working for National Grid shall use materials and equipment in accordance with the manufacturing guidelines. It is the contractors' responsibility to understand the manufacturers' limits and prescribed use of their tools and equipment before each use.

7. Workers shall test and verify that the underground cable is de-energized and guillotine the cable if needed from outside the hole. Rubber gloves shall be worn at all times while performing this task.

6.0 OVERHEAD LINE WORK

In addition to the other requirements referenced in this document, this section covers requirements that are specific to overhead line work.

6.1 PPE Requirements

All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0. In addition, contractors will follow ground-to-ground and cradle-to-cradle use of rubber gloves while performing work on energized overhead lines. Any foreign wire, including those on a pole or structure constitutes

an energized source and requires the use of rubber gloves (ex: Cable TV, telephone, fire alarm wire, etc.).

6.2 Fall Protection

All contractors who climb structures such as wood poles or transmission towers shall utilize enhanced fall protection equipment (fall arrest devices) and techniques (ex: *Buckingham Buck-Squeeze, Miller StopFall* or *Jelco Pole Choker*). When working on wooden and steel structures, a full body harness and lanyard shall provide 100% fall protection at all times (100% tie off, Shepperd's Hook, etc.). Climbers shall never be allowed to drop or slide down a pole or structure more than two feet.

Exceptions to fall protection shall be in accordance with Federal & State requirements.

6.3 Pole/Structure Inspection

Contractor shall ascertain the structural integrity of the pole or other structure prior to installation, removal, repair or modification of the equipment on the structure.

1. Prior to climbing any pole, an inspection and test of the condition of any pole being climbed shall be performed. The weight of the employee, the equipment being installed and other working stresses (such as the removal or re-tensioning of conductors) can lead to the failure of a defective pole or one that is not designed to handle the additional stresses.

2. If the pole is found to be unsafe to climb or to work from, it must be secured so that it does not fail while an employee is on it. The pole can be secured by a line truck boom, by ropes or guys, or by lashing a new pole alongside it. [29 CFR 1910.269(q)] If measures cannot secure the pole, the contractor must cease operations and notify the National Grid Construction Supervisor or designee

6.4 Electrical Work Methods

1. Jumpers of any type shall not be used to keep transformers, risers or transformer banks energized for the purpose of changing potted porcelain cutouts. A National Grid representative can provide information to the National Grid Electric Operation Procedure (EOP) D001 *Cutouts – Open Type* for more information.

2. Potted porcelain cutouts must be changed out when work is being completed on a pole even if this is not planned in the scope of the work provided.

3. Properly rated and inspected slings, chains or tongs shall be utilized to move poles and equipment. Winch lines must not be wrapped around poles or looped around transformer ears to lift without a sling or chain.

6.5 Transmission Overhead Lines

1. For work on transmission circuits, red tape shall be placed around any energized pole, pole structure, or tower adjacent to the de-energized line.

2. When one circuit of a double circuit pole or tower line is de-energized for work, a red or orange flag shall be placed on the energized side of the pole or tower nine feet below the lowest energized conductor. In addition, a red or orange flag shall be placed on the lower cage on the side toward the energized circuit at each arm level as employees work on them or pass them.

3. All contractors using ATV's, UTV's or RTV's for transmission or forestry work, are required to follow all local OHRV requirements for PPE and driving safety. Training shall include classroom and in-field instruction as well as a formal driving assessment on an annual basis for each type of vehicle planned for use: i.e. UTV specific training for UTV's and ATV specific training for ATV use. All contractor employees must be fully trained and qualified before use. Proof of individual operator training certifications for each operator shall be available at all times. US DOT rated helmets and safety glasses/goggles are required for any vehicle that does not have a seatbelt and a roll cage. In equipment with a roll cage and seatbelt, operators can utilize a hard hat and chin strap.

4. At the end of each day, unless other arrangements have been made for an extended outage, grounds will be removed and the National Grid project representative will be notified that all personnel are "clear" of the conductor bus work and equipment.

5. Wherever transmission line workers "touch" wires, a personal ground shall be installed at the work area to establish an equipotential zone, unless workers are engaged in live-line barehand work (29 CFR 1926.964)

7.0 SUBSTATIONS

In addition to the other requirements referenced in this document, this section covers requirements that are specific to substations work.

For additional information, a National Grid representative can provide a copy of the National Grid Substation Maintenance Procedure SMP 499.01.2 *Protective Grounding Procedure* under the Substation Work Methods Grid:home page for specifics regarding substation grounding practices.

Grounding plans for substation, major distribution and transmission projects will be submitted to the National Grid construction supervisor a minimum of 1 week prior to construction for review. This plan will show the steps, work area limits and ground cable size and amount. Once reviewed with the National Grid and prior to starting the job, the plan will be reviewed by the contractors with all employees and subcontractors on the project.

The use of an "Equipotential" step/platform or a conductive mat is required for access and egress from the following:

a. Crane or any other equipment, including aerial lift equipment, that is connected to the substation ground grid and/or bonded to transmission line conductors when working outside of the station fence
b. In the rights-of-way
c. In areas inside the substation where there is no ground grid present.

When work is performed inside the substation and there is a ground grid available, the "Equipotential" step/platform or conductive mat is not necessary.

All vehicles shall be grounded and barricaded per OSHA standards and the National Grid Electric Operating Procedure G026 *Mechanized Equipment Grounding*.

Proper clearances shall be maintained from adjacent energized substation bus, energized portions of substation equipment and other transmission lines at all times.

Use of proper insulated tooling (shotguns and sticks) shall be utilized per NECA standard maintaining MAD.

7.1 PPE Requirements

1. All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0.

2. Contractors who perform any ground breaking activities in a substation within a pre-marked area will require Dig Safe marks to be in place; otherwise, the job must be suspended and the National Grid construction supervisor or project representative shall be notified of the condition.

3. When using non-insulated man-lifts, and if provided by the manufacturer, a secure point of attachment for lifelines, or lanyards or deceleration devices shall be utilized, independent of the means to support or suspend the employee. Workers feet shall also always remain on the floor.

7.2 Notification of Control Authority When Entering a Substation

1. When a contractor enters and exits a National Grid substation, the contractor shall ensure that the System Control Center is notified. While work is being conducted, gates must be monitored at all times or the gates shall be locked. For more information, contact a National Grid representative regarding National Grid EOPG022 *Substation Security*.

2. Unescorted entry in substations can only be provided to contractors who provide assurance that their employees and subcontractors are electrically qualified as specified in 29 CFR 1910.269. Refer to Section 4.0 of this document

3. All National Grid specifically identified bulk power stations will require NERC-CIP training, certification and approval prior to entry to those sites.

7.3 Substation Work Area Identification (SWAI)

1. Contractors who will be working in substations shall follow the SWAI procedure. National Grid will provide a copy of this procedure if required by the project. For more information, contact a National Grid representative regarding National Grid SMP499.10.2 *Substation Work Area Identification Procedure*.

2. Qualified contractors as referenced in section 4.8 of this document shall install their own work area identification. National Grid shall arrange work area identification for non-qualified workers as required.

3. Designated storage areas for items not being used will be posted in the yard and should be the only place these items are kept.

8.0 GAS OPERATIONS WORK

In addition to the other requirements referenced in this document, this section covers requirements that are specific to Gas operations work. For more information, contact a National Grid representative regarding National Grid General Safety Requirements SHE1001 *Gas Policy* which can be found following this link:
http://dc-gasweb1/MelSite/WMSafetyAll.asp.

8.1 PPE Requirements

1. All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0.

2. The contractor shall wear all appropriate PPE and Class 2 rubber gloves for personal protection when digging or probing within 2 feet of known electrical conductors and when the location of energized conductors is unknown.

8.2 Gas Operations

1. Any contractor who performs covered tasks shall be operator qualified (OQ) as defined in the DOT Title 49 CFR, Subpart N and all applicable state requirements pursuant to the state the contractor is working in. Additionally, any qualifications of contractor employees shall be in full accordance with the Company's Operator Qualification written plan, (OQ Plan) Refer to the most current list of covered tasks in accordance with National Grids' Operator Qualification Program and the Northeast Gas Association, (NGA).

    a. The Operator Qualified status of contractor employees must be regularly updated and accessible through the ISN system. This listing must detail employees' current tasks they are qualified for, the next recertification date, associated documentation and a documented annual acknowledgement in ISN on their qualified workers as referenced in section 3.1 of this document.

    b. Contractor personnel involved with covered tasks may require certification by National Grid and an orientation of the involved tasks and National Grid Company standards. National Grid reserves the right to validate contractor qualifications prior to performing Live Gas work.

    c. Atmospheres are to be tested with a properly calibrated Combustion Gas Indicator (CGI) or Gas Measurement Instrument

(GMI) in accordance with National Grid excavation procedures as required.

d. Each employee in an excavation shall be protected from cave-ins by an adequate protective system, such as sloping, benching or an appropriate shoring system. For more information, contact a National Grid representative regarding National Grid Safety Procedure M-1301 *Standards for Working in Excavations.*

9.0 FORESTRY AND VEGETATION MANAGEMENT

In addition to the other requirements referenced in this document, this section covers requirements that are specific to vegetation management work.

9.1 PPE Requirements

1. All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0.

2. Flame Resistant Clothing is not required per the applicable OSHA Forestry standard. Forestry contractors must instead wear natural fiber clothing when working within 10 feet of energized equipment.

3. Forestry contractors must wear a properly adjusted full-body fall protection harness connected to an appropriate lanyard when working from an aerial lift. The lanyard must connect to an attachment anchored to either the boom or bucket mounting hardware. Attachment points anchored through only the fiberglass portion of the bucket are not acceptable.

4. Forestry contractors will be required to wear chaps while operating a chainsaw or when assisting and/or working in close proximity to a chainsaw that is being operated.

5. Saws shall not be left unattended with the engine running.

6. When a contractor employee carries a saw, the engine shall be off and/or covered or the saw shall be carried with the blade to the rear and locked.

7. Tree crews will not be allowed to fly their buckets in between the primary and secondary cables if the MAD will be violated in process of doing so.

9.2 Equipment and Work Methods

1. Forestry contractors shall utilize fiberglass sticks and stick saws for work around energized equipment. Additionally, integrity tests shall be performed and documented annually. Test results and expirations shall be available on each vehicle as needed.

2. Forestry contractors shall perform and document dielectric testing of all aerial units annually. Test results and expirations shall be available on each vehicle as needed.

3. For lump sum or unit price mileage trimming projects, a single foreman may supervise up to four (4) bucket trucks on the same project. The minimum qualifications for the "lead" person on each of the other trucks shall be a Journeyman Tree Trimmer or equivalent (Qualified Line Clearance Tree Trimmer). At least one other employee on the truck shall be an OSHA defined, Qualified Line Clearance Tree Trimmer Trainee. For Upstate New York only, it is understood that a Qualified Line Clearance Tree Trimmer shall carry the title, wage and benefits as outlined in IBEW LU 1249's existing contract of a Journeyman Treeman and that a Qualified Line Clearance Tree Trimmer Trainee shall carry, at a minimum, the title, wage and benefits as outlined in IBEW LU 1249's existing contract of a Treeman Trainee, 2nd year.

9.3 Training

1. Forestry contractor management will be required to attend safety council meetings hosted by National Grid as required. The contractor shall ensure that all appropriate safety personnel for the National Grid territory are in attendance.

2. Forestry contractors shall implement and provide the required training and certification programs necessary to provide OSHA defined Qualified Line Clearance Tree Trimmers or Qualified Line Clearance Tree Trimmer Trainees. Qualifications shall be provided in the ISN system. Forestry contractors shall provide an update HASP by April 1st of each year for all work being conducted at National Grid.

3. All contractors using ATV's, UTV's and RTV's for transmission or Forestry work are required to follow all local OHRV requirements for PPE and Driving safety

10.0 LNG PRODUCTION, TRANSPORT AND HANDLING

In addition to the other requirements referenced in this document, this section covers requirements that are specific to LNG Production facilities.

All contractors working at LNG plants will sign in and out of plants daily in the contractors log book. All other gas supply facilities and subcontractors require authorization under the contractor management official. If required by the project, trained National Grid plant personnel shall initially, and as needed, review and re-issue as needed, a work permit process which shall which describe the work being performed, valves with their locations and Lock-out/Tag-out numbers.

10.1 PPE Requirements

1. All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0 and shall include FR outer clothing.

2. Cryogenic protective gloves/gauntlets and face shields are required when making connections to load / unload LNG. National Grid retains the right to enhance PPE requirements as conditions warrant. The use of additional PPE shall be based on the task performed and the PPE matrix for work in production plants.

10.2 Training

1. Contractors who transport LNG/propane at National Grid facilities are required to be certified in first aid/CPR and are required to complete frost-bite awareness training. Documentation of training records shall be maintained in the ISN system.

2. National Grid expects contractors working at LNG plants to meet the requirements of 49 CFR 193 Subpart H for health, training or experience and/or any applicable National Grid procedures that supersede the above requirements. Contractors shall provide documentation on their qualified workers, as referenced in section 3.1 of this document.

3. All Contractor personnel performing work in LNG plants must meet the requirements of the National Fire Protection Association (NFPA), part 59.

11.0 ELECTRIC GENERATION

In addition to the other requirements referenced in this document, this section covers requirements that are specific to Electric Generation.

11.1 PPE Requirements

1. All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0

2. Hearing protection is required when working anywhere inside a generation plant and/or outside the plant where noise may be excessive. Acoustic barriers shall be maintained by the contractor as needed.

3. Safety shoes with a minimum height of six-inches are required in Generation plants.

4. Contractors working in generation plants are required to wear 8-Cal clothing protection. For additional guidance, a National Grid representative can provide reference to Electricity Distribution Operations Grid:home webpage under Electric Generation's Policies and Procedures EGO-028 *Personal Protective Clothing* & EGO-029 *Personal Protective Equipment*.

11.2 Training

1. Required training may include; PCB's, asbestos, mercury, confined space awareness and excavation competent person requirements. HAZCOM is required by contractors working in generation plants as applicable.

2. Contractors who work at a National Grid Generation Station shall attend an orientation regarding plant safety and as required, US Coast Guard Maritime Security (MARSEC) policies.

3. Equipment training is required per federal, state and local regulations and National Grid procedures. Operators of any powered industrial vehicle must be qualified and documentation shall be documented.

11.3 Equipment & Excavations

1. All excavations shall be performed in accordance with EGO-0005 *Procedure for Excavation in National Grid Generation Facilities* and National Grid Safety Procedure M-1301 *Standards for Working in Excavations.* For additional information, contact a National Grid representative for copies.

2. Gasoline and diesel powered fork trucks shall NOT be used inside the plant or other enclosed facility. Only propane/electric fork trucks are permitted except where additional hazards may exist.

3. All wood products necessary for the work must be made of flame retardant material.

11.4 Equipment Isolation

For isolation of hazardous energy sources while working in Generation plants, please contact a National Grid representative regarding EGO-0010, *Control of Hazardous Energy Sources-Work Permit System.*

12.0 CIVIL CONSTRUCTION

In addition to the other requirements referenced in this document, this section covers requirements that are specific to civil construction work.

12.1 PPE Requirements

1. All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0.

2. Rubber gloves shall be worn while carrying out work in and around energized or identified direct buried lines, live duct banks, transformer enclosures, manholes, switch gear and other electrical apparatus when performing civil investigations, installations or repairs.

12.2 Enclosed Space Assessment and Ventilation

Contact a National Grid representative regarding the National Grid EOP-UG006 *Underground Inspection and Maintenance* and National Grid Safety Procedure I-902 *Enclosed Space Procedure* for more information regarding enclosed space requirements.

1. Contractors are required to follow all procedures in this document in regards to enclosed spaces (manholes, sidewalk vaults, etc.), including assessment, ventilation, entry and rescue.

2. Each enclosed space shall be tested prior to removing manhole lids and entry. Atmospheric testing shall be continuous for the duration of the entry using a calibrated, industry approved atmospheric tester.

3. When performing hot work or when indicated by atmospheric monitoring, engineering controls such as forced mechanical ventilation shall be used when working in National Grid manholes at all times.

7. All contractors who are qualified electrical workers will treat these spaces as “enclosed spaces” and follow non-entry rescue provisions.

8. In some situations a boom is allowed for retraction from an enclosed space. Refer to Safety Procedure I-902 for more information.

9. Steel cable or wire rope for non-entry rescue is prohibited.

12.3 Equipment Safety Inspection

All contractors shall comply with the applicable equipment safety inspection procedures referenced in Section 5.3

12.4 Excavation Requirements

All excavation work shall be performed under the control of a competent person. All soils in National Grid territories are to be considered class “C”, considered unstable and shall require all excavations be performed in accordance with OSHA 1926.651, EGO-0005 *Procedure for Excavation in National Grid Generation Facilities* and National Grid Safety Procedure M-1301, *Standards for Working in Excavations.* For more information, contact a National Grid representative for a copy.

Crews that are performing Excavations shall include an excavation log with their job brief that states the soil type, expected depth and length as well as final depth and length. All required steps need to prevent collapse will be documented on this form as well prior to entry.

Protective systems shall be used for certain manhole installations. These scenarios are covered below:

- The hazard assessment, competent person and/or National Grid supervisor deems it necessary
- If an excavation for a manhole in a roadway is completed and installation of manhole and backfill is not able to be done before the day is complete, a protective system will be required before road plating
- Installation of any manhole 3 way or greater in size/

Where trench boxes are required to be built on site, the contractor shall submit a PE stamped plan and the location shall be designated on the excavation drawings.

All lifts (not limited to materials and equipment) shall be planned and rigged by a competent person. A lift plan shall be provided for all “critical lifts” and must be submitted by a qualified professional to the National Grid representative prior to the lift taking place.

12.5 Cable fault finding and replacements

For excavation work needed to support faulted cables and emergency cable locates, the use of Cable Avoidance Tooling (CAT) shall be used in addition to Dig Safe requirements as an added safeguard to further pin point unidentified buried cables.

For excavations within the tolerance zone, all hand digging in and around direct buried cables shall require basic PPE, non-metallic handled shovels, rubber gloves, FR clothing and EH rated work boots with Dielectric (DI) over shoes.

All excavation equipment shall be grounded in accordance with NG EOP G026. For additional information, contact a National Grid representative.

The use of GPR (Ground Penetrating Radar) shall also be required to verify the Dig Safe/811 locates after award of the project and prior to excavation. This shall include electric URD, UCD and Substation projects.

12.6 Technical Review

Where and when applicable, all trench and excavation work shall be reviewed and stamped by a civil PE in the state of record and will be executed under the supervision of a trenching and excavation competent person. All leading edges of trenches and excavations shall be appropriately demarcated, clearly posted and controlled to prevent unauthorized persons from entering and inadvertently falling into the excavation. All trenches and excavations shall be closed as soon as practical/possible. All excavations shall be fully controlled for the duration of the exposure by adequately substantial means to withstand the environment and conditions expected to be present.

All pot holing/test holing and exploratory excavations shall utilize vacuum excavation whenever near known underground utilities or hazards, and when the potential for unknown hazards such as live electrical or gas conveyances exist. When using vacuum extraction in combination with air blowing/air knife tools, all persons in the immediate area shall be wearing safety glasses in addition to a full face shields.

13.0 CONSTRUCTION PROJECTS AT CONTAMINATED SITES

In addition to other requirements referenced in this document, all work on contaminated sites must be conducted per the requirements of 29 CFR 1910.120, including the worker qualification and training requirements of 1910.120(e).

14.0 AVIATION

1. Helicopter Crews of two or more shall perform a preflight documented job brief.

2. Helicopter work shall require the use of aviation helmets for both the pilot and passengers.

3. Helicopter pilots and passengers shall participate in the "Flying in the Wire and Obstruction Environment" training prior to flight.

4. Helicopter pilots shall meet the following minimum flight time experience:
    a. 2000 hours as Pilot in Command or Second in command of a rotor craft
    b. 1000 hours in a turbine rotorcraft / helicopter
    c. 100 hours in a helicopter of the make and model to be utilized at National Grid
    d. 300 hours flight time in Wire Environments

For more information, contact a National Grid representative for a copy of EOP T012 *Helicopter Utilization & Notifications.*

15.0 TRANSPORTATION RISKS

Contractor shall define transportation related activities that can have potential process safety consequences. National Grid shall determine if additional risk assessment is needed and contractor shall participate in the assessment. Contractor shall modify their process to mitigate risk that is determined to be intolerable.

APPENDIX A: NATIONAL GRID CONTRACTOR RISK MATRIX

National Grid Contractor Risk Matrix			
Category	**Description of Work**	**Impact of Work**	**Examples to be included in this category (including, but not limited to)**
Medium / High Risk Exposure **Tier I** **Inclusion in ISN Program is Required**	Physical Work, activity, or service that is performed on National Grid property site or is performed off-site where Owner Client has responsibility and is liable for work performed. Includes, but is not limited to, any activity requiring confined space entry, elevated work, work on operating systems involving hazardous energy, work on contaminated sites, and most work requiring a general work permit, hot work permit, or confined space permit.	Work, activity, or service having: • A potential for causing a catastrophic operational incident; • Access to operations; and/or • A direct role in site operations or maintenance, where failure could result in serious harm to employee or public well-being, company assets, or the environment Also includes any Contractor personnel's job function which has no direct or very limited supervision for operational checks.	• Maintenance, Construction and demolition contractors • Chemical cleaning, tank cleaning • Electricians and Instrumentation Technicians • Movers • Welding • Heavy equipment operations • Well drilling and testing • Environmental investigation, remediation, monitoring activities • Hazardous waste handling and/or transport • Excavation • Food service and handling • Equipment Inspection (e.g., X-ray & other NDT) • On-site sampling / gauging activities (not including escorted storm water sampling) • Common carriers transporting Owner Client-owned LNG or petroleum products • Landscaping services • Snow Removal • Janitorial services

			• Vacuum truck affecting/involving process operations • Oil Spill Response Organizations (OSRO)
Low Risk Exposure **Tier II** **Inclusion in ISN Program is NOT Required**	Work that is office based such as: • Consultants that do not perform work or activities as described in the Medium/High Risk exposure category • Offsite services • On-site vendor pick-up/delivery and repair services • Work performed by public and private utilities • Personnel on-site with Visitor Status, when escorted	Work, activity, or service having an indirect role and no, or limited, access to operations or maintenance where failure could result in serious harm to employee or public well-being, company assets, or the environment.	• Mail/package/part delivery or pick-up (e.g. UPS, Fed EX, vendor-specific) • Samples pick-up by laboratory/courier • Office machine servicing (copiers, printer, computer, etc.) • Laboratory apparatus servicing • Storm water Sampling Labs/Contractors (When Escorted by Owner Client personnel) • Deliver/supply services (vending machine, bottled water, laundry) • Municipal waste pick-up • General trash removal services • Off-site repair/fabrication shops (such as pump, safety valve, piping, vehicle) • Telephone, electric, local municipal utility services • Regulatory representatives • Technical representatives • Engineering services (when escorted by Owner) • Auditors
A SHE VP can require any contractor to be part of ISN when deemed as a potential risk to National Grid			

FORWARD

National Grid's vision is to be a world-class safety organization, with zero injuries every day. A critical component of achieving this vision is the careful development, implementation and maintenance of safety procedures. This guidance document, COVID-19 Health and Safety Plan, describes pandemic response measures, taken by National Grid, to help prevent the spread of COVID-19.

Questions regarding this guidance should be referred to National Grid's Safety Department.

Record of Change

Revision	Date	Description
Initial	04/28/2020	Initial creation

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1.0 SCOPE OF HEALTH & SAFETY PLAN

National Grid has developed this Health & Safety Plan (HASP) to uniformly apply pandemic response measures to help prevent the spread of the COVID-19 virus. National Grid field personnel and crews have been provided this information and communications.

2.0 PROJECT PERSONNEL

2.1 Roles and Responsibilities

National Grid shall be responsible for the safety of all its employees and shall ensure COVID-19 pandemic measures are in place. Key National Grid personnel are as follows:

Incident Command Structure

The National Grid Incident Command Structure (ICS) has been activated within all Business Units of National Grid's US Operations to respond to the COVID-19 pandemic. Members of the ICS review and approve all operational decisions, with the Incident Commander ultimately responsible for these decisions. The Incident Commander relies upon subject matter experts within the ICS, including the Operations Officer, the Safety and Health Officer, to help set standards and guidance for protective measures to be used to limit the spread of the COVID-19 virus. These Officers, in turn, utilize the expertise of other members of the organization within Operations, Safety, and Health, to assess risks associated with the work being performed and provide guidance on the most effective measures to be used by employees to protect themselves, their coworkers, our customers, and members of the public.

Field Supervisor

The Field Supervisor shall have the responsibility for monitoring and enforcing National Grid COVID-19 pandemic measures and shall ensure that all employees have received and reviewed this Health & Safety plan.

- Serve as the appointed supervisor to oversee field personnel and ensure pandemic measures are being followed
- Ensure field personnel have the appropriate pandemic supplies
- Disseminate all new National Grid COVID-19 communications to all field employees
- Where non-compliance is observed, take prompt corrective action; and
- Have the authority to order a safety stop in the event of a serious safety issue.

Crew Leader

The National Grid crew leader shall be in charge of the day-to-day details of the work to be performed. They shall ensure that work is performed in accordance with National Grid COVID-19 pandemic measures. They will:

- Walk the job site at the start of each day to ensure a safe work environment;
- Where non-compliance is observed, take prompt corrective action; and
- Have the authority to order a safety stop in the event of a serious safety issue.
- Perform the daily job safety briefing before commencing work, whenever a visitor arrives to the job site, and if there is a significant change in the work or when an extended break occurs. As part of the COVID-19 pandemic response, the COVID-19 job brief checklist (Appendix A) shall be used in addition to the applicable departmental job brief form.

Employees

National Grid employees are responsible for following all COVID-19 pandemic measures;

- Each employee is responsible for reporting to supervision any symptoms of COVID-19, of any direct contact with an individual confirmed to have COVID-19, or in contact with a person in quarantine.
- Each employee is obligated to call a safety stop when a hazardous condition is observed.
- All lone workers shall conduct a self-assessment utilizing the COVID-19 job brief checklist (Appendix A) and adhere to the guidance outlined in this plan.

National Grid Field Safety Representative

National Grid Field Safety Representatives conduct routine and random crew visits to National Grid job sites. The National Grid Field Safety Department shall act as a resource for National Grid field personnel to effectively implement this COVID-19 Health & Safety Plan and will be available on an as-needed basis for inquiries related to this HASP.

3.0 COVID-19 PANDEMIC RESPONSE MEASURES

3.1 COVID-19 Symptoms

COVID-19 Symptoms may include the following:

- Fever
- Cough

- Shortness of Breath
- Chills
- Repeated shaking with chills
- Muscle Pain
- Headache
- Sore Throat
- New loss of taste or smell

3.2 Hygiene and Social Distancing

- Wash your hands often with soap and water for at least 20 seconds, especially after using the restroom, before eating, and after blowing your nose, coughing, or sneezing. Hand washing is the best way to prevent the spread of viruses.
- If soap and water are not readily available, use an alcohol-based hand sanitizer with at least 60% alcohol. Always wash hands with soap and water if hands are visibly dirty.
- **Proper hand washing/sanitizing products will be provided to all employees**
- Maintain a minimum of 6' social distance from other employees on site while performing work and during routine breaks. When work tasks prevent this, ensure proper face coverings are continued to be worn and proper hygiene
- Avoid touching your eyes, nose, and mouth.
- Cover your cough or sneeze with a tissue, then throw the tissue in the trash.
- Clean and disinfect frequently touched objects and surfaces using a disinfecting cleaning spray or wipe; if not available, use a soap and water solution.
- All cleaning product trash and potentially contaminated PPE will be stored in a trash bag and immediately disposed of at a National Grid facility at the end of each shift. Trash should not accumulate in any National Grid vehicle. Immediately wash hands upon disposing of trash bag.

3.3 COVID-19 PPE and Face Coverings

- Face coverings are a requirement for all National Grid employees. Face coverings must be worn by all employees:
    - When working in public places
    - When working in a customer's premises
    - When social distancing is not able to be maintained with a co-worker, customer or member of the public in a National Grid facility, barn/yard, work location or company vehicle.
- Non-Fire-Retardant/Arc Rated Face Covering– use when there is no potential for a gas ignition or electric arc flash. This can be National Grid supplied or a personal face covering. Fire Retardant Face Covering – must be used when there is potential for a gas ignition or electric arc flash.
- **Additional COVID-19 PPE guidance is provided in the attached Premise**

Entry Guidelines

3.4 COVID-19 Virus Risk Assessment and Adopted Measures

National Grid's prescribed measures (work practices, PPE, hygiene) were selected based upon the risk assessments completed by subject matter experts and reported up through the ICS for approval. They are based upon the Centers for Disease Control & Prevention (CDC) and OSHA guidance, as well as input from Operations, Safety, and Health team members. They are believed to address all risks posed to our workforce, as well as to our customers and members of the public, when jobs are conducted in public places. These measures are reviewed on a continuous basis, for both effectiveness and to ensure the latest guidance is incorporated, with changes made, as necessary, after these reviews.

4.0 COVID-19 REPORTING PROCESS

4.1 COVID-19 Job Brief Checklist

In addition to the applicable departmental job brief form, all crew leaders shall utilize the COVID-19 job brief checklist to facilitate crew discussion regarding symptoms of COVID-19 and allow for discussion to help facilitate the reporting of a COVID-19 incident. All visitors to the job site will be required to have the job brief and COVID-19 checklist reviewed with them by the crew leader prior to entry on the job site.

Remember to maintain social distancing while conducting the job brief

4.2 COVID-19 Incident Reporting

To ensure the safety of all employees and the public, any employee shall immediately contact their Supervisor and National Grid Employee Services if one of the following conditions occur:

- Employee is exhibiting symptoms of COVID-19
- Employee has been in close contact of another individual with COVID-19
- Employee has been in close contact of another individual who is currently being quarantine for a suspected case of COVID-19

  Close contact is defined as being within 6' of a sick/quarantined individual for more than 15 minutes.

Please refer to the COVID-19 Suspected/Confirmed Positive Process guidance document in Appendix A.

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Appendix A – National Grid COVID-19 Communications

A Message from John Bruckner

National Grid US Coronavirus Incident Commander

Updated Guidance on Face Coverings

April 16, 2020



The state of New York and the state of Rhode Island recently issued executive orders requiring all essential employees who are working in public places to wear face coverings when distance from the public or co-workers cannot be maintained. As a result, we are updating our company policy to align safety standards for all employees.

We had previously communicated that wearing a face covering was voluntary based on CDC recommendations. We are now **requiring** National Grid employees to wear face coverings in the situations below. Please note that this applies to both **office** and **field-based** employees, and applies across **all jurisdictions**.

Face coverings must be worn:

- ✓ When working in public places
- ✓ When working in a customer's premises
- ✓ When social distancing is not able to be maintained with a co-worker, customer or member of the public in a National Grid facility, barn/yard, work location or company vehicle.

- This directive is effective at 8:00 pm this evening for all New York employees.
- It is effective starting this Saturday for all Rhode Island and Massachusetts employees.
- If you are working from home, our company guidance remains: If you can work from home, you should.

What qualifies as a face covering?

Employees may use either a company-issued or a personal face covering, depending on preference and availability. These include:

- Disposable masks, which need to be changed daily or if significantly dirty.
- Reusable FR Balaclavas, which need to be laundered daily, according to CDC cleaning guidance.
- Reusable FR neck warmers, which need to be laundered daily, according to CDC cleaning guidance.
  - Please note: Face pieces must be made from Flame Resistant (FR) material if they are worn when working in an energized zone or there is potential for a gas ignition.

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How to get a face covering:

Our procurement and warehouse teams are working directly with teams to ensure a steady supply of face coverings.

It is our intention to provide company-supplied face coverings widely, but in instances where one is not available or preferred, a personal covering may still be used.

Operations teams should work through their normal channels to order face coverings. We will be providing further guidance to office-based colleagues on where they can access face coverings.

CDC guidance on personal face coverings can be found here:

- https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/cloth-face-cover.html
- https://www.cdc.gov/coronavirus/2019-ncov/downloads/DIY-cloth-face-covering-instructions.pdf

Face coverings should:

- Fit snugly but comfortably against the side of the face
- Be secured with ties or ear loops, if provided
- Include multiple layers of fabric
- Allow for breathing without restriction
- Be removed from behind head or ears to minimize hand contact with face
- Be laundered and machine dried if reusable

Cleaned, dried coverings can be kept in a clean plastic bag until needed for use

It is important to note that face coverings, whether company-issued or personal, are not a substitute for taking measures that are known to be effective in stopping the spread.

Handwashing, and maintaining a social distance of 6 feet apart from others remains the most critical guidance that we can follow.

Sincerely,

John Bruckner

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COVID-19 Job Brief Checklist

Please Distribute

Revised 5/7/2020

During this trying time it is important that we maintain our same level of focus at work locations conducting hazard assessments and identifying risks prior to the start of each task. Prior to beginning work at every location, when conditions, job focus or crew members change, after each meal period and after any prolonged interruption to the work, a **Job Briefing** shall be held.

The work to be performed shall be discussed and assigned, and the safety aspects of the job shall be reviewed. The National Grid protocol to screen all individuals to determine who may have been exposed to COVID-19 outside of work **must be reviewed** at the start of the workday and Job Briefing.

(Employees working alone shall conduct a self-assessment to determine if they may have been exposed to COVID-19 outside of work or should their condition change during the workday)

The questions are:

- ☐ Are you feeling ill in any way? For instance, do you have any of the following symptoms: A fever? A cough? Shortness of breath? Chills? Repeated shaking with chills? Muscle pain? Headache? Sore throat? New loss of taste or smell?
- ☐ Have you had close contact with a symptomatic person (e.g., fever, cough, and/or shortness of breath, chills, repeated shaking with chills, muscle pain, headache, sore throat, new loss of taste or smell) within the last 14 days?
- ☐ Have you had close contact with a person who was tested with results pending or positive for coronavirus within the last 14 days?
- ☐ Have you recently been out of state for non-work related travel (within the last 14 days)?

*Employees who answer **"YES"** to any of these questions must distance themselves from others, not enter the work area, and immediately contact their supervisor privately for further instruction.*

The employee must also contact the National Grid Employee Services Hotline 1-888-483-2123.

Employees who answer **"NO"** to all of these questions proceed with work activities as planned.

Please note on the Job Brief that you asked these COVID-19 Screening Questions.

To reduce multiple people handling the job brief during the COVID-19 pandemic crew leaders should handle all documentation and record who is present on site after they have reviewed the job brief with each employee or visitor.

REMINDER - Please be sure to follow CDC recommendations

- Maintain a minimum 6' social distance from other people
- Employees must wear a face covering: when working in public places, when working in a customers premise, or when social distancing is not able to be maintained with a co-worker, customer, or member of the public in a National Gird facility, barn/yard, work location, or company vehicle.
- Avoid touching your eyes, nose, and mouth.
- Clean and disinfect frequently touched objects and surfaces using either a EPA registered disinfectant (Lysol, Clorox, etc.), soap and water, or a bleach and water mixture (1/3rd cup bleach per gallon of water)
- Use the fold of your arm to cover a sneeze or cough
- Wash your hands often with soap and water for at least 20 seconds, especially after going to the bathroom; before eating; and after blowing your nose, coughing, or sneezing.
    - If soap and water are not readily available, use an alcohol-based hand sanitizer with at least 60% alcohol. Always wash hands with soap and water if hands are visibly dirty.

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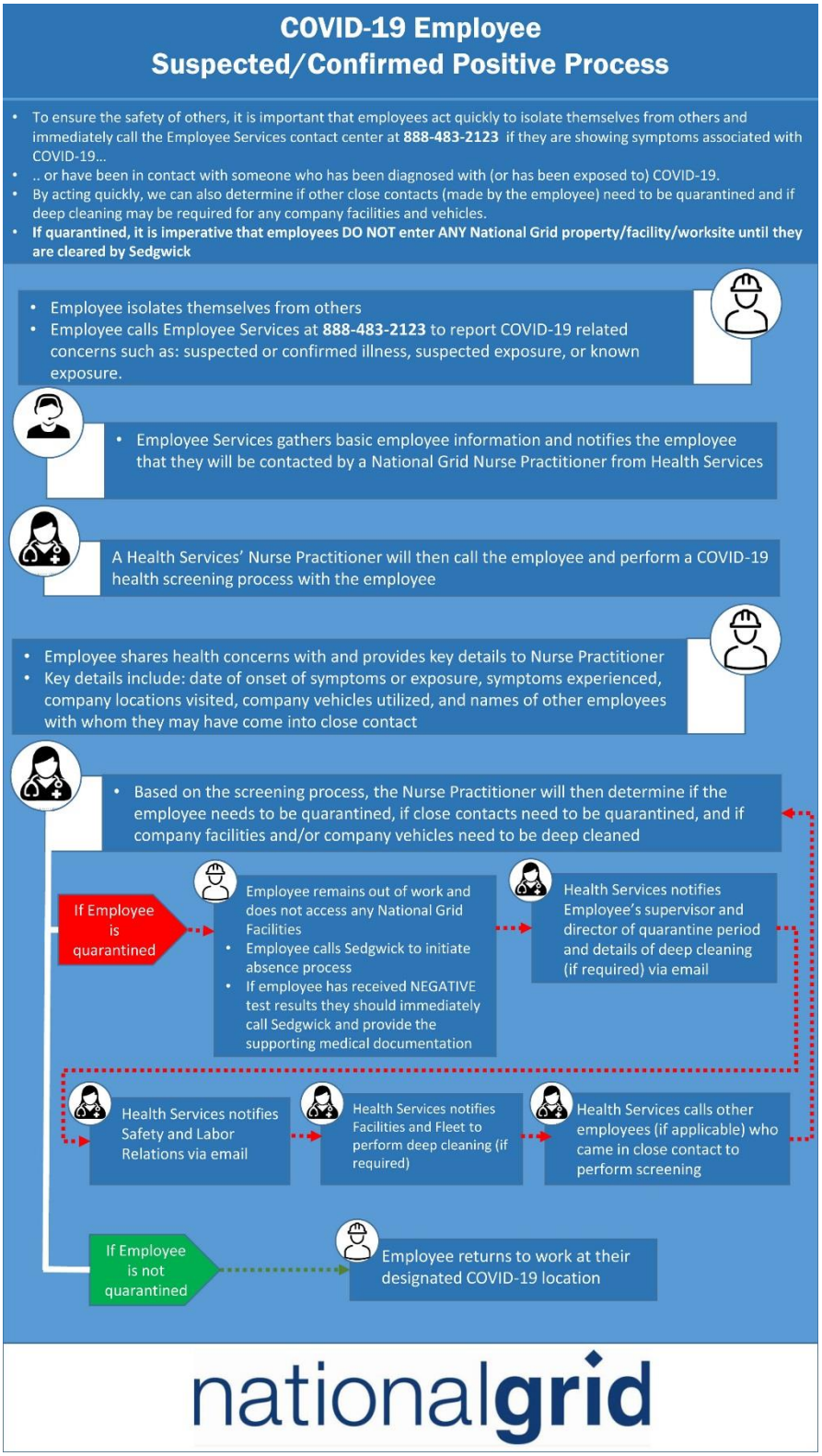

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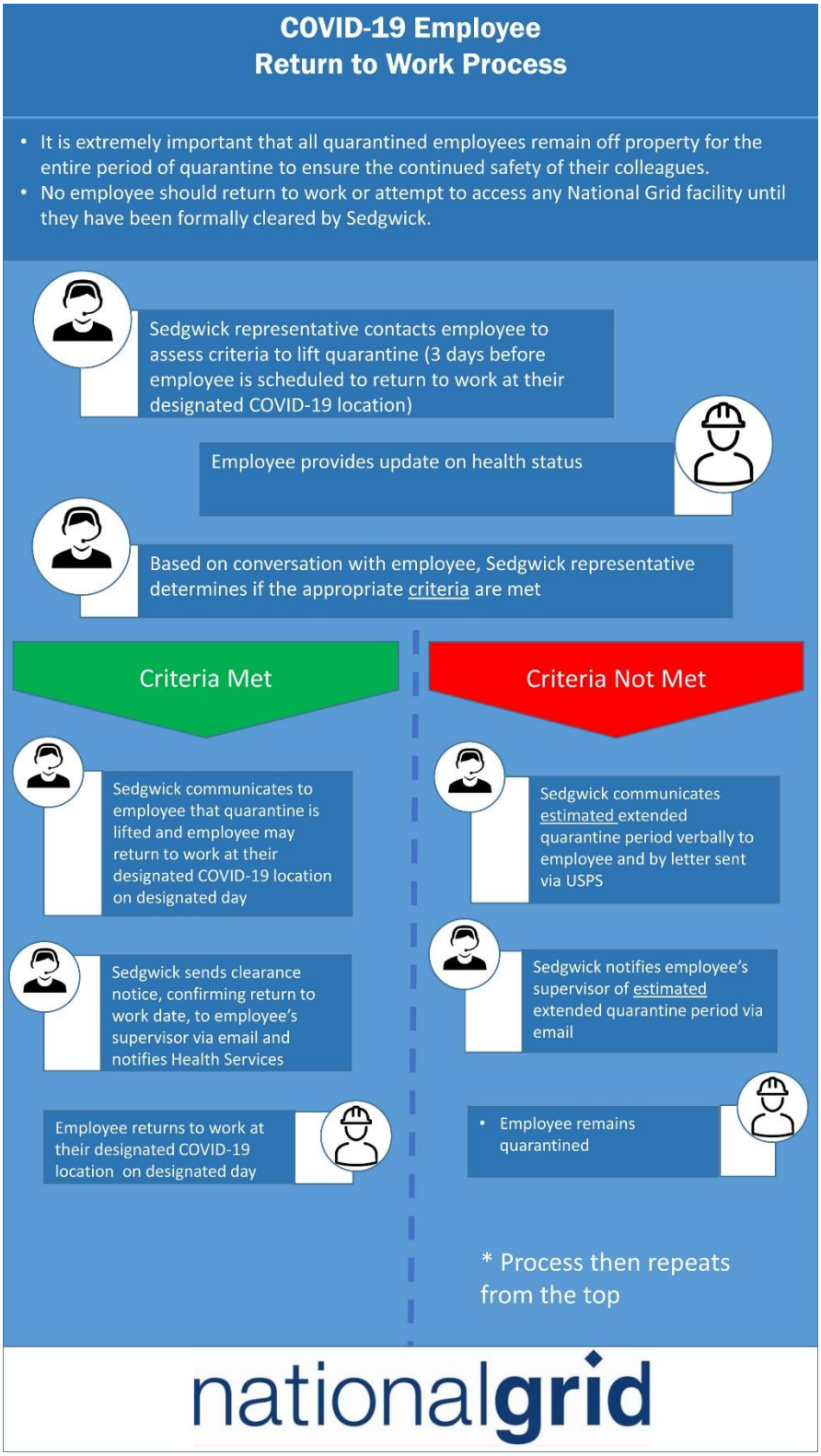

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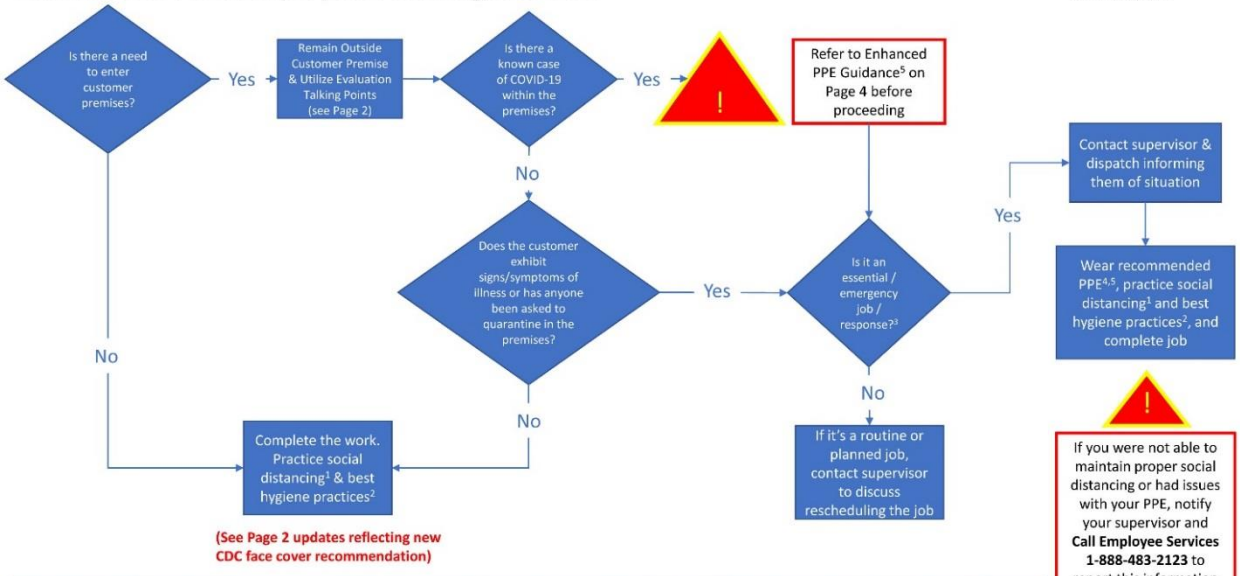
Guidance for Field Employees Entering Premises

Issued 4/7/20



(See Page 2 updates reflecting new CDC face cover recommendation)

See Page 2 for additional information on Talking Points, CDC Recommendations for (1) Social Distancing and (2) Best Hygiene Practices
See Page 3 for National Grid (3) Emergency Work at a Premises and (4) Standard PPE Guidance
See Page 4 for National Grid (5) Enhanced PPE Guidance

1

Issued 4/8/20

Talking Points - Engage Customer

Prior to entry, engage the customer and advise of social distancing practices. Here are some questions and statements.

- Does someone within the premises have a known case of COVID-19? Has someone within the premises tested positive for the COVID-19 virus?

(IF ANSWER IS 'YES' TO EITHER OF THE ABOVE QUESTIONS, REFER TO ENHANCED PPE GUIDANCE ON PAGE 4)

- Do you mind if I follow the social distancing practice today?
- Is anyone currently sick inside the premises?
- If you are feeling sick, would you mind remaining in another room while I am working This is a best practice policy my company is recommending. Can you tell me where your equipment is located?
- I will do my job, keep you updated and tell you when I am done

(1) Social Distancing

- Maintain at least 6 feet distance between yourself and the customer at all times
- Where social distancing measures cannot be maintained, face cover can be worn to help limit the spread of the virus (see National Grid's Face Cover Guidance for details)

(2) Best Hygiene Practices

- Face covering can be worn in public settings where social distancing measures cannot be maintained (see National Grid's Face Cover Guidance for details)
- Use alcohol-based hand sanitizer (at least 60% alcohol), before and after each home visit; OR wash hands using soap and water for 20 seconds

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(3) Emergency Work at a Premises

On arrival, assess the premise/situation in its entirety and consider these questions.

- Is it a multi-unit building?
  - Is the unit where work is required affected?
- What work can be done without interaction/entry?
- Is entry through a side or back door possible to limit exposure?
- Can make safe actions be taken without interaction/entry?
  - Securing Outside Meter/Curb Valve
- Would a hardship be caused by isolating the service?

Note: These questions and considerations are meant to help guide in the decision making process. There may be instances where access to a premise cannot be avoided in order to address immediate public safety concerns. Please reference the Social Distancing and applicable PPE Guidance in all situations.

(4) Standard PPE Guidance for Entering a Premises (No Known COVID-19 cases are present)

- Avoid touching ANYTHING in customer premises other than company equipment and customer equipment related to the job
- Wear disposable latex or nitrile gloves to prevent touching contaminated surfaces
- Latex or nitrile gloves should be donned before entering the home
  - If work gloves are needed to perform the task, remove disposable latex or nitrile gloves and dispose of them. Don work gloves and perform task. Once task is complete remove work gloves and store them. Don a new pair of disposable latex or nitrile gloves to exit the home.
- Remove latex or nitrile gloves and dispose in way that won't create other opportunities for exposure
- Immediately wash / sanitize hands after removing latex or nitrile gloves
- All other PPE normally required for the work being performed should be used

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(5) Enhanced PPE Guidance for Entering a Premise (Where a Known COVID-19 Case is Present)

The most effective way to protect the employees from contracting the virus is physical distance; if at all possible, the customer diagnosed with COVID-19 should be asked to move to a separate room before premises entry. When available and practicable, the following PPE items may be used at the premises with a known COVID-19 case present. These PPE items can be used in combination with our Social Distancing and Best Hygiene Practices to limit the spread of the virus.

- N-95 / KN-95 mask (see Page 5 for pictures of typical N-95 / KN-95 masks available)
- Reusable Face Shield
- Disposable Surgical Gloves (nitrile or latex)
- All other PPE required for doing the work (i.e. safety glasses, hard hat, etc.)
- If desired, FR-rated balaclava may be worn to provide additional protection while working

The following steps should be taken while conducting work in the premises:

- Prepare a paper or plastic bag for disposal of used PPE prior to entering the premises.
- Avoid touching ANYTHING in customer premises other than company equipment and customer equipment related to the job.
- Wear disposable latex or nitrile gloves to prevent touching contaminated surfaces.
- Any PPE should be donned before entering the home.
- If a mask is in use, avoid touching your face or adjusting the mask.
- If work gloves are needed to perform the task, remove disposable latex or nitrile gloves and dispose of them. Don work gloves and perform task. Once task is complete remove work gloves and store them. Don a new pair of disposable latex or nitrile gloves to exit the home.

Once work is completed in the home, follow these steps to safely remove the PPE items

- Remove face shield, taking care to avoid touching your face. Clean / disinfect and store properly.
- Remove mask from the back of the head first, taking care to avoid touching your face. Place used mask in a bag and dispose in normal trash.
- If balaclava has been worn, remove covering from back of head, similar to removal of mask.
- Remove latex or nitrile gloves (turn inside out while removing) and place in a bag. Dispose of bag in normal trash.
- Immediately wash / sanitize hands after removing latex or nitrile gloves, following Best Hygiene Practices.

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Typical N-95 / KN-95 masks





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Safeguarding your Vehicle

Now, more than ever, with COVID-19, precautions to safeguard your vehicle when transferring the vehicle to another employee, or when taking your vehicle in for maintenance, is very important.

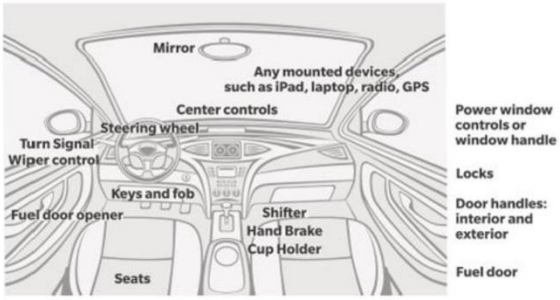
Here are some high-touch areas that should **never** be missed:

• Mirror • Center controls • Keys and fob • Wiper control • Climate control • Audio controls • Hand brake • Seats *(driver/passenger)*/Seatbelts • Fuel door opener • Windows • Headrests • Armrests	• All mounted devices *(any and all electronic devised used - i.e. iPad, laptop, radio, GPS, phone chargers)* • Steering wheel • Headlight • All cabin lighting controls • Shifter • Cup holder • Door handle*(inside and out)*/Window control/locks • Air vent • Sun visors

Use disinfectant wipes, diluted bleach solution, or damp soapy water wipes when cleaning all hard surfaces throughout the vehicle.

To guide your efforts when cleaning the vehicle, think about where droplets would fall when you sneeze or cough (*for example: do you turn your head to the side?) and remember to think about your own personal safety:*

- Be sure to wash your hands for **20 seconds** after completing the cleaning process.
- If you take your vehicle home at night, be sure to lock it to prevent it from being compromised.
- Make sure you have a mask and gloves (when/where appropriate).



Before you leave or enter the vehicle – here's a checklist to keep you safe and your team members safe as well:

Activity to Safeguard	✓
Keys / Fob	
Door Handles (interior/exterior)	
Steering Wheel, Shift Lever, Brake Lever, Wiper Stalk, Turn Signal Stalk	
Air Vents, Console, Dashboard, Cup Holder	
Exterior and Interior Fueling Latch, Cover, Cap	
Seats, Seatbelts, Headrests	
Mirrors, Windows, Window Controls	
Interior Lights	
Sun Visors	
Passenger and Driver Door Armrests, Grab Handles, Seat Adjusters	
All Electronic Devices used while in vehicle (iPads, Navigation Systems, Phone Chargers, Laptops, etc.)	

Additional considerations for crew trucks:

Handles on bin doors	
Equipment controls (bucket / digger)	

**** Please consider any other touch point identified by a crew member but not listed***

March 18, 2020

Dear Business Partner,

National Grid US continues to be acutely aware of the ongoing Coronavirus situation. We have received many inquiries from -our suppliers regarding -our response to Coronavirus (COVID-19).

As the World Health Organization has declared COVID-19 a pandemic, National Grid has begun to implement its business continuity plans, and as conditions evolve, we are taking actions to mitigate exposure and reduce the impact of the coronavirus to our customers, communities, and employees.

We have a comprehensive US pandemic strategy plan in place to ensure business continuity. Our Pandemic Plan contains specific actions and activities for different stages of the event. Examples can include such measures as facility cleaning, PPE requirements, distancing policies, work from home directives, visitor policies, exposure tracking, and return to work protocols.

As we have a commitment to our customers for safe and reliable delivery of gas and electricity, we also have a commitment of providing a safe working environment to our employees. As your organization has been identified as one which provides key services as part of our operations, we would ask that you do the same and work with us in helping to limit the spread of the virus. Most importantly, please be sure that your employees stay home if sick.

In the event that one of your employees has a potential of, or an actual case of COVID-19 and has had close contact with our employees, it is imperative that your Field Supervisor reports the incident to National Grid immediately, so we are able to assess associated risks and provide direction to all parties affected. All cases should be called into our Employee Services department at (888) 483-2123 which is staffed Monday – Friday 7:00 AM – 5:00 PM.

As a reference, we've also provided guidance to our employees to avoid being exposed to the virus as guided by the CDC which we'd encourage your organization to leverage as appropriate:

- Stay home when you are sick
    - Employees who have symptoms of respiratory illness should stay home until they are free of fever (<100.4° F using an oral thermometer) or other symptoms for at least 24 hours, without use of fever/symptom reducing medicines (e.g. cough suppressants).
- Cover your cough or sneeze with a tissue, then throw the tissue in the trash.
- Practice social distancing (keeping 6 feet from others) and avoid large groups and gatherings.
- Avoid close contact with people who are sick.
- When greeting people, do not engage in handshaking or any other physical contact.
- Avoid touching your eyes, nose, and mouth.
- Clean and disinfect frequently touched objects and surfaces using a regular household cleaning spray or wipe.
- Wash your hands often with soap and water for at least 20 seconds, especially after going to the bathroom; before eating; and after blowing your nose, coughing, or sneezing.
    - If soap and water are not readily available, use an alcohol-based hand sanitizer with at least 60% alcohol. Always wash hands with soap and water if hands are visibly dirty.
- Follow CDC's recommendations for using a face mask.

- To prevent spread of the disease, face masks should be used by people with symptoms of COVID-19, healthcare workers, and those caring for someone in close setting.
- CDC does NOT recommend that healthy people wear a face mask to protect themselves.

We are also asking contractor employees who interact with customers in their homes to consider the following:

- Ask before you enter - Employees should ask if anyone in the house is feeling sick, is on quarantine, or if there is any chance that a customer may have been exposed to an individual with the coronavirus.
- Keep your distance - The best way to prevent illness is to avoid being exposed to this virus. The CDC advises the public to avoid close contact with people who are sick.
- Ill or quarantined customers should be asked to isolate themselves in a different room with the door closed while our employee is there.
- If they must open the front door, they must step back and maintain a minimum distance of 6 feet from our employee before moving to a separate room.
- If the customer has a respirator mask, they should be asked to use it.
- If you feel it would be unsafe to enter the home, we ask that you contact your supervisor to report the incident and to await further guidance.

We all have an obligation to protect each other and to not put any individual in a position where they become exposed or a conduit for the virus. Thank you for reviewing this communication and taking this requirement seriously.

Please provide a confirmation of receipt of this request, and that you have communicated this to your teams by COB, March 20th, 2020 to SupplyChainFAQ@nationalgrid.com .

Sincerely,

Simon Harnett
Vice President, U.S. Procurement
National Grid

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